CITY OF GEORGETOWN, TEXAS

CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

FOR THE CONSTRUCTION OF

Dove Springs WWTP Rehabilitation

PROJECT NO. PRJ000261

NOVEMBER 2023

Proposal No. 202407

Contract No. 24-0043-CIP

CONFORMED CONSTRUCTION SET
JANUARY 2024

TBPE FIRM REGISTRATION NO. F-3043

8310-1 N. Capital of Texas Highway., Suite 250
Austin, Texas 78731
tel 512-346-1100
fax 512-345-1483

CDM Smith Project No. 2048-264953

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CERTIFICATIONS

Division 0	(All Sections)
Division CIP	(All Sections)
Division G	(Sections G2, G3, and G8)
Division W	(All Sections)
Division WW	(All Sections)
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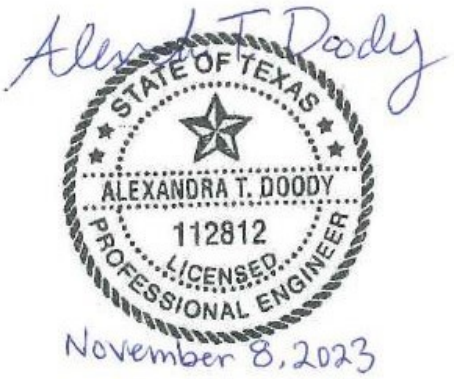
Division 2	(Section 024119)
Division 33	(All Sections)
Division 40	(Sections 400506 thru 400582)
Division 43	(All Sections)
Division 46	(All Sections)



Division G	(Sections G4, G5, and G9)
Division 2	(Section 025731)
Division 31	(All Sections)

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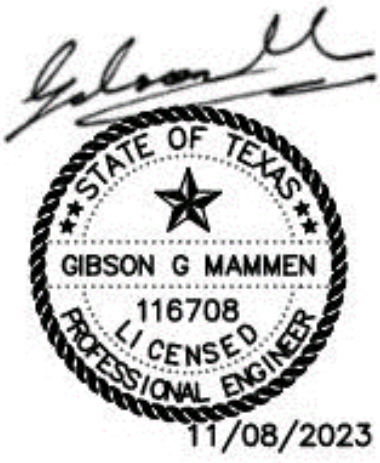
Division G	(Sections G6 and G7)
Division SD	(All Sections)
Division 32	(All Sections)

Division 4	(All Sections)
Division 7	(All Sections)
Division 8	(All Sections)
Division 9	(All Sections)

Division 23	(All Sections)



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CITY OF GEORGETOWN, TEXAS

Dove Springs WWTP Rehabilitation

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PROJECT MANUAL
as part of
the
Proposal Documents

GEORGETOWN
TEXAS
more than welcome

CONSTRUCTION SERVICES
for
Dove Springs WWTP Rehabilitation

RFP 202407

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Due: January 16, 2024

2PM CT

REQUEST FOR COMPETITIVE SEALED PROPOSALS

CITY OF GEORGETOWN

510 W 9th Street
Georgetown, TX 78626

PO Box 409
Georgetown, TX 78627

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INTRODUCTION

The City of Georgetown is seeking proposals from all qualified respondents to perform construction services of the Dove Springs WWTP Rehabilitation located at Rock Dove Lane, Georgetown, Texas 78626.

The successful Proposer (Contractor) must meet all requirements of this RFP, maintain proper licensing, and comply with all federal, state, and local laws and mandates relative to the services specified in this RFP.

DEFINITIONS

The following definitions shall be used to identify terms throughout this Request for Proposals:

A. AGREEMENT
A mutually binding legal document obligating the Contractor to furnish the services specified within this solicitation and obligating the City to pay for the services as agreed upon.

B. CITY/OWNER
The City of Georgetown, located in Williamson County, Texas.

C. CITY COUNCIL
The elected officials of the City of Georgetown, Texas, given the authority to exercise such powers and jurisdiction of all City business as conferred by the City Charter and State Constitution and Laws.

D. CONTRACTOR
Person or business enterprise providing goods or services to the City as fulfillment of obligations arising from an agreement pursuant to this Request for Proposals. The successful Proposer of this Request for Proposals.

E. E-BID SYSTEM
The City's electronic bidding system. This is a web-based system that provides all solicitation documents electronically to potential Proposers and allows interested Proposers to submit Proposals in response to solicitation documents. The term "e-bid" and/or "electronic bid" means the Proposer's electronic Proposal submitted to the City by way of the E-bid system. The terms "electronic bid" or "e-bid" are used inter- changeably to describe the above invitation for proposal process to submit an authorized Proposal to the City in response to this Request for Proposals.

F. PROPOSER
The **Individual, Firm or Corporation (Proposer)** that considers themselves qualified to provide the services specified herein and are interested in making an offer to provide the goods to the City.

G. PIGGYBACK CONTRACT
A contract or agreement that has been competitively solicited in accordance with State of Texas statutes, rules, policies and procedures and has been extended for the use of state and local agencies that have entered (or will) into an Interlocal Agreement with the City.

H. PROPOSAL
A complete, properly signed response to this solicitation.

I. PURCHASE ORDER

A purchase order records the financial obligation of the City to pay for goods or services properly received; therefore, a purchase order is also required for all contracts with an expenditure of funds entered into by the City Manager or City Council.

J. REQUEST FOR PROPOSALS (RFP)

This solicitation document issued by the City containing terms, conditions and specifications for the services to be procured.

NOTICE TO PROPOSERS

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A. NOTICE

All Proposals are due on or before **2:00 PM CT on January 16, 2024. Solicitations are posted and available to download from the City of Georgetown's On-Line Bidding System at https://gtowntx.ionwave.net.**

Proposers may receive notice of Requests for Proposals from the City of Georgetown from a variety of channels. Approved methods of dissemination include: City of Georgetown website or the City of Georgetown Purchasing Office. The receipt of solicitations through any other means may result in the receipt of incomplete specifications or addenda which could ultimately render your Proposal non-compliant. City of Georgetown accepts no responsibility for the receipt or notification of solicitations through any other source.

B. RECEIPT OF PROPOSALS

1. **Electronic Proposals. Sealed** Electronic Proposals shall be submitted through the City's web site at: https://georgetown.ionwave.net. All interested Proposers are required to register as a "supplier" on the City's E-bid System at the above web address and clicking on "Supplier Registration." Registration provides automatic access to the solicitation and its documents (specifications, attachments, exhibits), and for any changes to the solicitation including change(s) to the submission time and date.

   Electronic Proposals must be received prior to the time and date specified in the City's E-bid System. The mere fact that the Proposal was dispatched will not be considered; the Proposer must ensure that the Proposal was properly uploaded in the System. The time Proposals are received shall be determined by the electronic clock in the City's E-bid System.

C. QUESTIONS and INQUIRIES

Questions and inquiries about this Request for Proposals shall be submitted in writing to the following individual:

Donna Cantwell
Purchasing Department
Email: Donna.Cantwell@georgetown.org

D. ANTICIPATED SCHEDULE OF IMPORTANT DATES

The City will generally comply with the following schedule for the selection process, subject to changes necessary to ensure fairness and to accommodate unanticipated events:

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Release RFP		**November 29, 2023**
Pre-Proposal Meeting	10:00 AM CT	**December 7, 2023**
Deadline for Questions and Inquiries	5:00 PM CT	**January 4, 2024**
Proposals Closing Date and Time	2PM CST	**January 16, 2024**
City's Review of Proposals		**January 2024**
Earliest Award by City		**March 1, 2024**

E. NON-MANDATORY PRE-PROPOSAL MEETING

A **NON-MANDATORY** Pre-Proposal meeting will be conducted virtually through Microsoft Teams, beginning at 10:00 AM CT on **December 7, 2023.** This meeting is not mandatory. Any questions and answers addressed during the conference meeting will be issued in an addendum and posted on the City website.

The project site will be available for a site visit by prospective proposers on the afternoon of the pre-proposal meeting at 1:00 pm CT.

Non-Mandatory Pre-Proposal Teams Meeting:

Click here to join the meeting
Meeting ID: 210 013 000 090
Passcode: LapP7f
Download Teams | Join on the web

Or call in (audio only)
+1 857-327-8948,,986225881# United States, Boston
(844) 566-5330,,986225881# United States (Toll-free)
Phone Conference ID: 986 225 881#

Non-Mandatory Site Visit Meeting Location: Dove Springs WWTP
Rock Dove Lane
Georgetown, TX 78626

GENERAL TERMS AND CONDITIONS

A. ADDENDA

If it becomes necessary to revise any part of this Request for Proposals, prior to the due date and time, a written addendum will be provided to all known interested Proposers. The City is not bound by any oral representations, clarifications, or changes made in the written specification by the City's employees, unless such clarification of change is provided to Proposers in written addendum form from the City.

Addenda will be transmitted to all that are known to have received a copy of the Request for Proposals and specifications. However, it shall be the sole responsibility of the Proposer to verify issuance of any addenda and to check all avenues of document availability prior to the opening date and time. Proposer shall provide written acknowledgment of all addenda.

B. BUSINESS PRACTICES

Minority business enterprises and/or historically underutilized businesses will be afforded full opportunity to submit Proposals in response to this invitation and will not be discriminated against on the grounds of race, color, creed, sex, or national origin in consideration for an award.

C. CERTIFICATION

This Request for Proposals includes a certification page. Proposer must:

1. Furnish complete name, mailing address, telephone number and email of the individual duly

authorized to execute contractual documents on behalf of the Proposer.

2. Furnish name of individual(s), along with respective telephone numbers and email addresses, who will be responsible for answering all questions.
3. Certify that they have not conspired with any other potential Proposers in any manner to attempt collusion, conspiracy or otherwise obtain an advantage against the City.
4. Certify that they are duly qualified, capable and otherwise bondable business entity not in receivership or contemplating same and has not filed bankruptcy.

D. COLLUSION

Advanced disclosures of any information to any particular Proposer which gives that particular Proposer any advantage over any other interested Proposer in advance of the opening of Proposals, whether in response to advertising or an informal request for proposals, made or permitted by a member of the governing body or an employee or representative thereof, will cause to void all responses to that particular solicitation or request.

E. COMMUNICATION

To insure the proper and fair evaluation of this Proposal, the City prohibits ex parte communication (e.g., unsolicited) initiated by the Proposer to the City Official or Employee evaluating or considering the Proposals prior to the time an award has been made. Communication between Proposers and the City will be initiated by the appropriate City Official or Employee in order to obtain information or clarification needed to develop a proper and accurate evaluation of the Proposal(s). Ex parte communication may be grounds for disqualifying the offending Proposer from consideration or award, or any future solicitation.

Unless otherwise specified, all requests for clarification or questions regarding a solicitation must be directed as provided herein.

F. DISCLOSURE

All proposals will be kept confidential during the negotiation process. Except for trade secrets and confidential information which Proposers identify as proprietary, all proposals will be open for public inspection after the contract award.

G. DISCLOSURE OF CONFLICT OF INTEREST

Chapter 176 of the Texas Local Government Code requires that any vendor or person considering doing business with a local government entity disclose the vendor's or person's affiliation or business relationship that might cause a conflict of interest with a local government entity. The Conflict of Interest Questionnaire form is available from the Texas Ethics Commission at www.ethics.state.tx.us. Any completed Conflict of Interest Questionnaires shall be submitted to the City. Any attempt to intentionally or unintentionally conceal or obfuscate a conflict of interest may automatically result in the disqualification of the Proposer.

H. DISCLOSURE OF INTERESTED PARTIES

Contracting hereunder may require compliance with Texas Government Code §2252.908/Disclosure of Interested Parties for contracts that (1) require an action or vote by the City Council before the contract may be signed; or (2) has a value of at least $1 million. The law provides that a governmental entity may not enter into certain contracts with a business entity unless the business entity submits a disclosure of interested parties to the governmental entity at the time the business entity submits the signed contract to the governmental entity or state agency.

The process as implemented by the Texas Ethics Commission ("TEC") is as follows:

a. The disclosure of interested parties must be performed using the Texas Ethics Commission's electronic filing application listing each interested party of which the business entity is aware on Form 1295, obtaining a certification of filing number for this form from the TEC, and printing a copy of it to submit to the City.
b. The copy of Form 1295 submitted to the City must contain the unique certification number from the TEC. The form must be filed with the City pursuant to Section 2252.908 Texas Government Code, "at the time the business entity submits the signed contract" to the City.
c. The City, in turn, will acknowledge a copy of the disclosure form to the TEC not later than the 30th day after the date the City receives the disclosure of interested parties from the business entity.

I. EFFECTIVE DATE and TERM

The Agreement shall be effective upon the latter of the following: the Proposer's signature on the Proposal and approval by the City Council, or their designee and issuance of an agreement and shall continue in effect until all obligations are performed in accordance with the terms and conditions herein.

J. EXCEPTIONS

Any deviations from terms, conditions or specifications contained herein must be clearly indicated in the Proposal. Any deviations or exceptions are subject to review by the City and may deem the Proposal disqualified or non-responsive. If no exceptions are stated, it will be understood that all general terms and conditions and specific requirements will be complied with, without exception.

K. INTERLOCAL AGREEMENT

Other governmental entities may be extended the opportunity to purchase from solicitations awarded by the City, with the consent and agreement of the successful Proposer(s) and the City. Such consent and agreement shall be conclusively inferred from lack of exception to this clause in Proposer's Proposal. However, all parties indicate their understanding and all parties hereby expressly agree that the City is not an agent of, partner to or representative of those outside agencies or entities and that the City is not obligated or liable for any action or debts that arise out of such independently negotiated piggyback procurements.

L. MANAGEMENT

Should there be a change in management after the due date and time, but before a contract is awarded, Proposers must notify the City immediately. This may result in further evaluation. Should a change in management occur after the contract is awarded, the contract shall be canceled unless a mutual agreement is reached with the new owner or manager to continue the contract. Any resulting contract is nontransferable by either party.

M. PERSONAL INTEREST

No officer, employee, independent consultant or elected official of the City who is involved in the development, evaluation or decision-making process of this Solicitation shall have a financial interest, direct or indirect, in the resulting Agreement. Any willful violation of this Paragraph shall constitute impropriety in office, and any officer or employee guilty thereof shall be subject to disciplinary action up to and including dismissal. In the event a member of the governing body or an appointed board or commission of the City belongs to a cooperative association, the City may purchase services from the association only if no member of the governing body, board or commission will receive pecuniary benefit from the purchase, other than as reflected as in increase in dividends distributed generally to members of the association. Any violation of this provision with the knowledge, expressed or implied,

by the Vendor shall render the Agreement voidable by the City. Nevertheless, the City may obtain the services under the Agreement if a conflict of interest affidavit is filed and the Council member recuses his/herself.

N. PRICE WARRANTY

The Proposer warrants that the prices proposed are fair and reasonable and not higher than those for similar projects of the same size and scope offered to other local governments in the United States.

O. PERFORMANCE AND PAYMENT BONDS

The successful Proposer shall provide a Performance and Payment Bond. Each bond shall be issued in an amount of one hundred percent (100%) of the Contract Amount by a solvent surety or insurance company licensed to do business in the State of Texas and as specifically prescribed in the General Conditions and Supplemental Conditions.

P. PRIORITY of DOCUMENTS

In the event there are inconsistencies between the RFP terms and conditions, scope of work or Agreement terms and conditions contained herein, the latter will take precedence.

Q. PROTEST PROCEDURES

1. Proposers are advised that protests of specifications, terms, conditions or any other aspect of this solicitation, must be made prior to the proposal due date. Protest of specifications and solicitation terms and conditions made after the due date and time will not be considered by the Buyer.

2. Protest of award must be made immediately, and in no event later than five (5) days after the aggrieved party knows, or should have known, the facts giving rise thereto. All protests must include the following information:
   - The name, address and telephone number of the protestor
   - The signature of the protestor or protestor's representative
   - The solicitation or contract number
   - A detailed statement of the legal and/or factual ground of the protest
   - The form of relief/result requested

Protests may be emailed or mailed to the Purchasing Department, P.O. Box 409, Georgetown, TX 78627, Attention: Listed Buyer. Award will be made in the best interest of the City.

R. PUBLIC INFORMATION

All Proposals are subject to release as public information unless the Proposal or specific parts of the Proposal can be shown to be exempt from the Texas Public Information Act. Proposers are advised to consult with their legal counsel regarding disclosure issues and take the appropriate precautions to safeguard trade secrets or any other proprietary information. The City assumes no obligation or responsibility for asserting legal arguments on behalf of potential Proposers.

If a Proposer believes that a Proposal or parts of a Proposal are confidential, then the Proposer shall so specify. The Proposer shall stamp in bold red letters the term "**CONFIDENTIAL**" on that part of the Proposal, which the Proposer believes to be confidential. Vague and general claims as to confidentiality shall not be accepted. All Proposals and parts of Proposals that are not marked as confidential will be automatically considered public information.

S. REIMBURSEMENTS

There is no expressed or implied obligation for the City of Georgetown to reimburse responding Proposers for any expenses incurred in preparing Proposals in response to this Request for Proposals and the City will not reimburse responding Proposers for these expenses, nor will the City pay any subsequent costs associated with the provision of additional information or presentation, or to procure a contract for these goods or services.

T. REPRESENTATIONS and RESPONSIBILITIES

By submitting a Proposal in response to this RFP, Proposer represents that it has carefully read and understands all elements of this RFP; has familiarized itself with all federal, state, and local laws, ordinances, and rules and regulations that in any manner may affect the cost, progress, or performance of the work; and has full knowledge of the scope, nature, quality and quantity of services to be performed.

By submitting a Proposal in response to this RFP, the Proposer represents that it has not relied exclusively upon any technical details in place or under consideration for implementation by the City, but has supplemented this information through due diligence research and that the Proposer sufficiently understands the issues relative to the indicated requirements.

The failure or omission of Proposer to receive or examine any form, instrument, addendum, or other documents or to acquaint itself with existing conditions or other details shall in no way relieve any Proposer from any obligations with respect to its proposal or to the contract.

U. RESERVATIONS

The City reserves the right to request clarification or additional information specific to any Proposal after all Proposals have been received and the solicitation due date has passed**.** Additionally, the City reserves the right to accept or reject all or part of any Proposal, waive any formalities or technical inconsistencies, delete any portion of the Scope of Work, or terminate the Request for Proposals when deemed to be in City's best interest.

V. RETAINAGE

Retainage in the amount of five percent (5%) will be withheld pursuant to Texas Government Code § 2252, and such retainage will be withheld until thirty (30) days after Final Completion.

W. SALES AND USE TAXES

OWNER is exempt from Texas state sales and use taxes on materials and equipment to be incorporated in the Work, pursuant to the provisions of Section 151.309(5) of the Texas Tax Code. Said taxes shall not be included in the Proposal. Refer to paragraph 6.10 of the General Conditions for additional information

X. SUBSTITUTE AND "OR EQUAL" ITEMS

The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Proposal Documents without consideration of possible substitute or "or equal" items. Whenever it is specified or described in the Proposal Documents that a substitute or "or equal" item of material or equipment may be furnished or used by CONTRACTOR if acceptable to ENGINEER, application for such acceptance will not be considered by ENGINEER until after the Effective Date of the Agreement. The procedure for submission of any such application by CONTRACTOR and consideration by ENGINEER is set forth in the General Conditions and may be supplemented in the General Requirements.

Y. SUBCONTRACTORS, SUPPLIERS, AND OTHERS

Proposer shall identify the Major Subcontractors Proposer proposes for this Project in Section 00400 Statement of Proposer's Experience. Such list shall be accompanied by an experience statement with

pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity as provided on Attachment E of Statement of Proposer's Experience. If OWNER or ENGINEER, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, OWNER may, before the Notice of Award is given, request apparent Successful Proposer to submit a substitute, in which case apparent Successful Proposer shall submit an acceptable substitute.

If apparent Successful Proposer declines to make any such substitution, OWNER may award the Contract to another Proposer that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Proposer. Any Subcontractor, Supplier, individual, or entity so listed and against which OWNER or ENGINEER makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to OWNER and ENGINEER subject to revocation of such acceptance after the Effective Date of the Agreement as provided in paragraph 6.06 of the General Conditions.

CONTRACTOR shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom CONTRACTOR has reasonable objection.

Z. SECURITY

Proposers must submit with their Proposal, a Cashiers Check or a Certified Check, drawn on a bank or trust company authorized to do business in the State of Texas, payable to the City of Georgetown in the amount at least equal to five percent (5%) of the maximum amount of Proposal Price, as a guarantee that a contract will be entered into or in lieu of cash or certified check, the Proposer may submit a Proposal Bond in the form prescribed in Section 00410 of the Documents.

AA. STANDARD FORM of AGREEMENT

The City's Standard Form of Agreement together with the General Conditions, Supplementary Conditions and Exhibits are attached to this RFP as Exhibits 00500, 00610, 00620, 0700 and 0800. The successful Proposer will be required to execute this Agreement. All Proposers shall be required to thoroughly read and understand the terms, conditions, and provisions in this Agreement. All required Certificates of Insurance and endorsements will be required before award recommendation is taken to City Council. Any exceptions taken to the City's Standard Form of Agreement must be indicated in your Response. Failure to note any exceptions will be acknowledgement that you accept the terms and condition without modifications.

BB. WITHDRAWAL by CITY

The City makes no guarantees or representations that any award will be made and reserves the right to cancel this solicitation for any reason, including:

- Reject any and all Proposals received as a result of this RFP.
- Waive or decline to waive any informality and any irregularities in any Proposals received.
- Negotiate changes in the Scope of Work or services to be provided.
- Withhold the award of contract(s).
- Select Proposer(s) it deems to be most qualified to fulfill the needs of the City. Proposer(s) with the lowest priced proposal(s) will not necessarily be selected, since a number of criteria other than price are important in the determination of the most acceptable proposal(s).
- Terminate the RFP process.

CC. WITHDRAWAL by PROPOSER

Respondents may request withdrawal of a sealed Proposal ***prior to the scheduled opening time***, provided the request for withdrawal is submitted to the City in writing.

D D . VENUE

Any contract awarded as a result of this RFP shall be governed by and construed in accordance with the laws of the State of Texas, and is fully performable in Georgetown, Texas, and venue for any action related to this contract will be Williamson County, Texas.

BACKGROUND and CURRENT CIRCUMSTANCES

A. CITY OF GEORGETOWN

Georgetown is a Home Rule Charter City and operates under a Council - Manager form of government. A mayor, elected at large, and seven Council members, elected from single member districts, serve staggered, three-year terms. Georgetown is located on Interstate 35, the major corridor between Dallas and San Antonio, at the intersection of State Highway 130. Georgetown was founded in 1848 with a strong agricultural base, in the heart of Williamson County, 26 miles north of Austin. Today, Georgetown has an estimated population of 74,180 within the city limits, with an estimated population of 93,961 within the extra-territorial jurisdiction (ETJ) and serves as the county seat of Williamson County.

Georgetown's economic development initiatives to expand jobs and tax base have been with a careful focus of maintaining and expanding its status as a signature destination. The award- winning historic downtown square, along with its extensive, award-winning parks and river trail systems along the North and South San Gabriel Rivers and Lake Georgetown have been leveraged to make the City one of the most attractive places to live and work.

This unique character and small-town charm were key factors for Del Webb Corporation when it built its first Texas development in Georgetown with the 1995 opening of Sun City, Texas. Today, over 7,200 homes with over 13,500 retirees make Sun City and Georgetown their home.

Georgetown is also home to Southwestern University, which continues to receive national recognition. The University has been named to Kiplinger's list of the 100 best values in liberal arts colleges and has been noted as one of 'America's Best Value Colleges' by the *Princeton Review*. With more than 1,528 students and over 500 employees, the University provides substantial economic and cultural contributions to Georgetown.

B. ESTIMATED BUDGET

The City has established twelve million and two hundred thousand dollars ($12,200,000.00) as the estimated budget for all the Work, including alternates as described in the Drawings, Technical Specifications, and other Contract Documents prepared by the Engineer.

C. ESTIMATED CONSTRUCTION TIME

The estimated construction time for this project is 365 calendar days for the Temporary Package Plant Substantial Completion, 640 calendar days for the Balance of Plant Substantial Completion, and 700 calendar days for Final Completion.

D. SUBSURFACE, PHYSICAL CONDITIONS, AND HAZARDOUS ENVIRONMENTAL CONDITION

The Supplementary Conditions (Exhibit 00800) identify:

1. Those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the RFP Documents.

2. Those drawings of physical conditions in or relating to existing surface and subsurface structures at or contiguous to the Site (except Underground Facilities) that ENGINEER has used in preparing the RFP Documents.

3. Those reports relating to a hazardous environmental condition identified at the Site, if any, that Engineer has used in preparing the RFP Documents.

Copies of reports and drawings referenced in subparagraphs D.1, D.2, and D.3 above will be made available by the Engineer to any Proposer on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Proposer is entitled to rely as provided in the Supplementary Conditions. Proposer is responsible for any interpretation or conclusion Proposer draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

E. UNDERGROUND FACILITIES

Information and data shown or indicated in the RFP Documents with respect to existing Underground Facilities at or contiguous to the Site is based upon information and data furnished to OWNER and ENGINEER by owners of such Underground Facilities, including OWNER, or others.

SCOPE OF WORK

SCOPE OF WORK

A. General

The project consists of providing all labor and materials required for the construction of the Dove Springs Wastewater Treatment Plant Rehabilitation Project as further defined in the attached Contract Documents and the Construction Plans and Specifications (the "Work").

B. Construction Documents

Construction Plans and Specifications for the Dove Springs WWTP Rehabilitation are provided with this RFP, stamped and signed November, 2023.

EVALUATION AND SELECTION PROCESS

As this is a solicitation by Competitive Sealed Proposals pursuant to Government Code Chapter 2269, the City will select a Proposer whose Proposal is determined to be the most advantageous to the City considering the relative importance of price and the other evaluation factors included in this Request for Proposals.

The City has attempted to provide a comprehensive statement of requirements through this RFP for the

work contemplated. Written proposals must present Proposer's qualifications and understanding of the work to be performed. Proposers are asked to address each evaluation criteria and to be specific in presenting their qualifications. Proposals must be as thorough and detailed as possible so that the City may properly evaluate capabilities to provide the requested services.

By submission of a proposal, Proposer acknowledges acceptance of the evaluation process, the evaluation criteria, scope of work, approach and methodology, and all other terms and conditions set forth in this RFP. Further, Proposers acknowledge that subjective judgements must be made by the City during this process.

The evaluation process may include, but is not limited to, the following steps. Steps may be omitted or reordered depending on the proposal evaluation requirements. For example, Best and Final Offers may be required prior to Interviews and/or Presentations.

A. CLARITY AND QUALITY OF PROPOSAL **Pass / Fail**

Proposers must provide comprehensive responses to every section within this RFP in the described format. It is not the intent of the City to constrain Proposers with regard to content, but to assure that the specific requirements set forth in this RFP are addressed in a uniform manner amenable to review and evaluation. Failure to do so may result in your Proposal being disqualified from further review and consideration. Supplemental information requested in the proposal shall be printable on letter size 8.5” x 11” single-sided paper using a font size not less than 10 unless noted otherwise.

B. PROPOSAL EVALUATIONS

The City has established specific, weighted criteria for selection. This section presents the evaluation criteria, description, and relative weight assigned to each (100 points maximum). The City will evaluate each Proposer’s responses to the requirements contained in this RFP.

C. COST PROPOSAL **80 points total**

Total contract cost shall be considered but shall not be the sole determining factor. The Owner shall have the right to accept alternates in any order or combination unless otherwise specifically provided in the Proposal Documents.

D. CONTRACTOR’S EXPERIENCE AND QUALIFICATIONS **5 points total**

The Proposer’s experience relative to the Project, the reputation of the Proposer in similar past projects, and overall reputation and experience of the Proposer shall be considered. The Owner will evaluate the projects submitted per Exhibit 00400 to determine relevancy to the specified scope of this Project and review the Proposer’s performance on the submitted projects. Proposer must provide evidence of a minimum of three (3) successfully completed water or wastewater treatment plan installation projects of comparable size (minimum value of $10 million), complexity, and scope (at least two projects must be at operational wastewater treatment plants) within the United States successfully completed by the Offeror within the past ten (10) years. The Owner may contact the past project references, as may be necessary to verify the qualifications, experience, and reputation of the Proposer. This requirement can be met through the employment of a qualified subcontractor.

E. KEY PERSONNEL AND TEAM STRUCTURE **5 points total**

Key personnel will be evaluated for experience with the type and scope of work required for this Project, previous work history as a team, definition of roles in previous experience, and length of time with the company. In addition to the Key Personnel submitted per Exhibit 00400, the Proposer shall provide an organizational chart (maximum one (1) 8.5” x 11” page) showing the Proposer’s team

structure and key team personnel that will be assigned to the Project.

F. PROJECT APPROACH AND UNDERSTANDING **10 points total**

Proposers will be evaluated by general project approach, understanding of specific challenges, summary of available critical equipment (status, location, and refurbishment needs), approach to mitigating unforeseen conditions, safety and risk management, management of subs/suppliers, quality management, and schedule.

The Proposer shall provide a written approach and understanding not to exceed ten pages narrative and ten pages graphics, including timelines/schedules, describing the planned approach for constructing this project within the time indicated in the proposal. 8.5" x 11" pages may only be used for the narrative and 11" x 17" pages may be used for graphics, including timelines/schedules.

G. REFERENCE CHECKS

The City reserves the right to check any reference(s), regardless of the source of the reference information. Information may be requested and evaluated from references. The City reserves the right to use a third party to conduct reference checks. Only top scoring Proposers may receive reference checks and negative references may eliminate Proposers from further consideration.

H. EVALUATION and RANKING

Following the Technical and Cost proposal evaluation, the City will compile the final scores. If the Evaluation Committee determines that clarifying information is not required, the evaluation process is complete. The award recommendation will be made to the Proposer which, in the City's opinion, has submitted the Proposal most beneficial to the City for award.

I. VENDOR SELECTION

Contract negotiations will begin with the highest ranked Offeror following any presentations and/or interviews. Should negotiations with the highest ranked Offeror fail to yield a contract, or if the Offeror is unable to execute the City's contract, negotiations will be formally ended and then commence with the second highest ranked Offeror, etc. The City may, in its sole discretion, negotiate and award a contract without presentations or interviews, based solely on information supplied in the proposal responses. The City may, at its option, request best and final offers from one or more Offerors.

SUBMISSION REQUIREMENTS

The City will not accept hard copy or oral proposals, or proposals received by telephone or FAX machine. Proposals must be prepared simply and economically, providing a straightforward, concise description of Proposer's ability to meet all requirements and specifications of this RFP. Emphasis should be focused on completeness, clarity of content and responsiveness to all requirements and specifications of this RFP. Refer to https://gtowntx.ionwave.net/Login.aspx for further information on how to submit proposals electronically.

The City of Georgetown requires comprehensive responses to every section within this RFP. To facilitate the review of the responses, Proposers shall follow the described format. The intent of the proposal format is to expedite review and evaluation. It is not the intent to constrain Proposers with regard to content, but to assure that the specific requirements set forth is this RFP are addressed in a uniform manner amenable to review.

The submission of a Proposal will constitute an incontrovertible representation by Proposer that Proposer has complied with every requirement of this RFP, that without exception the Proposal is premised upon

performing and furnishing the Work required by the RFP Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the RFP Documents.

A. EXHIBIT 00300 PROPOSAL FORM

Complete and submit Exhibit 00300 Proposal Form.

B. EXHIBIT 00400 – STATEMENT OF PROPOSER'S EXPERIENCE

Complete and submit Exhibit 00400 and it would be preferred that this information be included with the proposal. If desired, the experience descriptions may be provided no later than 24 hours after the opening at the Purchasing Office with the Proposal's name and Project name included on the envelope.

C. EXHIBIT 00410 PROPOSAL BOND

Complete and submit Exhibit 00410 Proposal Bond.

D. CERTIFICATION and ACKNOWLEDGEMENT PAGES

Complete and include the Certification and Acknowledgment on page 16 of the RFP and Certification Required by Texas Government Code Chapter 2270 on page 17 of this RFP.

CERTIFICATION and ACKNOWLEDGEMENT

The undersigned affirms that they are duly authorized to submit this Proposal, that this Proposal has not been prepared in collusion with any other Offeror, and that the contents of this Proposal have not been communicated to any other Offeror prior to the official opening. Further, Offeror certifies that Offeror is not engaged in business with Iran, Sudan, or a foreign terrorist organization.

Signed By: _____ Title: _____

Typed Name: _____ Company Name: _____

Phone No.: _____ Fax No.: _____

Email: _____

Proposal Address: _____
P.O. Box or Street City State Zip

Order Address: _____
P.O. Box or Street City State Zip

Remit Address: _____
P.O. Box or Street City State Zip

Federal Tax ID No.: _____

DUNS No.: _____

Date: _____

CERTIFICATION REQUIRED BY TEXAS GOVERNMENT CODE

The undersigned makes the following certifications or represents that it satisfies the requirements of one or more exceptions to the Texas Government Code provisions listed below:

- **Contractor Certification Regarding Boycotting Israel.** Pursuant to Chapter 2271, Texas Government Code, Firm certifies that it (1) is a sole proprietorship or company with fewer than ten (10) employees; **or** (2) does not currently boycott Israel and will not boycott Israel during the term of this Agreement.
    - Exception: This provision only applies to contracts for goods and services between a governmental entity and a Company with ten (10) or more full-time employees with a value of $100,000 or more that is to be paid wholly or partly from public funds of the governmental entity.
- **Contractor Certification Regarding Business with Certain Countries and Organizations.** Pursuant to Subchapter F, Chapter 2252, Texas Government Code, Firm certifies it (1) is a "Company," as that term is defined in Texas Government Code Section 806.001; and (2) is not engaged in business with Iran, Sudan, a foreign terrorist organization, or any company that is identified on a list prepared and maintained under Texas Government Code Section 806.051, 807.051, or 2252.153.
    - Exception: A company that the United States government affirmatively declares to be excluded from its federal sanctions regime relating to Sudan, its federal sanctions regime relating to Iran, or any federal sanctions regime relating to a foreign terrorist organization is not subject to contract prohibition under this subchapter.
- **Contractor Certification Regarding Boycotting Energy Companies.** Pursuant to Chapter 2274, Texas Government Code, Firm certifies that either (1) is a sole proprietorship or company with fewer than ten

  (10) employees; **or** (2) Firm does not currently boycott energy companies and will not boycott energy companies during the Term of this Agreement.

  3.1. Exception: This provision only applies to contracts for goods and services between a governmental entity and a Company with ten (10) or more full-time employees with a value of $100,000 or more that is to be paid wholly or partly from public funds of the governmental entity.
- **Contractor Certification Regarding Boycotting Firearm and Ammunition Industries.** Pursuant to Chapter 2274, Texas Government Code, Firm certifies that either (1) Contractor is a sole proprietorship or company with fewer than ten (10) employees; **or** (2) Firm does not currently boycott firearm and ammunition industries and will not boycott firearm and ammunition industries during the term of this Agreement.
    - Exception: This provision only applies to contracts for goods and services between a governmental entity and a Company with ten (10) or more full-time employees with a value of $100,000 or more that is to be paid wholly or partly from public funds of the governmental entity.
- **Contractor Certification Regarding Doing Business in Texas.** Firm certifies that it has not been debarred from doing business in the State of Texas.

Firm acknowledges this Agreement may be terminated and payment withheld if this certification is inaccurate.

For purposes of this form, the terms have the meanings assigned by Texas Government Code sections referenced above.

Signed By:_____ Title:_____

Typed Name: _____

Company Name:_____

Date:_____

COMPLETE THIS SECTION ONLY IF YOU BELIEVE YOU ARE NOT REQUIRED TO PROVIDE THE WRITTEN CERTIFICATION LISTED ABOVE FOR THE REASONS CITED BELOW.

Firm is not required to provide the certifications listed above because of the following exemptions (explain the specific exemptions that apply pursuant to the applicable Chapter of the Texas Government Code):

_____

_____

_____

EXHIBIT 00300 – PROPOSAL FORM

The Proposal Form is attached to this Exhibit 00300.

Proposers shall provide the estimated quantities for trench safety implementation based on their proposed construction means and methods.

A . ALLOWANCES

Owner's Contingency Allowance

Allowance to be used for additional facility improvements, landscaping, and/or miscellaneous modifications.

Electric Utility Allowance

Allowance to be used for paying fees and charges for permanent electrical service from Georgetown Utility Systems. Refer to Drawing E-3 (Electrical General Notes), Service and Metering notes.

Fence Relocation Allowance

Allowance for the fence relocation at Dove Springs WWTP, as needed.

B . ALTERNATES

Deductive Alternate D-1

Base bid shall be based on payment of 95 percent of the invoiced equipment value for equipment upon delivery as specified in the General Conditions of the Contract.

For this Deductive Alternate, Proposer shall indicate the credited price to the Owner for the following alternate payment terms for equipment (multistage blowers, ceramic diffusers, submersible pumps, and motor control centers) will be allowed based on the following terms:

- 5% of invoiced equipment value upon approval of shop drawings.
- 90% of invoiced equipment value upon delivery.

Additive Alternate A-1

For this Additive Alternate, Proposer shall indicate the additional price to the Owner to provide maintenance assistance at the Pecan Branch WWTP including provision of temporary piping, cleaning of a RAS forcemain, and leveling of weirs as specified in Section 464313 – PECAN BRANCH MAINTENANCE.

C. ALTERNATE PROPOSAL DEVIATIONS

Proposer must submit a Proposal that is in strict conformance with the Contract Documents as modified by Addenda. Provided this fully compliant Proposal is submitted, Proposer may submit up to three (3) Alternate Proposal Deviations that offer Work that is not in strict compliance with the Contract Documents. Describe the intent and substance of the changes in the Alternate Proposal Deviations in adequate detail so that the changes are clearly understood. Acceptance of Alternate Proposal Deviations is at the sole discretion of the Owner and will not be considered if the intent of the change is not clearly

understood or is deemed to be in the Owner's best interest.

Alternate Proposal Deviations are to be clearly marked as 00300-B Alternate Proposal Deviations and are to be submitted with the fully compliant base Proposal. Do not provide a duplicate of the base Proposal. Identify components that are different in the proposed Alternate Proposal Deviation.

Describe the intent and substance of the changes in the Alternate Proposal Deviation in adequate detail so the changes are clearly understood using Section 00300-B Alternate Proposal Deviations form. Details in the base Proposal will remain in effect unless specifically listed in the Alternate Proposal Deviation using Section 00300-B Alternate Proposal Deviations. All provisions not specifically modified by the Alternate Proposal Deviation are to remain in effect in the Alternate Proposal Deviation.

Each and every deviation from the terms, conditions, specifications, or performance requirements of these Contract Documents shall be listed using Section 00300-B Alternate Proposal Deviations upon submission of your Proposal. Proposer may submit up to three (3) deviations listed in Section 00300-B Alternate Proposal Deviation. The Alternate Proposal Deviation will consist of those deviations accepted by Owner. Owner reserves the right to reject proposed deviations.

Alternate Proposal Deviations must clearly show the difference in cost of the Alternate Proposal Deviation. Clearly note the cost impact of each submitted deviation.

SECTION 00300 PROPOSAL FORM

PROPOSER'S NAME_____

PROJECT IDENTIFICATION:

City of Georgetown
Project Name: Dove Springs WWTP Rehabilitation
Project Address: Rock Dove Ln. Georgetown, TX 78626

RFP NUMBER: 202407

THIS PROPOSAL IS SUBMITTED TO:

The City of Georgetown, Texas
Georgetown Municipal Court
Purchasing Department
510 W. 9th Street
Georgetown, Texas 78626

1.01 The undersigned Proposer proposes and agrees, if this Proposal is accepted, to enter into an Agreement with Owner in the form included in the Proposal Documents to perform all Work as specified or indicated in the Proposal Documents for the prices and within the times indicated in this Proposal and in accordance with the other terms and conditions of the Proposal Documents.

1.02 Proposer understands and agrees that the Owner has the right to reject any or all Proposals and to waive any minor technicalities.

2.01 Proposer accepts all of the terms and conditions of the Advertisement or Request for Proposal and Instructions to Proposers, including without limitation those dealing with the disposition of Proposal security. The Proposal will remain subject to acceptance for 90 days after the Proposal opening, or for such longer period of time that Proposer may agree to in writing upon request of Owner.

3.01 In submitting this Proposal, Proposer represents, as set forth in the Agreement, that:

A. Proposer has examined and carefully studied the Proposal Documents, the other related data identified in the Proposal Documents, and the following Addenda, receipt of all which is hereby acknowledged.

Addendum No.	Addendum Date
_____	_____
_____	_____
_____	_____
_____	_____

B. Proposer has visited the Site and become familiar with and is satisfied as to the general, local and Site conditions that may affect cost, progress, and performance of the Work.

C. Proposer is familiar with and is satisfied as to all federal, state and local laws and regulations that may affect cost, progress and performance of the Work.

D. Proposer has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in paragraph 4.02 of the General Conditions, and (2) reports and drawings of a Hazardous Environmental Condition, if any, which has been identified in the Supplementary Conditions as provided in paragraph 4.06 of the General Conditions.

E. Proposer has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Proposer, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Proposal Documents to be employed by Proposer, and safety precautions and programs incident thereto.

F. Proposer does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Proposal for performance of the Work at the price(s) proposed and within the times and in accordance with the other terms and conditions of the Proposal Documents.

G. Proposer is aware of the general nature of work to be performed by OWNER and others at the Site that relates to the Work as indicated in the Proposal Documents.

H. Proposer has correlated the information known to Proposer, information and observations obtained from visits to the Site, reports and drawings identified in the Proposal Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Proposal Documents.

I. Proposer has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that Proposer has discovered in the Proposal Documents, and the written resolution thereof by ENGINEER is acceptable to Proposer.

J. The Proposal Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Proposal is submitted.

4.01 Proposer further represents that this Proposal is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Proposer has not directly or indirectly induced or solicited any other Proposer to submit a false or sham Proposal; Proposer has not solicited or induced any individual or entity to refrain from proposing; and Proposer has not sought by collusion to obtain for itself any advantage over any other Proposer or over OWNER.

5.01 Proposer will complete the Work in accordance with the Contract Documents for the following price(s):

UNIT PRICE SCHEDULE FOR DOVE SPRINGS WWTP REHABILITATION					
ITEM NO.	**ESTIMATED QUANTITY**	**UNIT**	**ITEM DESCRIPTION & PRICE IN WORDS**	**UNIT PRICE IN FIGURES**	**TOTAL ESTIMATED PRICE**
1	1	LUMP SUM	Insurance, Bonds and Mobilization/Demobilization Related Expenses not to exceed 5% of Total Proposal.	$_____	$_____
2	1	LUMP SUM	Furnish all necessary labor, materials, equipment and incidentals necessary to construct the **Dove Springs WWTP Rehabilitation** improvements to the 2.5 million gallons per day Dove Springs Wastewater Treatment Plant including pipe connections to the Temporary Wastewater Treatment Package Plant, as more fully described in the Drawings and the Summary of Work contained in Section CIP3 and the delineation of Package Plant scope provided in Section 015353. This item shall include all work as specified and shown on the Drawings including all ancillary equipment, complete in place including incidental work obviously needed for the complete project, except those costs specifically included in the other items in this Schedule of Prices. Procurement of the Package Plant equipment has been provided by the City under a separate solicitation.	$_____	$_____
3	1	LUMP SUM	Furnish all necessary labor, materials, equipment, and incidentals necessary to **Refurbish and Relocate the existing three Multistage Blowers** for use at the Package Plant as more fully described in the Drawings, the Summary of Work in Section CIP3, and in Section 431117.	$_____	$_____
4	400	WET TONS	Furnish all necessary labor, materials, equipment and incidentals necessary to perform **Removal, Loading, Transport, and Disposal** of wastewater solids, grit, rags, and debris from the Aeration Basins Tanks and all other related work complete in place as detailed on the Drawings and as specified in Section 460200 “Tank and Structure Cleaning” except those costs specifically included in other items in this Schedule of Prices.	$_____	$_____

ALLOWANCES FOR BASE PROPOSAL:

UNIT PRICE SCHEDULE FOR DOVE SPRINGS WWTP REHABILITATION					
ITEM NO.	**ESTIMATED QUANTITY**	**UNIT**	**ITEM DESCRIPTION & PRICE IN WORDS**	**UNIT PRICE IN FIGURES**	**TOTAL ESTIMATED PRICE**
1	1	LUMP SUM	Owner's Contingency Allowance are considered provisional amounts to be used only if directed and are exclusive of work indicated in the Contract Documents for which payment is included in other items in the Schedule of Prices. Contractor's cost for bonds, insurance, overhead, profits, etc. associated with this allowance shall be included in the lump sum Proposal items above; no mark-up shall be allowed for these funds, the sum of one million dollars and no cents.	$ 1,000,000.00	$ 1,000,000.00
2	1	LUMP SUM	Allowance to be used for paying fees and charges for permanent electrical service from Georgetown Utility Systems. Refer to Drawing E-3 (Electrical General Notes), Service and Metering notes. The cost for the work to be performed shall be negotiated and Contractor shall be paid for the work out of this allowance, the sum of one hundred and seventy thousand dollars and no cents.	$ 170,000.00	$ 170,000.00
3	1	LUMP SUM	Allowance for additional relocation of fence around Dove Springs WWTP beyond the scope of work shown on the Contract Drawings, as needed for the sum of ten thousand dollars and no cents.	$ 10,000.00	$ 10,000.00

TOTAL OF ALL ESTIMATED PRICES - BASE PROPOSAL

*$*_____ (in Figures)

_____ (in Words)

ALTERNATE PROPOSAL:

UNIT PRICE SCHEDULE FOR DOVE SPRINGS WWTP REHABILITATION					
ITEM NO.	**ESTIMATED QUANTITY**	**UNIT**	**ITEM DESCRIPTION & PRICE IN WORDS**	**UNIT PRICE IN FIGURES**	**TOTAL ESTIMATED PRICE**
D-1	1	LUMP SUM	Deductive cost if Owner accepts alternative payment terms as detailed in this Proposal Form.	$ _____	$ _____
A-1	1	LUMP SUM	Additive cost if Owner accepts the price provided for assistance with maintenance items at the Pecan Branch WWTP as specified in Section 464313 – PECAN BRANCH MAINTENANCE.	$ _____	$ _____

Unit Prices have been computed in accordance with paragraph 11.03.B of the General Conditions.

Proposer acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Proposals, and final payment for all Unit Price Proposal items will be based on actual quantities provided, determined as provided in the Contract Documents.

6.01 Proposer agrees that the Work will be substantially complete within 640 calendar days after the day of the written Notice to Proceed and that the Work including all Package Plant lease will be fully complete and ready for final payment within 700 days after the date of the written Notice to Proceed.

6.02 Proposer accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the times specified above, which shall be stated in the Agreement.

7.01 The following documents are attached to and made a condition of this Proposal:

A. Required Proposal security in the form of _____;

B. Section 00400, Statement of Proposer's Experience, including Attachments A – I.

8.01 The terms used in this Proposal with initial capital letters have the meanings indicated in the Instructions to Proposers, the General Conditions, and the Supplementary Conditions.

SUBMITTED on _____, 20____.

PROPOSAL EQUIPMENT

Equipment Item or Material	Spec Section	Manufacturer/Supplier
Lift Station Submersible Pumps	432513	a. Wilo b. Hydromatic c. Myers
New Multistage Centrifugal Blowers (for Treatment Units)	431118	a. Lone Star Blower b. Continental c. Hoffman Lamson Gardner Denver
Multistage Centrifugal Blower Refurbishment and Relocation (for Package Plant)	431117	a. Lone Star Blower b. Continental c. Hoffman Lamson Gardner Denver
Ceramic Disc Fine Bubble Diffusers	465136	a. ITT-Sanitaire Xylem b. Aquarius Technologies c. EDI
Programmable Logic Controllers	406343	a. Allen-Bradley

ALTERNATE MANUFACTURERS/SUPPLIERS

Proposer proposes the following alternate manufacturers and suppliers for the equipment or material categories identified:

Equipment Item or Material	Drawing No.	Spec. Section	Alternative Manufacturer/Supplier (List One Only)	Deductible Amount (Indicate whether lump sum or unit price)
1.				
2.				
3.				
4.				
5.				

SCHEDULE OF SUBCONTRACTORS

Proposer proposes the following subcontractors to be used for the Project. All subcontractor specialties indicated below and any subcontractors that, due to the nature of the construction work, comprise a critical or essential element of the construction such that the amount of the subcontract is equal to or greater than 10% of the construction budget or $50,000, whichever is greater must be listed and submitted with the Proposal. Proposers shall provide the address and phone number for each subcontractor listed and three (3) references for similar size and type of project (Attachment D of Section 00400) with the Proposal in accordance with Section 00100. The references shall include name of project, and contact information, including name, phone number and address, for the Owner, Engineer and General Contractor for each project. Failure to provide this information by the specified date and time will disqualify the Proposal from consideration.

Proposer may change subcontractors after Proposal submittal only as approved in writing by the Engineer. The information provided will be used in the evaluation of the Proposer.

SUBCONTRACTOR	SPECIALTY
1.	Electrical
2.	Instrumentation
3.	
4.	
5.	

IF PROPOSER IS:

An Individual

Name (typed or printed): _____

By: _____(SEAL)

(Individual's signature)

Doing business as: _____

Business address: _____

Phone No.: _____ FAX No.: _____

A Partnership

Partnership Name: _____(SEAL)

By: _____

(Signature of general partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Business address: _____

Phone No.: _____ FAX No.: _____

A Corporation

Corporation Name: _____(SEAL)

State of Incorporation: _____

Type (General Business, Professional, Service, Limited Liability):_____

By: _____

(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(CORPORATE SEAL)

Attest _____

(Signature of Corporate Secretary)

Business address: _____

Phone No.: _____ FAX No.: _____

Date of Qualification to do business is _____.

A Joint Venture

Joint Venturer Name: _____(SEAL)

By: _____

(Signature of joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ FAX No.: _____

Joint Venturer Name: _____(SEAL)

By: _____

(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ FAX No.: _____

Phone and FAX Number, and Address for receipt of official communications:

_____

_____

Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.

ALTERNATE PROPOSAL DEVIATIONS

Proposer:

_____

Proposer's Certification: *The Proposer is offering to complete the Work described in the Contract Documents with the deviations described in this request as an Alternate Proposal Deviation. The Proposer certifies that, with the exception of the deviations specifically described in this list of Alternate Proposal Deviations, the Proposal is based on completing Work in strict compliance with the Contract Documents and Owner can rely on this certification in consideration of awarding a contract for this Alternate Proposal Deviation.*

Certified by: _____ Date: _____

Deviation Number: _____Description: _____

Specification Section: _____ Page Number: _____Paragraph: _____

Drawing Number: _____Detail Description: _____

Describe Deviation and Benefits to Owner: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Proposed Change in Contract Price: ☐ Add ☐ Deduct $_____

Change in Contract Time: ☐ Add ☐ Deduct _____ Days

Deviation Number: _____ Description: _____

Specification Section: _____ Page Number: _____ Paragraph: _____

Drawing Number: _____ Detail Description: _____

Describe Deviation and Benefits to Owner: _____

_____

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Proposed Change in Contract Price: ☐ Add ☐ Deduct $_____

Change in Contract Time: ☐ Add ☐ Deduct _____ Days

Deviation Number: _____ Description: _____

Specification Section: _____ Page Number: _____ Paragraph: _____

Drawing Number: _____ Detail Description: _____

Describe Deviation and Benefits to Owner: _____

_____

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_____

Proposed Change in Contract Price: ☐ Add ☐ Deduct $_____

Change in Contract Time: ☐ Add ☐ Deduct _____ Days

EXHIBIT 00400 – STATEMENT OF PROPOSER'S EXPERIENCE

PROPOSER'S NAME: _____

Project Name: Dove Springs WWTP Rehabilitation

All questions on this form must be answered and data given must be clear and comprehensive. If necessary, questions may be continued on separately attached sheets.

PART 1, PART 2, and PART 3 below are to be submitted as part of the Proposal.

PART 1 – GENERAL

1.1 Proposer must submit Attachments A through J contained in this Statement of Proposer's Experience form signed and notarized within 24-hours of its Proposal. Failure to do so will constitute an incomplete Proposal, which will be rejected.

1.2 The Proposer and Owner agree that, in determining the apparent Successful Proposal, the responsibility of the Proposers will be considered in awarding a Contract for this Project. In connection therewith, all Proposers are required to submit a set of additional completed attachments to the Statement of Proposer's Experience Form for the OWNER's consideration.

PART 2 – PROPOSER'S INFORMATION

2.1 Proposer's Information

In order to make a responsive Proposal, Proposer must answer all questions completely and all information must be clear, accurate and comprehensive. If necessary, questions may be answered on separate attached sheets. **The forms to complete this requirement are attached hereto as Attachment A.**

PART 3 – EXPERIENCE REQUIREMENTS

The Proposer must provide the following information with its Proposal:

3.1 In order to make a responsive Proposal, the Proposer must provide evidence of a minimum of 3 and no more than 10 successfully completed water or wastewater treatment plant installation projects of comparable size (minimum value of $5 million), complexity, and scope (at least two projects must be at operational wastewater treatment plants) within the United States successfully completed by the Proposer and/or Proposer's Subcontractor(s) within the past 10 years. This documentation shall be presented sufficiently and completely to demonstrate that water or wastewater treatment plant projects are a primary business focus and service provided by the Proposer, and / or Proposer's Subcontractor(s), and that such services have been successfully provided by the Proposer and/or Proposer's Subcontractor(s) for at least 10 continuous year(s). **The forms to complete this requirement are attached hereto as Attachment B.**

If the Proposer chooses to fulfill any of the specific experience requirements listed in this document with subcontracted resources, the Proposer must indicate so on Attachment B, to be submitted with its Proposal, in accordance with this RFP. Additionally, Attachments E and I must be submitted with its Proposal in accordance with paragraph 1.1, above, and in accordance with this RFP.

3.2 In order to make a responsive Proposal, the Proposer shall provide information on the experience of its proposed staff by completing Attachment C. The submitted Attachment C should include information and resumes for the proposed staff for the project. **The forms to**

complete this requirement are attached hereto as Attachment C.

3.3 **The same requirements shall apply to each Major Subcontractor proposed for this project. Major Subcontractors for this project include: Electrical Subcontractor and Instrumentation and Control Subcontractor.**

Should it be the intention of the Proposer to perform all or a portion of these services with its own forces, the Proposer shall provide previous project experience in the respective section demonstrating that the Proposer has previously successfully performed these services. Proposer must provide information on each major Subcontractor by completing Attachment D, located at the end of this Section. **The forms to complete this requirement are attached hereto as Attachment D.**

3.4 **The Owner seeks Contractors that can complete the Work within the Contract time given for completion. Anything that might negatively impact a Proposer's ability to timely complete the Work may result in the Proposer being determined to not be the most responsible Proposer.**

3.6 **A completed Attachment E (located at the end of this section) providing a list of equipment** that is available to the Contractor / Subcontractor(s) and **specifically intended to be used on the Work under this Contract,** and notification whether the equipment is owned or to be leased by the Contractor and/or Subcontractor(s).

3.7 **A completed Attachment F (located at the end of this section) providing a list of the available workforce** for the various disciplines and crafts required for the Work on this project including the number of work crews, and number of employees anticipated to be assigned to the project.

3.8 **A completed Attachment G (located at the end of this section) providing a list of all current projects**, including ***all City of Georgetown projects***. Include the following: a brief statement regarding the job type, the estimated project duration, project contact, and project description of all jobs that Proposer is currently committed to or are currently underway.

3.9 **A completed Attachment H (located at the end of this section) providing a list of all completed projects**, including ***all City of Georgetown projects***. Include the following: a brief statement regarding the job type, the estimated project duration, project contact, and project description of the jobs that Proposer has completed in the past Ten (10) years by calendar year or life of company if less than Ten (10) years.

3.10 **A completed Attachment I (located at the end of this section) Authentication of Proposal Submittal.** The Proposer must authenticate and acknowledge the preceding information by providing witness in the presence of a notary public duly licensed and authorized to act in that capacity under the laws and statutes of the State of Texas, on the form provided on the following page.

The forms to complete this requirement are attached hereto as Attachment A through I.

ATTACHMENT A

PROPOSER'S INFORMATION

(To be returned with the Proposal)

Proposer must answer all questions completely and all information must be clear, accurate and comprehensive. If necessary, questions may be answered on separate attached sheets.

A. Name of Proposer: _____

B. Proposer's Permanent Address: _____

C. Proposer's Phone No.: _____

D. Number of years in business under current company name: _____

(Note: A minimum of the (10) year's existence as a business is required under the current company name. Changes in company name during the experience period are acceptable if the continuity of the company structure can be demonstrated. Attach separate documentation, if applicable.)

If response is "YES" for questions E – I, attach brief description or explanation.

E. Has the Proposer ever defaulted on a contract?

YES (___) NO (___)

F. Are there currently any judgments, claims, or lawsuits pending against the Proposer?

YES (___) NO (___)

G. Does Proposer currently have any claims, judgments or lawsuits pending against any prior client?

YES (___) NO (___)

H. Is the Proposer or principals of Proposer now, or has the Proposer or principals of Proposer ever been, involved in any bankruptcy or reorganization proceedings?

YES (___) NO (___)

I. Has the Proposer ever had any claims, judgments, or lawsuits against the City or CDM Smith?

YES (___) NO (___)

ATTACHMENT B

STATEMENT OF EXPERIENCE

(To be returned with the Proposal)

Using the summary format included below, list and describe Proposer's construction experience for a minimum of 3 and no more than 10 successfully completed water or wastewater treatment plant installation projects of comparable size (minimum value of $5 million), complexity, and scope (at least two projects must be at operational wastewater treatment plants) within the past 10 years. Evidence of successful operational wastewater treatment plants must be provided for at least 2 projects. Part 3 of this section outlines the experience requirements which must be demonstrated with the 3 to 10 successfully completed sample projects. (Use additional sheets as deemed necessary or appropriate.)

Are any of the experience requirements outlined in Part 3 to be fulfilled by subcontracted resources? (circle one) YES / NO

NOTE: If yes, Attachment E (Statement of Experience for Proposer's Listed Subcontractors) and Attachment J (Authentication of Post-Proposal Submittal) as well as any other required Post-Proposal forms must be submitted as a Post-Proposal Submittal as outlined in Paragraph 1.2 of Section #00400.

Project No. 1 – Experience

Name of Project:_____Location: _____

Owner's Name and Address: _____

Owner's Contact Person (Print): _____Phone/Fax No.:_____/_____

Payment Bond (circle one) YES / NO

Performance Bond (circle one) YES / NO

Initial Contract Price: _____Final Contract Price: _____

Contract Start Date: _____(Date of Notice To Proceed)

Contract Time: _____( ) Calendar Days ( ) Working Days

Contract Substantial Completion Date: _____

Actual Substantial Completion Date: _____

If contract completion time extensions were added to the contract as a result of Proposer's responsibilities, provide a short explanation of each.

_____

_____

_____

Project Description and Statement of Relevance to this Contract:

_____

_____

_____

Project No. 2 - Experience

Name of Project: _____Location: _____

Owner's Name and Address: _____

Owner's Contact Person (Print): _____Phone/Fax No.:_____/_____

Payment Bond (circle one) YES / NO

Performance Bond (circle one) YES / NO

Initial Contract Price: _____Final Contract Price: _____

Contract Start Date: _____(Date of Notice To Proceed)

Contract Time: _____( ) Calendar Days ( ) Working Days

Contract Substantial Completion Date: _____

Actual Substantial Completion Date: _____

If contract completion time extensions were added to the contract as a result of Proposer's responsibilities, provide a short explanation of each.

_____

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_____

Project Description and Statement of Relevance to this Contract:

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_____

Project No. 3 - Experience

Name of Project: _____Location: _____

Owner's Name and Address: _____

Owner's Contact Person (Print): _____Phone/Fax No.:_____/_____

Payment Bond (circle one) YES / NO

Performance Bond (circle one) YES / NO

Initial Contract Price: _____Final Contract Price: _____

Contract Start Date: _____(Date of Notice To Proceed)

Contract Time: _____( ) Calendar Days ( ) Working Days

Contract Substantial Completion Date: _____

Actual Substantial Completion Date: _____

If contract completion time extensions were added to the contract as a result of Proposer's responsibilities, provide a short explanation of each.

_____

_____

_____

Project Description and Statement of Relevance to this Contract:

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_____

_____

Project No. 4 - Experience

Name of Project: _____Location: _____

Owner's Name and Address: _____

Owner's Contact Person (Print): _____Phone/Fax No.:_____/_____

Payment Bond (circle one) YES / NO

Performance Bond (circle one) YES / NO

Initial Contract Price: _____Final Contract Price: _____

Contract Start Date: _____(Date of Notice To Proceed)

Contract Time: _____( ) Calendar Days ( ) Working Days

Contract Substantial Completion Date: _____

Actual Substantial Completion Date: _____

If contract completion time extensions were added to the contract as a result of Proposer's responsibilities, provide a short explanation of each.

_____

_____

_____

Project Description and Statement of Relevance to this Contract:

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_____

Project No. 5 - Experience

Name of Project: _____Location: _____

Owner's Name and Address: _____

Owner's Contact Person (Print): _____Phone/Fax No.:_____/_____

Payment Bond (circle one) YES / NO

Performance Bond (circle one) YES / NO

Initial Contract Price: _____Final Contract Price: _____

Contract Start Date: _____(Date of Notice To Proceed)

Contract Time: _____( ) Calendar Days ( ) Working Days

Contract Substantial Completion Date: _____

Actual Substantial Completion Date: _____

If contract completion time extensions were added to the contract as a result of Proposer's responsibilities, provide a short explanation of each.

_____

_____

_____

Project Description and Statement of Relevance to this Contract:

_____

_____

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_____

ATTACHMENT C

STATEMENT OF EXPERIENCE FOR PROPOSER'S KEY PERSONNEL

(To be returned with the Proposal)

Proposer will provide an Organization Chart of all staff committed to delivering this project with a summary table for each individual that indicates: total years of experience, years of experience with the firm, years of experience in the current role, percent of time on the project site, and percent of time committed to the project. Proposer will also provide information on the team's bench strength in the event of loss of key personnel assigned to the project.

Attach resumes for the following personnel who will be assigned to this project. The resumes must demonstrate that these individuals have worked on at least three similar, successfully completed projects in the position indicated, or other supervisory capacity, as applicable, during the last 10 years. The key project personnel must be committed to this project for the duration of the project and cannot be removed from the project by the contractor except with the Owner's approval.

Principal:

Name: _____

Percent of Time Allocated to Project: _____

Percent of Time On-Site: _____

Project Manager:

Name: _____

Percent of Time Allocated to Project: _____

Percent of Time On-Site: _____

Superintendent:

Name: _____

Percent of Time Allocated to Project: _____

Percent of Time On-Site: _____

Quality Control Lead:

Name: _____

Percent of Time Allocated to Project: _____

Percent of Time On-Site: _____

Safety Officer:

Name: _____

Percent of Time Allocated to Project: _____

Percent of Time On-Site: _____

Insert Resumes (no more than 2 pages per person) & Experience

ATTACHMENT D

STATEMENT OF EXPERIENCE FOR PROPOSER'S MAJOR SUBCONTRACTORS

(To be returned with the Proposal)

Name of Proposer: _____

Proposer must supply the following project history information for each major Subcontractor included for the Work. Owner may reject any Subcontractor whose project history information OWNER deems insufficient for the task. Proposer must answer all questions completely and all information must be clear, accurate and comprehensive. If necessary, questions may be answered on separate attached sheets. Use multiple copies of Attachment D to ensure a submittal for every Major Subcontractor.

Major Subcontractor's type of work: _____

Name of Major Subcontractor: _____

Subcontractor's Permanent Address: _____

Subcontractor's Phone No.: _____

Number of years in business under current company name: _____

Project No. 1 - Major Subcontractor's Experience Information

Name of Project: _____ Location: _____

Owner's Name and Address: _____

Owner's Contact Person (Print): _____ Phone No.: _____

Project Description and Statement of Relevance to this Contract: _____

_____

_____

_____

_____

Subcontract Price: _____

Contract Start Date: _____ (Date of Notice To Proceed)

Contract Time: _____ ( ) Calendar Days ( ) Working Days

Contract Substantial Completion Date: _____

Actual Substantial Completion Date: _____

If contract completion time extensions were added to the contract as a result of subcontract responsibilities, provide a short explanation of each.

_____

_____

Project No. 2 - Major Subcontractor's Experience Information

Name of Project: _____ Location: _____

Owner's Name and Address: _____

Owner's Contact Person (Print): _____ Phone No.: _____

Project Description and Statement of Relevance to this Contract: _____

_____

_____

_____

_____

Subcontract Price: _____

Contract Start Date: _____ (Date of Notice To Proceed)

Contract Time: _____ ( ) Calendar Days ( ) Working Days

Contract Substantial Completion Date: _____

Actual Substantial Completion Date: _____

If contract completion time extensions were added to the contract as a result of subcontract responsibilities, provide a short explanation of each.

_____

_____

Project No. 3 - Major Subcontractor's Experience Information

Name of Project: _____ Location: _____

Owner's Name and Address: _____

Owner's Contact Person (Print): _____ Phone No.: _____

Project Description and Statement of Relevance to this Contract: _____

_____

_____

_____

_____

Subcontract Price: _____

Contract Start Date: _____ (Date of Notice To Proceed)

Contract Time: _____ ( ) Calendar Days ( ) Working Days

Contract Substantial Completion Date: _____

Actual Substantial Completion Date: _____

If contract completion time extensions were added to the contract as a result of subcontract responsibilities, provide a short explanation of each.

_____

_____

Project No. 4 - Major Subcontractor's Experience Information

Name of Project: _____ Location: _____

Owner's Name and Address: _____

Owner's Contact Person (Print): _____ Phone No.: _____

Project Description and Statement of Relevance to this Contract: _____

_____

_____

_____

_____

Subcontract Price: _____

Contract Start Date: _____ (Date of Notice To Proceed)

Contract Time: _____ ( ) Calendar Days ( ) Working Days

Contract Substantial Completion Date: _____

Actual Substantial Completion Date: _____

If contract completion time extensions were added to the contract as a result of subcontract responsibilities, provide a short explanation of each.

_____

_____

Project No. 5 - Major Subcontractor's Experience Information

Name of Project: _____ Location: _____

Owner's Name and Address: _____

Owner's Contact Person (Print): _____ Phone No.: _____

Project Description and Statement of Relevance to this Contract: _____

_____

_____

_____

_____

Subcontract Price: _____

Contract Start Date: _____(Date of Notice To Proceed)

Contract Time: _____( ) Calendar Days ( ) Working Days

Contract Substantial Completion Date: _____

Actual Substantial Completion Date: _____

If contract completion time extensions were added to the contract as a result of subcontract responsibilities, provide a short explanation of each.

_____

_____

ATTACHMENT E

AVAILABLE EQUIPMENT LIST

(To be returned with the Proposal)

Provide a list of equipment that is available to the Contractor / Subcontractor(s) and specifically intended to be used on the Work under this Contract, and notification whether the equipment is owned or to be leased by the Contractor and/or Subcontractor(s).

EQUIPMENT	**OWNED OR LEASED**	**COMMITTED TO ANOTHER PROJECT?** (Yes / No)	**AVAILABLE / RELEASE DATE**

ATTACHMENT F

AVAILABLE WORKFORCE

(To be returned with the Proposal)

Provide a list of the available workforce for the various disciplines and crafts required for the Work on this project including the number of work crews, and number and worker classification for each equipment operator, mechanic, and laborer for that portion of the Work that Proposer will actually perform.

Number of Anticipated Work Crews: _____

DISCIPLINE OR CRAFT	**NO. OF EMPLOYEES**	**COMMITTED TO ANOTHER PROJECT?** (Yes / No)	**AVAILABLE /RELEASE DATE**
Professional (specify)			
Superintendent			
Technical (specify)			
Skilled Workers (specify)			
Semiskilled Workers (specify)			
Equipment Operators (list)			
Other			
Other			
Other			

Use additional pages, as necessary.

ATTACHMENT G

CURRENT PROJECT LISTING (INCLUDING ALL CITY OF GEORGETOWN PROJECTS)

(To be returned with the Proposal)

Provide a list of **all current projects**, including ***all City of Georgetown projects***. Include the following: a brief statement regarding the job type, the estimated project duration, project contact, and project description of all jobs that Proposer is currently committed to or are currently underway.

Name of Project: _____ Location: _____

Type of Job: _____ City of Georgetown Job? (circle one) Yes / No

Project Start Date: _____ Estimated Completion Date: _____

Project Contact: _____

Brief Description: _____

_____

_____

Name of Project: _____ Location: _____

Type of Job: _____ City of Georgetown Job? (circle one) Yes / No

Project Start Date: _____ Estimated Completion Date: _____

Project Contact: _____

Brief Description: _____

_____

_____

Name of Project: _____ Location: _____

Type of Job: _____ City of Georgetown Job? (circle one) Yes / No

Project Start Date: _____ Estimated Completion Date: _____

Project Contact: _____

Brief Description: _____

_____

_____

Use additional pages, as necessary.

ATTACHMENT H

PROJECT HISTORY LISTING (INCLUDING ALL CITY OF GEORGETOWN PROJECTS)

(To be returned with the Proposal)

Provide a list of **all completed projects**, including ***all Public projects***. Include the following: a brief statement regarding the job type, the estimated project duration, project contact, and project description of the jobs that Proposer has completed in the past ten (10) years by calendar year or life of company if less than ten (10) years.

Calendar Year of _____

Name of Project: _____ Location: _____

Type of Job: _____ City of Georgetown Job? (circle one) Yes / No

Project Duration: _____ Project Contact: _____

Brief Description: _____

_____

_____

Name of Project: _____ Location: _____

Type of Job: _____ City of Georgetown Job? (circle one) Yes / No

Project Duration: _____ Project Contact: _____

Brief Description: _____

_____

_____

Name of Project: _____ Location: _____

Type of Job: _____ City of Georgetown Job? (circle one) Yes / No

Project Duration: _____ Project Contact: _____

Brief Description: _____

_____

_____

Use additional pages as necessary to achieve a representative listing covering 10 years.

ATTACHMENT I

AUTHENTICATION OF PROPOSAL SUBMITTAL

(To be returned with the Proposal)

The Proposer must authenticate and acknowledge the preceding information by providing witness in the presence of a notary public duly licensed and authorized to act in that capacity under the laws and statutes of the State of Texas, on the form provided on the following page.

NOTARIZE ONLY THE LAST PAGE OF THIS FORM

Signed By: _____ Typed Name: _____

Typed Title: _____

Limited Partnership Acknowledgement

State of Texas

County of _____

Before me _____(insert Notary's name), a Notary Public, on this day personally appeared _____(insert name of person signing on behalf of general partner of limited partnership), _____, title of officer or manager and_____, name of corporation or LLC); the General Partner of _____(insert name of limited partnership), known to me personally or on the basis of legally sufficient identification to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that he or she executed the same for the purposes and consideration therein expressed.

[Seal] Given under my hand and seal of office this ___day of _____, A.D., 20_____.

_____

Notary Public, State of Texas

Signed By: _____ Typed Name: _____

Typed Title:_____

Corporation or Limited Liability Company Acknowledgement

State of Texas

County of _____

Before me _____(insert Notary's name), a Notary Public, on this day personally appeared _____(insert name of person signing on behalf of corporation or LLC) as _____, (title of officer or manager and name of corporation or LLC); known to me personally or on the basis of legally sufficient identification to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that he or she executed the same for the purposes and consideration therein expressed.

[Seal] Given under my hand and seal of office this ___day of _____, A.D., 20_____.

_____
Notary Public, State of Texas

Signed By: _____ Typed Name: _____

Typed Title:_____

This page intentionally left blank.

EXHIBIT 00410 – PROPOSAL BOND

PROPOSER/BIDDER (Name and Address):

SURETY (Name and Address of Principal Place of Business):

OWNER (Name and Address):
City of Georgetown
808 Martin Luther King, Jr. St.
Georgetown, Williamson County, Texas 78626

4

RFP NO.: 202407
RFP DUE DATE: 2 pm CT. January 16, 2024
PROJECT: Dove Springs WWTP Rehabilitation
PROJECT NO.: PRJ000261

BOND
BOND NUMBER:
DATE (Not later than Proposal due date):
PENAL SUM:_____$_____
(Words) (Figures)

IN WITNESS WHEREOF, Surety and Proposer, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

PROPOSER	SURETY
_____(Seal)	_____(Seal)
Proposer's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature and Title	Signature and Title (Attach Power of Attorney)
Attest: _____	Attest: _____
Signature and Title	Signature and Title

Note: (1) Above addresses are to be used for giving required notice.
(2) Any singular reference to Proposer, Surety, OWNER or other party shall be considered plural where applicable.

1. Proposer and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to pay to OWNER upon default of Proposer the penal sum set forth on the face of this Bond.

2. Default of Proposer shall occur upon the failure of Proposer to deliver within the time required by the Proposal Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Proposal Documents and any Performance and Payment Bonds required by the Proposal Documents.

3. This obligation shall be null and void if:
   3.1 OWNER accepts Proposer's Proposal and Proposer delivers within the time required by the Proposal Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Proposal Documents and any Performance and Payment Bonds required by the Proposal Documents, or
   3.2 All Proposals are rejected by OWNER, or
   3.3 OWNER fails to issue a Notice of Award to Proposer within the time specified in the Proposal Documents (or any extension thereof agreed to in writing by Proposer and, if applicable, consented to by Surety when required by paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default by Proposer and within 30 calendar days after receipt by Proposer and Surety of written notice of default from OWNER, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of and any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by OWNER and Proposer, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 90 days from Proposal due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in paragraph 4 above is received by Proposer and Surety and in no case later than one year after Proposal due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Proposer and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power or Attorney evidencing the authority of the officer, agent or representative who executed this Bond on behalf of Surety to execute, seal and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Proposal" as used herein includes a Bid, offer, or proposal as applicable.

SECTION 00500
STANDARD FORM OF AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT

THIS AGREEMENT is by and between the City of Georgetown, Texas, a home-rule city and municipal corporation with principal offices located at 808 Martin Luther King, Jr. St., Georgetown, Williamson County, Texas 78626 (hereinafter called Owner) and _____ (hereinafter called Contractor).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

Construction of the Dove Springs Wastewater Treatment Plant Rehabilitation.

ARTICLE 2 – THE PROJECT

2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

A. The project consists of furnishing, installing and providing all labor and materials required for the rehabilitation improvements to the 2.5 million gallons per day Dove Springs WWTP as more fully described in the Drawings and Summary of Work contained in Technical Specification CIP 3.

ARTICLE 3 – ENGINEER

3.01 The Project has been designed by: CDM Smith (Engineer), which is to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Dates for Milestones, Substantial Completion and Final Payment*

A. The Work will be substantially completed as defined below:

1. Temporary Package Plant Substantial Completion: Within 365 days after the date when the Contract Times commence to run as provided in Paragraph 2.03 of the General Conditions.

2. Balance of Plant Substantial Completion: Within 640 days after the date when the Contract Times commence to run as provided in Paragraph 2.03 of the General Conditions.
3. Completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions within 700 days after the date when the Contract Times commence to run.

4.03 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner $1,500.00 for each calendar day that expires after the time specified Paragraph 4.02.A above
for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner $1,000.00 for each calendar day that expires after the time specified in Paragraph 4.02 above for completion and readiness for final payment until the Work is completed and ready for final payment.

4.04 Contractor shall commence performance of the Work on the date when the Contract Times commence to run.

ARTICLE 5 – CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to Paragraphs 5.01.A below:

A. For all Work, at the prices stated in Contractor's Proposal, attached hereto as an Exhibit and shown below:

$_____

(FIGURES)

_____

_____

(WRITTEN)

5.02 Owner agrees to pay Contractor from available funds for satisfactory performance of this Agreement in accordance with Contract Documents, and Owner agrees to make payment on account thereof as provided in the Contract Documents. Lack of funds shall render this Agreement null and void to the extent funds are not available.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 Submittal and Processing of Payments

B. Contractor shall submit Applications for Payment in accordance with Article 14 of the General

Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the **15th day** of each month during performance of the Work as provided in Paragraph 6.02.A.1 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the General Conditions.

   a. **95** percent of Work completed (with the balance being retainage). If the Work has been 50 percent completed, as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and

   b. **95** percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions and less 200 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

C. Partial payments will be made for materials and equipment stored on Site but not installed, in accordance with Article 14 of the General Conditions. The amount paid for stored materials shall be for amount actually paid by Contractor and include any discounts received for early payment. Payment for materials and equipment not incorporated in the Work shall be subject to the retainage described in Paragraph 6.02.1.b above. In order to receive approval for partial payment of any materials and equipment stored on Site, the Contractor must submit copies of the original invoice with the Application for Payment for all materials and equipment, in order to be approved for payment.

D. Payment for Insurance and Bonds

1. Contractor's Insurance and Bonds shall include costs for insurance plus Performance and Payment Bonds.
2. Payment for Insurance and Bonds will be made on the first approved monthly pay request with suitable evidence of the cost thereof. The amount should agree with the suitable evidence provided.

3. The amount of the Insurance and Bonds shall not exceed 2.5 percent of the total contract amount. The amount of the Insurance, Bonds, and Mobilization/Demobilization shall not exceed 5 percent of the total contract amount.

E. Payment for Mobilization and Demobilization

1. Mobilization and Demobilization includes costs of personnel, equipment and supplies, construction offices and the utility costs associated therewith, etc.

2. Payments for Mobilization and Demobilization will be made as follows based upon the "adjusted contract amount" for construction items. The "adjusted contract amount" is defined as the total contract amount less the amount for Insurance and Bonds (Paragraph 6.02.D.3 above) and less the amount for Mobilization and Demobilization.

3. When 1 percent of the adjusted contract amount for construction items is earned, 25 percent of the mobilization and demobilization amount will be paid.

4. When 10 percent of the adjusted contract amount for construction items is earned, 50 percent of the mobilization and demobilization amount will be paid.

5. When 25 percent of the adjusted contract amount for construction items is earned, 75 percent of the mobilization and demobilization amount will be paid.

6. Upon Final Completion of all Work items, payment for the remainder of the mobilization and demobilization amount will be made.

7. The amount for Insurance, Bonds, and Mobilization/Demobilization shall not exceed 5 percent of the total contract amount.

6.03 *Final Payment*

A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07.

ARTICLE 7 – INTEREST

7.01 All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest as provided in Tex. Gov. Code Chapter 2251.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

8.01 In order to induce Owner to enter into this Agreement, Contractor makes the following representations:

A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Proposal Documents.

B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions

at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities), if any, that have been identified in Paragraph 4.02 of the General Conditions as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in the Supplementary Conditions as provided in Paragraph 4.06 of the General Conditions.

E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) Contractor's safety precautions and programs.

F. Based on the information and observations referred to in Paragraph 8.01.E above, Contractor does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

A. The Contract Documents consist of the following:

1. This Agreement (pages 1 to 9, inclusive).
2. Performance bond (page 1 of 1, inclusive).
3. Payment bond (page 1 of 1, inclusive).
4. Proposal bond (pages 1 to 2, inclusive).
5. Certificate of Insurance
6. Form 1295
7. General Conditions (pages 1 to 48, inclusive).
8. Supplementary Conditions (pages 1 to 13, inclusive).
9. Specifications as listed in the table of contents of the Project Manual.

10. Drawings consisting of 129 sheets with each sheet bearing the following general title: Dove Springs WWTP Rehabilitation.

11. Addenda.

12. Exhibits to this Agreement (enumerated as follows):

    a. Contractor's Proposal (pages _____ to _____, inclusive).

    b. Documentation submitted by Contractor prior to Notice of Award (pages _____ to _____, inclusive).

13. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:

    a. Notice to Proceed (pages 1 to 2, inclusive).

    b. Work Change Directives.

    c. Change Orders.

    d. Written Amendments.

B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 9.

D. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the General Conditions.

E. To the extent of any direct conflict or inconsistency between any of the Contract Documents, the Contractor shall immediately seek clarification from the Engineer and notify the Owner that clarification has been requested. The Engineer shall clarify such discrepancy, within a reasonable time under the circumstances.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 *Assignment of Contract*

A. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns*

A. Owner and Contractor each binds itself, its partners, successors, assigns, and legal representatives

to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the proposal process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the proposal process or the execution of the Contract to the detriment of Owner, (b) to establish Proposal or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Offerors, with or without the knowledge of Owner, a purpose of which is to establish Proposal prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the proposal process or affect the execution of the Contract.

B. **Contractor Certification Regarding Boycotting Israel.** Pursuant to Chapter 2271, Texas Government Code, Contractor certifies that it (1) is a sole proprietorship or company with fewer than ten (10) employees; **or** (2) does not currently boycott Israel and will not boycott Israel during the term of this Agreement.

C. **Contractor Certification Regarding Business with Certain Countries and Organizations.** Pursuant to Subchapter F, Chapter 2252, Texas Government Code, Contractor certifies it (1) is a "Company," as that term is defined in Texas Government Code Section 806.001; and (2) is not engaged in business with Iran, Sudan, a foreign terrorist organization, or any company that is identified on a list prepared and maintained under Texas Government Code Section 806.051, 807.051, or 2252.153.

D. **Contractor Certification Regarding Boycotting Energy Companies.** Pursuant to Chapter 2274, Texas Government Code, Contractor certifies that either (1) is a sole proprietorship or company with fewer than ten (10) employees; **or** (2) Firm does not currently boycott energy companies and will not boycott energy companies during the Term of this Agreement.

E. **Contractor Certification Regarding Boycotting Firearm and Ammunition Industries.** Pursuant to Chapter 2274, Texas Government Code, Contractor certifies that either (1) Contractor is a sole proprietorship or company with fewer than ten (10) employees; **or** (2) Firm does not currently boycott firearm and ammunition industries and will not boycott firearm and ammunition industries during the term of this Agreement.

10.06 *Waiver of Breach*

A. Waiver of any breach of this Agreement shall not constitute waiver of any subsequent breach.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement. Counterparts have been delivered to Owner and Contractor. All portions of the Contract Documents have been signed or have been identified by Owner and Contractor or on their behalf.

This Agreement will be effective on _____ (which is the Effective Date of the Agreement).

OWNER:	CONTRACTOR
City of Georgetown	
By:	By:
Title: Josh Schroeder, Mayor	Title:
Attest:	
Title: City Secretary	
Address for giving notices:	Address for giving notices:
510 W. 9th Street	
Georgetown, TX 78626	

APPROVED AS TO FORM:

_____

City Attorney

This page intentionally left blank.

Notice of Award

Date: _____

Project: Dove Springs WWTP Rehabilitation

Owner: City of Georgetown	Owner's Contract No.: 24-0043-CIP
Project Nos.: PRJ000261	Engineer's Project No.: 264953
Proposer:	
Proposer's Address:	

You are notified that your Proposal dated_____for the above Contract has been considered. You are the Successful Proposer and are awarded a Contract for Dove Springs WWTP Rehabilitation.

The project consists of furnishing, installing and providing all labor and materials required for construction of rehabilitation improvements to the 2.5 million gallon per day Dove Springs Wastewater Treatment Plant, as more fully described in the Drawings and the summary of work contained in Section CIP3.

The Contract Price of your Contract is _____ Dollars ($_____)

(3) copies of the proposed Contract Documents (except Drawings) accompanied the Notice of Impending Award.

Sets of the Drawings will be delivered separately or otherwise made available to you immediately.

You must comply with the following conditions precedent within 15 days of the date you receive this Notice of Award, if you have not already.

1. Deliver to the Owner 3 fully executed counterparts of the Contract Documents.
2. Deliver with the executed Contract Documents the Contract security [Bonds] as specified in the Instructions to Bidders (Article 20), General Conditions (Paragraph 5.01), and Supplementary Conditions (Paragraph SC-5.01).

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Proposal security forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Contract Documents.

City of Georgetown
Owner

By:_____
Authorized Signature

CIP Manager
Title

Copy to Engineer

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Notice to Proceed

Date: _____

Project: Dove Springs WWTP Rehabilitation

Owner: City of Georgetown	Owner's Contract No.: 24-0043-CIP
Project Nos.: PRJ000261	Engineer's Project No.: 264953
Contractor:	
Contractor's Address:	

You are notified that the Contract Times under the above Contract will commence to run on _____. On or before that date, you are to start performing your obligations under the Contract Documents. In accordance with Article 4 of the Agreement, the Work will be substantially completed 730 calendar days from Notice to Proceed; and, the Work will be completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions 820 calendar days from Notice to Proceed.

Before you may start any Work at the Site, Paragraph 2.01.B of the General Conditions provides that you and Owner must each deliver to the other (with copies to Engineer and other identified additional insureds and loss payees) certificates of insurance which each is required to purchase and maintain in accordance with the Contract Documents.

Also, before you may start any Work at the Site, you must:

1. Submit and receive approval on the construction sequence and schedule of values.
2. Hold the pre-construction meeting.

City of Georgetown
Owner

Given By:

_____
Authorized Signature

CIP Manager
Title

_____
Date

Copy to Engineer

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SECTION 00610

TEXAS STATUTORY PERFORMANCE BOND

Bond No.:

KNOW ALL MEN BY THESE PRESENTS:

THAT, _____(hereinafter called the Principal, and _____, a corporation organized and existing under the laws of the State of Texas, licensed to do business in the State of Texas and admitted to write bonds, as surety, (hereinafter called the Surety), are held and firmly bound unto the City of Georgetown, Texas (hereinafter called the Obligee), in the amount of _____Dollars ($_____.____) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain contract with the Obligee, dated the _____day of _____, 20___ for Dove Springs WWTP Rehabilitation which contract is hereinafter referred to as the "Contract."

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform the work required by the Contract and shall, in all respects, duly and faithfully observe and perform all and singular the covenants, conditions and agreements in and by said Contract, agreed and covenanted by the Principal to be observed and performed, including but not limited to, the repair of any and all defects in said work occasioned by and resulting from defects in materials furnished by or workmanship of, the Principal in performing the work covered by said Contract and occurring within a period of twelve (12) months from the date of Final Completion and all other covenants and conditions, according to the true intent and meaning of said Contract and the Plans and Specifications hereto annexed, then this obligation shall be void; otherwise to remain in full force and effect;

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253 of the Texas Government Code and all liabilities on this bond shall be determined in accordance with the provision, conditions and limitations of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____day of _____, 20___.

_____	_____
Principal	Surety
_____	_____
Printed Name	Printed Name
By: _____	By: _____
Title: _____	Title: _____
Address: _____	Address: _____
_____	_____

Resident Agent of Surety:

_____
Signature

_____
Printed Name

_____	_____
Street Address	Email
_____	_____
City, State & Zip Code	Telephone Number

SECTION 00620

TEXAS STATUTORY PAYMENT BOND

Bond No.:

KNOW ALL MEN BY THESE PRESENTS:

THAT, _____(hereinafter called the Principal), as principal, and _____, a corporation organized and existing under the laws of the State of Texas, licensed to do business in the State of Texas and admitted to write bonds, as surety, (hereinafter called the Surety), are held and firmly bound unto the City of Georgetown, Texas (hereinafter called the Obligee), in the amount of _____ Dollars ($_____.00) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain contract with the Obligee, dated the _____ day of _____ , 20___ for Dove Springs WWTP Rehabilitation which contract is hereinafter referred to as the "Contract."

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall pay all claimants supplying labor and material to him or a subcontractor in the prosecution of the work provided for in said Contract, then, this obligation shall be null and void; otherwise to remain in full force and effect;

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253 of the Texas Government Code and all liabilities on this bond shall be determined in accordance with the provision, conditions and limitations of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20___.

_____	_____
Principal	Surety
_____	_____
Printed Name	Printed Name
By: _____	By: _____
Title: _____	Title: _____
Address: _____	Address: _____
_____	_____

Resident Agent of Surety:

_____
Signature

_____
Printed Name

_____	_____
Street Address	Email
_____	_____
City, State & Zip Code	Telephone Number

SECTION 00650
Certificate of Insurance

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SECTION 00680
Form 1295

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SECTION 00700 – GENERAL CONDITIONS

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the Controlling Law.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By

ACEC
American Council of Engineering Companies

National Society of Professional Engineers
Professional Engineers in Private Practice

ASCE American Society of Civil Engineers

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
a practice division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

_____

AMERICAN COUNCIL OF ENGINEERING COMPANIES

_____

AMERICAN SOCIETY OF CIVIL ENGINEERS

This document has been approved and endorsed by

The Associated General Contractors of America

Knowledge for Creating and Sustaining the Built Environment

Construction Specifications Institute

National Society of Professional Engineers
1420 King Street, Alexandria, VA 22314

American Council of Engineering Companies
1015 15th Street, N.W., Washington, DC 20005

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor Nos. C-520 or C-525 (2002 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the EJCDC Construction Documents, General and Instructions (No. C-001) (2002 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. C-800) (2002 Edition).

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Proposal Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*--Written or graphic instruments issued prior to the opening of Proposals which clarify, correct, or change the Proposal Requirements or the proposed Contract Documents. In case of inconsistency between the Contract Documents and any Addenda, the Addenda supersede other Contract Documents.

2. *Agreement*--The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*--The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Proposal*--The offer or proposal of an Offeror submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Offeror*--The individual or entity who submits a Proposal directly to Owner.

7. *Proposal Documents*--The Proposal Requirements and the proposed Contract Documents (including all Addenda).

8. *Proposal Requirements*--The Advertisement or Request for Proposal, Instructions to Offerors, security of acceptable form, if any, and the Proposal Form with any supplements.

9. *Change Order*--A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement. Extra Work will not be considered for a Change Order or for an adjustment in the Contract Price or the Contract Times unless the document is executed by both Owner and Contractor. Furthermore, the parties agree that under no circumstances will an act or failure to act on the part of the Owner or the Engineer constitute a waiver of the written Change Order requirement for extra work. A written Change Order is a strict condition precedent for payment of extra work.

10. *Claim*--A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*--The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral including, without limitation, all prior iterations of these General Conditions, the Supplementary Conditions, or any other document not specifically listed in the Agreement.

12. *Contract Documents*-- The Contract Documents consist of the Agreement between Owner and Contractor, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Work Change Directive or (4) a Field Order. Unless specifically enumerated in the Agreement, the Contract Documents do not include other documents such as proposal requirements (advertisement or Request for Proposal, Instructions to Proposers, sample forms, the Contractor's Proposal, portions of Addenda relating to proposal requirements), Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions.

13. *Contract Price*--The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*--The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any, (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*--The individual or entity with whom Owner has entered into the Agreement. For purposes of giving or receiving notice, directives, change orders, or any other information from the Engineer or Owner to the Contractor, the Contractor shall designate one person as Project Manager to receive such notice, directives, change orders, or other information. If the person so identified by the Contractor is not present on the job site during normal working hours for any consecutive 48-hour period, the Contractor shall in writing addressed to the Engineer and Owner identify the individual who is acting as Project Manager.

16. *Cost of the Work*--See Paragraph 11.01.A for definition.

17. *Drawings*--That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*--The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver. However, Contractor has no rights or remedies arising from execution of the Agreement prior to receiving a Notice to Proceed from Owner or Engineer.

19. *Engineer*--The individual or entity named as such in the Agreement. The Engineer shall identify a specific individual to serve as liaison between the Owner and Contractor and between Engineer and Contractor. The Engineer will notify the Owner and Contractor of the name of an acting replacement as Engineer representative whenever the person so designated is not available. Whenever the Contractor or Owner requires information, direction, or assistance, the Contractor or Owner shall notify the individual designated by the Engineer.

20. *Field Order*--A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times. The Engineer will promptly obtain the signature of the Contractor on all Field Orders. This signature confirms that the Contractor is not entitled to any change in the Contract Price or the Contract Times. The Engineer will endeavor to obtain the signature of the Contractor on all Field Orders on a weekly basis.

21. *General Requirements*--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

22. *Hazardous Environmental Condition*--The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

23. *Hazardous Waste*--The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*--Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens*--Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*--The written notice by Owner to the Successful Offeror stating that upon timely compliance by the Successful Offeror with the conditions precedent listed therein, Owner, if the Owner decides to proceed with the Work, will sign and deliver the Agreement, to the apparent successful Offeror. However, the Notice of Award shall not be construed as an agreement, meeting of the minds, contract, or any other legal obligation between Owner and Contractor. Until Contractor receives a Notice to Proceed from the Owner, the Contractor has no remedy against the Owner.

28. *Notice to Proceed*--A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

29. *Owner*--The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed. As a general matter, the Contractor should utilize the Engineer's designated representative as the liaison between the Contractor and the Owner. However, in an exceptional circumstance, the Contractor can notify Owner's designated representative.

30. *PCBs*--Polychlorinated biphenyls.

31. *Petroleum*--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*--A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

33. *Project*--The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*--The bound documentary information prepared for proposing and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*--Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Related Entity* -- An officer, director, partner, employee, agent, consultant, or subcontractor.

37. *Resident Project Representative*--The authorized representative of Engineer who may be assigned to the Site or any part thereof.

38. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

39. *Schedule of Submittals*--A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

40. *Schedule of Values*--A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

41. *Shop Drawings*--All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

42. *Site*--Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

43. *Specifications*--That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

44. *Subcontractor*--An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

45. *Substantial Completion*--The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Owner, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

46. *Successful Offeror*--The Offeror submitting a responsive Proposal to whom Owner makes an award.

47. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.

48. *Supplier*--A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.

49. *Underground Facilities*--All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

50. *Unit Price Work*--Work to be paid for on the basis of unit prices.

51. *Work*--The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

52. *Work Change Directive*--A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or

revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The following words or terms are not defined but, when used in the Proposal Requirements or Contract Documents, have the following meaning.

B. *Intent of Certain Terms or Adjectives*

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered", "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day*

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents, or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents, or

c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 - PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor shall each deliver to Owner, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which Owner or any additional insured may reasonably request) which Contractor is required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to four (4) printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

A. TIME IS OF THE ESSENCE OF THIS CONTRACT. This is a Calendar Day Contract. The Contract Times will commence to run on the day indicated in the Notice to Proceed. The Owner will provide a Notice to Proceed at a reasonable time after the effective date of the Agreement. In no event will the Owner have any obligations or duties to the Contractor under the Agreement until the Notice to Proceed is given to the Contractor.

2.04 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run as set forth in the Notice to Proceed. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Owner and Engineer for timely review**:**

1. a preliminary Progress Schedule; indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious, economical, and practicable execution of the Work. The Contractor shall perform all Work in accordance with the most recent Progress Schedule submitted to the Owner and Engineer. Nothing contained herein will impose on Owner or Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

a. The Progress Schedule shall be in a detailed precedence-style critical path method ("CPM") or primavera-type format satisfactory to the Owner. The Progress Schedule shall also (i) provide a graphic representation of all activities and events that will occur during performance of the Work; (ii) identify each phase of construction and occupancy; and (iii) set forth dates that are critical in ensuring the timely and orderly completion of the Work in accordance with the requirements of the Contract Documents (hereinafter referred to as "Milestone Dates"). Upon review and acceptance by the Owner of the Milestone Dates, the Progress Schedule shall be deemed part of the Contract Documents. If not accepted, the Progress Schedule shall be promptly revised by Contractor in accordance with the recommendations of the Owner and resubmitted for acceptance. The Contractor shall monitor the progress of the Work for conformance with the requirements of the Progress Schedule and shall promptly advise the Owner of any delays or potential delays. The accepted Progress Schedule shall be updated to reflect the actual conditions as set forth in Paragraph 2.6.1 or if requested by either the Owner or the Engineer.

b. The parties acknowledge and agree that notwithstanding any theoretical delays or theoretical extensions of time for completion as may be shown on the Progress Schedule, the Interim Completion Dates, Milestone Dates, and the Scheduled Completion Date shall be governed by the Contract and shall be extended only in accordance with the procedures set forth in the Contract Documents.

c. In the event that the Owner or Engineer determines that the Work has not progressed or reached the level of completion required by the Contract Documents, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, without limitation, (i) working additional shifts or overtime, (ii) supplying additional manpower, equipment, and facilities, and (iii) other similar measures. Contractor agrees to take such corrective measures to expedite the progress of construction until the progress of the Work complies with the state of completion required by the Contract Documents.

d. In the event Owner or Engineer determines that Contractor is not timely performing any of its Work or that Contractor is not keeping up with the Progress Schedule, Owner may, in addition to Owner's rights stated herein, request Contractor to prepare a Recovery Schedule. In such event, Contractor will prepare a Recovery Schedule in such form and in such detail as Owner may request. Contractor further agrees that it will work as necessary to meet the requirements of the Recovery Schedule and bring its Work into compliance with the current Progress Schedule (all without any additional cost to Owner). No approval by Owner or Engineer of Contractor's Recovery Schedule pursuant to this Paragraph shall constitute a waiver by Owner of any damages or losses which Owner may suffer as a result of Contractor's failure to meet the Scheduled Completion Date.

2. Contractor's Schedule of Submittals will be acceptable to Owner and Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Owner and Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

4. If required by Owner, Contractor shall also prepare and furnish project cash flow projections, manning charts for all key trades, and schedules for the purchase and delivery of all equipment and materials, together with the periodic updating thereof.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

D. In the event of inconsistencies within or between the parts of the Contract Documents, or between the Contract Documents and applicable standards, codes, or ordinances, the Contractor shall (i) provide the better quality or greater quantity of Work or (ii) comply with the more stringent requirement; either or both in accordance with the Engineer's interpretation.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Proposals (or on the Effective Date of the Agreement if there were no Proposals), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, or Engineer, or any of, their Related Entities, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies

1. *Contractor's Review of Contract Documents Before Starting Work*: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Owner and Engineer any conflict, error, ambiguity, or discrepancy which Contractor may discover in the Contract Documents, or any condition at the site affecting the Work, and shall obtain a written interpretation or

clarification from Owner and Engineer before proceeding with any Work affected thereby. The Contractor shall be liable to the Owner for failure to report any conflict, error, ambiguity or discrepancy in the Contract Documents which the Contractor knew or reasonably should have known.

2. *Contractor's Review of Contract Documents During Performance of Work*: If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall promptly report it to Owner and Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor knew or reasonably should have known thereof.

4. The terms "knowledge," "recognize," and "discover," their respective derivatives, and similar terms in the Contract Documents, as used in reference to the Contractor, shall be interpreted to mean that which the Contractor knows (or should know), recognizes (or should recognize), and discovers (or should discover) in exercising the care, skill, and diligence required by the Contract Documents. Analogously, the expression "reasonably inferable" and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a contractor familiar with the Project and exercising the care, skill, and diligence required of the Contractor by the Contract Documents.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work can only be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample; (Subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

Any variations and deviations in the Work arising from any of the methods set forth in Paragraph 3.04.B will not authorize any Amendments to the Contract Price or Contract Times. The sole method to amend the Contract Price or Contract Times is pursuant to Paragraph 3.04.A.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier or other individual or entity performing or furnishing all of the Work under a direct or indirect contract with Contractor, shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or Engineer's consultants, including electronic media editions; or

2. reuse any of such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaption by Engineer.

B. The prohibition of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

A. Copies of data furnished by Owner or Engineer to Contractor or Contractor to Owner or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the

receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. The Contractor hereby covenants that it has examined the site of the proposed Work and is familiar with all of the conditions surrounding construction of the Project, having conducted all inquiries, tests and investigations for the Work.

1. The Contractor acknowledges that he has satisfied himself as to the nature and location of the Work; the general and local conditions, particularly those bearing upon availability of transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, river/stream stages, or similar physical conditions at the site; the conformation and conditions of the ground; the character of equipment and facilities needed preliminary to and during the prosecution of the Work and all other matters which can in any way affect the work or the cost

thereof under this Contract.

2. The Contractor further acknowledges that he has satisfied himself as to the character, quality, and quantity of surface and subsurface materials to be encountered from inspecting the Site and from evaluating information derived from exploratory work, if any, that has been presented in any geotechnical report, as well as from information presented in the Supplementary Conditions. Any failure by the Contractor to acquaint himself with all the available information will not relieve him from responsibility for properly estimating the difficulty or cost of successfully performing the Work. Neither the Owner nor the Engineer assume responsibility for any conclusion or interpretation made by the Contractor on the basis of the information made available by the Owner or the Engineer. All risks of differing site conditions shall be borne solely by the Contractor.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all such information and data,

b. locating all Underground Facilities shown or indicated in the Contract Documents and notifying Texas One Call Service,

c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction, and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

3. Notwithstanding any other provision to the contrary, the Contractor shall be solely responsible for the location and protection of any and all public lines and utility customer service lines in the Work area. For the purposes of this section, "public lines" means the utility distribution and supply system within public rights-of-way or easements, and "utility customer service lines" (service) means any utility line connecting a utility customer to the utility distribution system. Generally, existing service connections within right-of-way or easements are not shown on the Drawings. The Contractor shall notify the Owner and “Texas One Call Service” and exercise due care to locate and to mark, uncover or otherwise protect all such lines in the construction zone and any of the Contractor’s work or storage areas. The Contractor’s obligation hereunder shall be primary and non-delegable. **The Contractor shall indemnify or reimburse such expenses or costs (including fines that may be levied against the Owner) that may result from unauthorized or accidental damage to all public lines and utility customer service lines in the Work area.** The Owner reserves the right to repair such damage the Contractor may cause, at the Contractor’s expense.

B. *Not Shown or Indicated*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, within 24 hours after the Contractor discovers and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

C. The Contractor shall take reasonable precaution to avoid disturbing primitive records and antiquities of archaeological, paleontological or historical significance. No objects of this nature shall be disturbed without written permission of the Owner and the Texas Department of Antiquities Protection. When such objects are uncovered unexpectedly, the Contractor shall stop all Work in close proximity and notify Owner's Representative and the Texas Department of Antiquities Protection of their presence and shall not disturb them until written permission and permit to do so is granted. All primitive rights and antiquities uncovered on the Owner’s property shall remain property of the State of Texas, the Texas Department of Antiquities Protection conforming to the Texas Natural Resources Code. If it is determined by the Owner, in consultation with the Texas Department of Antiquities Protection, that exploration or excavation of primitive records or antiquities on Project site is necessary to avoid loss, the Contractor shall cooperate in salvage work attendant to preservation. If the Work stoppage or salvage work causes an increase in the Contractor’s cost of, or time required for, performance of the Work, the Contract Amount and/or Contract Time may be equitably adjusted.

4.05 *Reference Points*

A. Engineer shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by a Registered Professional Land Surveyor at Contractor's expense.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* Reference is made to the Supplementary Conditions for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the Engineer in the preparation of the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. The Contractor must take all precautions to discovery and locate any Hazardous Environmental Condition(s) at the site that may present a substantial danger to persons or property exposed thereto in connection with the Work at the site. The Contractor is responsible for any damages caused by such Hazardous Environmental Condition(s) created on the site by a Contractor, Subcontractor, Supplier, or anyone else for whom the Contractor is responsible. Within 24 hours of the time when the Contractor discovers the Hazardous Environmental Condition(s), the Contractor will follow the procedures set forth in Paragraph 4.06.D.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered to Contractor written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 - BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent must be accompanied by a certified copy of the agent's authority to act.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents shall be obtained from solvent surety or insurance companies that are duly licensed by the State of Texas and authorized to issue bonds or insurance policies for the limits and coverages required by the Contract Documents. The bonds shall be in a form acceptable to the Owner and shall be issued by a surety which complies with the requirements of Art. 7.19-1, Texas Insurance Code and which is otherwise acceptable to the Owner. Owner may require the surety to obtain reinsurance for any portion of the risk that exceeds 10% of the surety's capital and surplus. For bonds exceeding $100,000, the surety must also hold a certificate of authority from the U.S. Secretary of the Treasury or have obtained reinsurance from a reinsurer that is authorized as a reinsurer in Texas and holds a certificate of authority from the U.S. Secretary of the Treasury.
Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

5.04 *Contractor's Liability Insurance*

A. Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insured (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment.

a. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 Workers' Compensation Insurance Coverage.

A. Definitions:

Certificate of coverage ("certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project, for the duration of the Project.

Duration of the Project - includes the time from the beginning of the work on the project until the contractor's/person's work on the project has been completed and accepted by the governmental entity.

Persons providing services on the project ("subcontractor" in §406.096) - includes all persons or entities performing all or part of the services the contractor has undertaken to perform on the project, regardless of whether that person contracted directly with the contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

B. The Contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all employees of the Contractor providing services on the project, for the duration of the project.

C. The Contractor must provide a certificate of coverage to the governmental entity prior to being awarded the Contract.

D. If the coverage period shown on the contractor's current certificate of coverage ends during the duration of the project, the contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing that coverage has been extended.

E. The Contractor shall obtain from each person providing services on a project, and provide to the governmental entity:

(1) a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the project; and

(2) no later than seven days after receipt by the contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.

F. The Contractor shall retain all required certificates of coverage for the duration of the Project and for one year thereafter.

G. The Contractor shall notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.

H. The Contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage. This notice does not satisfy other posting requirements imposed by the Act or other commission rules. This notice must be printed with a title in at least 30 point bold type and text in at least 19 point normal type, and shall be in both English and Spanish and any other language common to the worker population. The text for the notices shall be the following text provided by the commission on the sample notice, without any additional words or changes:

"REQUIRED WORKERS' COMPENSATION COVERAGE"

"The law requires that each person working on this site or providing services related to this construction project must be covered by workers' compensation insurance. This includes persons providing, hauling, or delivering equipment or materials, or providing labor or transportation or other service related to the project, regardless of the identity of their employer or status as an employee."

"Call the Texas Workers' Compensation Commission at 512-440-3789 to receive information on the legal requirement for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage."

I. The Contractor shall contractually require each person with whom it contracts to provide services on a project, to:

(1) provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all of its employees providing services on the project, for the duration of the project;

(2) provide to the Contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the Project, for the duration of the Project;

(3) provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;

(4) obtain from each other person with whom it contracts, and provide to the Contractor:

(a) a certificate of coverage, prior to the other person beginning work on the Project; and

(b) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;

(5) retain all required certificates of coverage on file for the duration of the Project and for one year thereafter;

(6) notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project; and

(7) contractually require each person with whom it contracts, to perform as required by Paragraphs (1) - (7), with the certificates of coverage to be provided to the person for whom they are providing services.

J. By signing this Contract or providing or causing to be provided a certificate of coverage, the Contractor is representing to the Owner that all employees of the Contractor who will provide services on the Project will be covered by workers' compensation coverage for the duration of the Project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the Contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.

K. The Contractor's failure to comply with any of these provisions is a breach of contract by the Contractor which entitles the Owner to declare the Contract void if the Contractor does not remedy the breach within ten days after receipt of notice of breach from the Owner.

5.06 *Builder's Risk Insurance*

A. Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, wind, hail, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, flood, and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. Contractor shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, partners, employees, agents, consultants and

subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insured or additional insured (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for:

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order .

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. The Contractor shall have an English-speaking, competent Superintendent on the Work at all times that Work is in progress. Upon request of Owner, the Contractor shall present the resume of the proposed Superintendent to Owner showing evidence of experience

and successful superintendence and direction of work of a similar scale and complexity. If, in the opinion of Owner, the proposed Superintendent does not indicate sufficient experience in line with the Work, he/she will not be allowed to be the designated Superintendent for the Work. The Superintendent shall not be replaced without Written Notice to Owner. If the Contractor deems it necessary to replace the Superintendent, the Contractor shall provide the necessary information for approval, as stated above, on the proposed new Superintendent. A qualified substitute Superintendent may be designated in the event that the designated Superintendent is temporarily away from the Work, but not to exceed a time limit acceptable to Owner. The Contractor shall replace the Superintendent upon the Owner's request in the event the Superintendent is unable to perform to the Owner's satisfaction. The Superintendent will be the Contractor's representative on the Work and shall have the authority to act on behalf of the Contractor. All communications given to the Superintendent shall be as binding as if given to the Contractor. Either the Contractor or the Superintendent shall provide an emergency and home telephone number at which one or the other may be reached if necessary when work is not in progress.

C. The Contractor agrees to employ only orderly and competent workers, skillful in performance of the type of Work required under the Contract. The Contractor, Subcontractors, Sub-subcontractors, and their employees may not use or possess any firearms, alcoholic or other intoxicating beverages, illegal drugs or controlled substances while on the job or on the Owner's property, nor may such workers be intoxicated, or under the influence of alcohol or drugs, on the job. If the Owner or Owner's Representative notifies the Contractor that any worker is incompetent, disorderly or disobedient, has knowingly or repeatedly violated safety regulations, has possessed any firearms, or has possessed or was under the influence of alcohol or drugs on the job, the Contractor shall immediately remove such worker from performing Contract Work, and may not employ such worker again on Contract Work without the Owner's prior written consent. The Contractor shall at all times maintain good discipline and order on or off the site in all matters pertaining to the Project.

6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified but nevertheless accepted in writing by Owner and Engineer, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. The Contractor agrees to assign to the Owner at the time of final completion of the Work any and all manufacturer's warranties relating to materials and labor used in the Work, and the Contractor further agrees to perform the Work in such manner to preserve any and all manufacture's warranties. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

1. The Contractor shall furnish twenty-four (24) hour callback maintenance service for the equipment provided by the Contractor for a period of three (3) months after completion and acceptance of the Work. This service shall include regular examination of the equipment by competent and trained employees of the Contractor and shall include all necessary adjustments, greasing, oiling, cleaning, supplies, and parts to keep the equipment in proper operation, except parts made necessary by misuse, accident, or negligence not caused by the Contractor or any Subcontractors of any tier.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjust-

ments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below, provided that, such "or-equal" items may not be used without Engineer's written approval, and Engineer shall not be obligated to approve such items.

1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole,

3) it has a proven record of performance and availability of responsive service; and

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times, and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. Substitute Items

a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented in the General Requirements and as Engineer may decide is appropriate under the circumstances.

d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

1) shall certify that the proposed substitute item will:

a) perform adequately the functions and achieve the results called for by the general design,

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time;

b) whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

c) whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

a) all variations of the proposed substitute item from that specified , and

b) available engineering, sales, maintenance, repair, and replacement services;

4) and shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change,

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. *Engineer's Evaluation:* Engineer will be allowed seven (7) days within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. *Engineer's Cost Reimbursement*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B Whether or not Engineer approves a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

F. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Not later than 14 days after the execution of the Agreement by the Contractor and Owner, the Contractor shall furnish the Owner and the Engineer, in writing, with (1) the name, trade, and subcontract amount for each Subcontractor and (2) the names of all persons or entities proposed as manufacturers of the products identified in the Specifications (including those who are to furnish materials or equipment fabricated to a special design) and, where applicable, the name of the installing Subcontractor. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Proposal Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity, nor

2. shall anything in the Contract Documents create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, and Engineer,, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of Owner or Engineer its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Proposals, or, if there are no Proposals, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations. The Contractor shall plan and execute its operations in compliance with all applicable Federal, State and local laws and regulations, including those concerning control and abatement of water pollution and prevention and control of air pollution. The Contractor shall conduct activities in compliance with applicable laws and regulations and other requirements of the Contract relating to the environment, and its protection at all times. Unless otherwise specifically determined, the Contractor is responsible for obtaining and maintaining permits related to storm water run-off. The Contractor shall conduct operations consistent with storm water run-off permit conditions.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other

professionals and all court or other dispute resolution costs) arising out of or relating to such Work.

C. Changes in Laws or Regulations not known at the time of opening of Proposals (or, on the Effective Date of the Agreement if there were no Proposals) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. For the avoidance of doubt, any Laws or Regulations or international events that affect costs or inflation do not constitute a change in law that could give rise to a Change Order. Contractor shall bear the risk of inflation. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

B. The Owner is an exempt organization as defined by Chapter 11 of the Property Tax Code of Texas and is thereby exempt from payment of Sales Tax under Chapter 151, Limited Use Sales, Excise and Use Tax, Texas Tax Code, and Article 1066 (C), Local Sales and Use Tax Act, Revised Civil Statutes of Texas. The Owner may issue a "Texas Sales and Use Tax Exemption Certification" authorizing the Contractor to use same in the purchase of materials for the Project.

6.11 *Use of Site and Other Areas*

A. Limitation on Use of Site and Other Areas

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

B. The Record Documents shall be updated to show the "As-Constructed" Drawings and Specifications monthly prior to submission of periodic Applications for Payment. Failure to update the "As-Constructed" Drawings and Specifications constitutes cause for denial of a progress payment otherwise due.

C. Upon Substantial Completion of the Work, these record documents, samples and Shop Drawings shall be promptly delivered to Owner. Prior to requesting a Substantial Completion inspection, Contractor shall furnish a complete set of the marked up "As-Constructed" Drawings and Specifications and one copy of same. Concurrently, Contractor shall submit a preliminary copy of each operating and maintenance manual required by

the Contract Documents for review by the Owner and Engineer. Once determined acceptable, Contractor shall provide Mylar prints of professionally drafted "As Constructed" Drawings and Specifications in bound volumes along with electronic copies on CD in a format acceptable to Owner, two (2) sets of photocopies of the Mylar prints, two sets of operating and maintenance manuals, two sets of approved submittals, and any other record documents required by the Contract Documents.

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or , or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

D. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

E. When the Work requires excavation which either exceed four (4) feet in depth or results in any worker's upper body being positioned below grade level, the Contractor is required to submit a trenching plan to the Owner prior to commencing trenching operations. The plan is required to be prepared and sealed by a professional engineer registered in the State of Texas, and employed by the Contractor. Said engineer cannot be anyone who is otherwise engaged directly or indirectly with this Project.

F. The Contractor shall erect and maintain, as required by existing conditions and performance of the Contractor, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

G. When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

6.14 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer written notice immediately, and in no instance more than 24 hours after the alleged emergency, if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by

Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the acceptable Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. Shop Drawings

a. Submit number of copies specified in the General Requirements.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:* Contractor shall also submit Samples to Engineer for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals.

a. Submit number of Samples specified in the Specifications.

b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. Submittal Procedures

1. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:

a. all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. the suitability of all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto; and

d. shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations, that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample Submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. Engineer's Review

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. If Engineer makes such a determination, it shall constitute an "Approved Submittal."

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility

for complying with the requirements of Paragraph 6.17.C.1.

E. Resubmittal Procedures

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its Related Entities shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage, provided that Contractor demonstrates the Work was properly installed as originally built.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. Owner's acceptance of nonconforming or defective work will not be implied. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others; or

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. CONTRACTOR SHALL INDEMNIFY AND HOLD OWNER HARMLESS AGAINST ANY LOSS OR DAMAGE TO PERSONS OR PROPERTY AS A RESULT OF OPERATIONS GROWING OUT OF THE PERFORMANCE OF THIS CONTRACT AND CAUSED BY THE NEGLIGENCE OR CARELESSNESS OF CONTRACTOR, CONTRACTOR'S EMPLOYEES, SUBCONTRACTORS, AND AGENTS OR LICENSEES. THE CONTRACTOR SHALL UNCONDITIONALLY DEFEND AT ITS OWN COST AND SHALL INDEMNIFY AND HOLD HARMLESS THE OWNER, ENGINEER, ENGINEER'S CONSULTANTS AND SUB-CONSULTANTS AND THEIR RESPECTIVE OFFICERS, DIRECTORS, PARTNERS, EMPLOYEES, AGENTS AND OTHER CONSULTANTS AND ANY OF THEM FROM AND AGAINST ALL CLAIMS, JUDGMENTS, COSTS, LIENS, LIABILITIES, LOSSES, DAMAGES, PENALTIES, INTEREST, FEES, FINES, COSTS AND EXPENSES (INCLUDING BUT NOT LIMITED TO ALL FEES AND CHARGES OF ENGINEERS, ARCHITECTS, ATTORNEYS AND OTHER PROFESSIONALS AND ALL COURT OR OTHER DISPUTE RESOLUTION COSTS) IN ANY MANNER ARISING DIRECTLY OR INDIRECTLY OUT OF, OR RESULTING FROM, THE WORK PERFORMED HEREUNDER OR THE MATERIALS TO BE FURNISHED UNDER THE CONTRACT DOCUMENTS, THAT IS:

1. ATTRIBUTABLE TO BODILY INJURY, SICKNESS, DISEASE OR DEATH (INCLUDING EMPLOYEES OF CONTRACTOR AND OWNER), OR TO INJURY TO OR DESTRUCTION OF TANGIBLE PROPERTY (INCLUDING PROPERTY OF CONTRACTOR AND OWNER AND THE WORK ITSELF), INCLUDING THE LOSS OF USE RESULTING THEREFROM, AND

2. CAUSED IN WHOLE OR IN PART BY ANY NEGLIGENT ACT, ERROR OR OMISSION; SOLE NEGLIGENCE; CONCURRENT NEGLIGENCE; JOINT NEGLIGENCE; ACTIVE OR PASSIVE NEGLIGENCE; GROSS NEGLIGENCE; NEGLIGENCE PER SE; STRICT LIABILITY; INVERSE CONDEMNATION, PATENT INFRINGEMENT; COPYRIGHT; CONDITION OF PROPERTY OR ITS PREMISES; LATENT DEFECTS; DEFECTS IN MATERIALS, WORKMANSHIP, OR DESIGN; WORKERS' COMPENSATION CLAIMS; DISABILITY ACT CLAIMS; EMPLOYEE BENEFIT CLAIMS; AND FAILURE TO COMPLY WITH ANY OF THE PROVISIONS OF THE CONTRACT DOCUMENTS; OR OTHER ACT OR OMISSION OF CONTRACTOR, OR CONTRACTOR'S EMPLOYEES, SUBCONTRACTORS, OR AGENTS OR LICENSEES.

B. In any and all claims against Owner or Engineer or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 - OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or via other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, a

reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's actions or inactions.

C. Contractor shall be liable to Owner and any other contractor for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's action or inactions.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

A. Owner shall furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by Engineer in preparing the Contract Documents.

8.06 *Insurance*

A. Owner's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility in respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents and will not be changed without written consent of Owner and Engineer.

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. The Engineer will obtain on a weekly basis the Contractor's signature on all Field Orders that will contain an acknowledgement by the Contractor that the Field Order does not involve an adjustment in the Contract Price or in the Contract Times.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believe that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to, the Resident Project Representative, if any, and assistants, if any.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be

performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided). A change in the Contract Price or the Contract Times shall be accomplished only be written Amendment, a written Change Order, or a written Work Change Directive. Accordingly, no course of conduct or dealings between the parties, no expressed or implied acceptance of alterations or additions to the Work, and no claim that the Owner has been unjustly enriched by any alterations or additions to the Work shall be the basis of any claim for an increase in any amount due under the Contract Documents or a change in any time period provided for in the Contract Documents.

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.B.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

Agreements on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of a Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments to the Contract Price and the Contract Times. In the event a Change Order increases the Contract Price, the Contractor shall include the Work covered by such Change Order in Applications for Payment as if such Work were originally part of the Contract Documents.

10.04 *Notification to Surety*

A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any bond to be given to a surety, the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim, shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part,

2. approve the Claim, or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

G. In calculating the amount of any claim or measure of damages for breach of contract (such provision to survive any termination of following such breach), the following standards shall apply:

1. No indirect or consequential damages will be allowed;

2. No recovery shall be based on a comparison of planned expenditures to total actual expenditures, or on estimated losses of labor efficiency, or on a comparison pf planned manloading to actual manloading, or any other analysis that is used to show damages indirectly;

3. Damages are limited to extra costs specifically shown to have been directly caused by a proven wrong;

4. No damages shall be allowed for delay;

5. No damages will be allowed for home office overhead or other home office charges or any Eichleay formula calculation; and

6. No profit will be allowed on any damage claim.

ARTICLE 11 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in Paragraph 11.01.B.

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized in writing by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to Engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work, but

only to the extent authorized and approved in writing by Owner and Engineer.

5. Supplemental costs including the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expresses, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A and 11.01.B.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

E. *Pricing Information Requirements:* The Contractor agrees to provide and require all Subcontractors to provide a breakdown of allowable labor and labor burden cost information as outlined herein. This information will be used to evaluate the potential cost of labor and labor burden related to Change Order Work. It is intended that this information represent an accurate estimate of the Contractor's actual labor and labor burden cost components. This information is not intended to establish fixed billing or Change Order pricing labor rates. However, at the time Change Orders are priced the submitted cost data for labor rates may be used to price Change Order Work. The accuracy of any such agreed-upon labor cost components used to price Change Orders will be subject to later audit. Approved Change Order amounts may be adjusted later to correct the impact of inaccurate labor cost components if the agreed-upon labor cost components are determined to be inaccurate.

11.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. Cash Allowances

1. Contractor agrees that:

a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. Contingency Allowance

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Proposals and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. When "plan quantity" is indicated for a proposal item, the Contractor shall be paid the amount specified in the Contract Documents without any measurements.

E. A Major Item is any individual proposal item in the Proposal that has a total cost equal to or greater than five
percent (5%) of the original Contract Amount or $50,000, whichever is greater, computed on the basis of proposal quantities and Contract unit prices.

F. The Owner or the Contractor may make a Claim for an adjustment in the Contract Amount if:

1. the actual quantity of any Major Item should become as much as twenty percent (20%) more than or twenty percent (20%) less than in the Proposal; or

2. The Contractor presents proper documentation contesting the accuracy of "plan quantity," and Owner's Representative verifies quantity and determines original quantity is in error by five percent (5%) or more.

ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order.

1. If the total of amount of all Change Orders, in the aggregate, involves a decrease or an increase of more than $25,000, no Change Order shall be valid unless it is approved by the City Council of the City of Georgetown. The original Contract Price may not be increased by more

than twenty-five percent (25%) under any circumstances and it may not be decreased more than twenty-five percent (25%) without the consent of the Contractor to such decrease.

2. Any claim for an adjustment in the Contract Amount shall be made by Written Notice delivered by the party making the Claim to the other party promptly (but in no event later than thirty (30) calendar days) after the start of the occurrence or event giving rise to the Claim and stating the general nature of the Claim, but in any case before proceeding to execute the work considered to be additional costs (except for Emergencies as described in Article 6). Notice of the amount of the Claim with supporting data shall be delivered within thirty (30) calendar days after Written Notice of Claim is delivered by claimant, and shall represent that the adjustment claimed covers all known amounts to which claimant is entitled as a result of said occurrence or event.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 10 percent;

b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 10 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

C. All time limits stated in the Contract Documents are of the essence of the Agreement. The Contractor acknowledges and understands that failure by the Contractor to complete the Work in accordance with the construction schedule will cause significant damages to the Owner, and subject Contractor to Liquidated Damages as stated in the Agreement.

12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer and the Related Entities of each of them shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of Engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

F. Notwithstanding anything to the contrary in the Contract Documents, an extension in the Contract Times, to the extent permitted under Paragraphs 12.02 and 12.03, shall be the sole and exclusive remedy of the Contractor for any (1) delay in the commencement, prosecution, or completion of the Work; (2) hindrance or obstruction in the performance of the Work; (3) loss of productivity; or (4) other similar claims (collectively referred to in this paragraph as "Delays") whether or not such Delays are foreseeable. In no event shall the Contractor be entitled to any compensation or recovery of any damages, in connection with any Delay, including, without limitation, consequential damages, lost opportunity costs, impact damages, or other similar remuneration. The Owner's exercise of any of its rights or remedies under the Contract Documents (including, without limitation, ordering changes in the Work, directing suspension, rescheduling, or correction of the Work, or terminating this Agreement for its convenience), regardless of the extent or frequency of the Owner's exercise of such rights or remedies, shall not be construed as active interference with the Contractor's performance of the Work. If the Contractor submits a progress report indicating, or otherwise expressing an intention to achieve, completion of the Work prior to any completion date required by the Contract Documents or expiration of the Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied.

G. Under a Calendar Day Contract, the Contractor may also be granted an extension of time because of unusual inclement weather that is beyond the normal weather expected for the Georgetown, Texas area. Normal weather which prevents the Contractor from performing Work is expected during a Calendar Day Contract, and is <u>not</u> a justification for an extension of time. The following delineates the number of days per month for which, for purposes of Calendar Day Contracts, expected normal weather will prevent performance of Work:

January.....	7 days
February.....	7 days
March.....	7 days
April.....	7 days
May.....	8 days
June.....	6 days
July.....	6 days
August.....	5 days
September.....	7 days
October.....	7 days
November.....	7 days
December.....	7 days

Days per month exceeding the number shown above may be credited as Rain Days if a Claim is made in accordance with this Article 12 and meets the following definition: a "Rain Day" is any day in which a weather event occurs at the site and is sufficient to prevent the Contractor from performing units of Work critical to maintaining the Progress Schedule.

ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise

them of Contractor's Site safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in said Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, it must, if requested by Engineer, be uncovered for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted in the time set forth in the Contractor's notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others), unless the Contractor fails to provide written notice as required by Paragraph 13.03.F; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If, the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or other

dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service for the benefit of the Owner before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other

contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. Applications for Payments

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Notwithstanding anything to the contrary herein, Owner is not obligated to pay for Approved Submittals or materials and equipment ordered from a supplier that have not yet been delivered to the Site. In Owner's absolute discretion, Owner may choose to pay up to a maximum of five percent (5%) for Approved Submittals, as such is defined in Section 6.17(D)(1). Further, if Owner opts to pay any amount for such Approved Submittals, Owner will not under any circumstances pay any additional amounts to alternative suppliers for replacement material or equipment; all prior payments shall be deemed paid for such materials and equipment, and Contractor bears the burden of recovering any costs previously paid for material or equipment that is defective or not delivered.

3. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

4. The OWNER will pay to the CONTRACTOR the total amount of approved Application for Payment, less five percent (5%) of the amount thereof, which five percent (5%) or the highest maximum amount of retainage as may be allowed under Government Code Chapter 2253 will be retained until thirty (30) days after Final Completion of the Work, less all previous payments and less all sums that may be retained by the OWNER under the terms of this Contract. The CONTRACTOR, at the OWNER'S option, may be relieved of the obligation to complete the Work and, thereupon, the CONTRACTOR shall receive payment of the balance due under the Contract subject to the conditions stated under paragraph 15.2.

5. Each application for payment shall be accompanied by the following, all in form and substance satisfactory to the Owner:

a. A current Contractor's lien waiver and duly executed and acknowledged sworn statement showing all Subcontractors and material suppliers with whom the Contractor has entered into Subcontracts, the amount of each such Subcontract, the amount requested for any Subcontractor and material supplier in the requested progress payment, and the amount to be paid to the Contractor from such progress payment, together with similar sworn statements from all such Subcontractors and material suppliers;

b. Duly executed waivers of mechanics' and material suppliers' liens from all Subcontractors and,

when appropriate, from material suppliers and lower-tier Subcontractors establishing payment or satisfaction of payment of all amounts requested by the Contractor on behalf of such entities or persons in any previous application for payment;

c. updated Progress Schedule;

d. monthly subcontractor report;

e. Contractor's estimate of the amount of the Work performed, labor furnished, and materials included in the Work using the agreed schedule of values; and

f. any other documentation required under the Supplementary Conditions or elsewhere in the Contract Documents; and

g. All information and materials required to comply with the requirements of the Contract Documents or reasonably requested by the Owner or the Engineer.

6. The Contractor shall also comply with the following specific requirements:

a. With each application for payment, the Contractor shall submit to the Owner a written list identifying each location where materials are stored off the project site and the value of the materials at each location. The Contractor shall procure insurance satisfactory to the Owner for material stored off the project site in an amount not less than the total value thereof.

b. The consent of any surety shall be obtained to the extent required prior to payment for any materials stored off the project site.

B. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations on the Site of the executed Work as an experienced and qualified design professional and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

a. the Work has progressed to the point indicated;

b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to any other qualifications stated in the recommendation); and

c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

b. that there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

a. to supervise, direct, or control the Work, or

b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or

e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because

of subsequently discovered evidence or the results of subsequent review, inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

b. the Contract Price has been reduced by Change Orders;

c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09;

d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A; or

e. Engineer later determines that Contractor's Application for Payment did not contain the material required in Paragraph 14.02.A.

C. *Payment Becomes Due*

1. Thirty (30) days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

c. there are other items entitling Owner to a set-off against the amount recommended;

d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A;

e. reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Amount;

f. damage to the Owner or another contractor;

g. reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;

h. failure of the Contractor to submit a schedule of values in accordance with the Contract Documents;

i. failure of the Contractor to submit a submittal schedule in accordance with the Contract Documents;

j. failure of the Contractor to submit or update construction schedules, including Progress Schedule(s), in accordance with the Contract Documents;

k. failure of the Contractor to maintain a Record Documents;

l. failure of the Contractor to maintain weekly payroll reports;

m. failure of the Contractor to submit monthly Subcontractor reports;

n. the Contractor's neglect or unsatisfactory prosecution of the Work, including failure to clean up;

o. assessment of fines and/or penalties for violations of any federal or state law;

p. notice of potential claims by subcontractors or suppliers; or

q. failure of the Contractor to comply with any provision of the Contract Documents.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor corrects to Owner's satisfaction the reasons for such action.

3. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1.

E. No money shall be paid by the Owner upon any claim, debt, demand or account whatsoever, to any person, firm or corporation who is in arrears to the City of Georgetown for taxes; and the City of Georgetown shall be entitled to counterclaim and offset against any such debt, claim, demand or account in the amount of taxes so in arrears and no assignment or transfer of such debt, claim, demand or account after said taxes are due, shall affect the right of the Owner to so offset said taxes, and associated penalties and interest if applicable, against the same.

14.03 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

(1) The Contractor further expressly undertakes to defend the Owner and Engineer, at the Contractor's sole expense, against any actions, lawsuits, or proceedings brought against the Owner, Engineer, or any third party as a result of liens filed against the Work, the site of any of the Work, the project site and any improvements thereon, payments due the Contractor, or any portion of the property of the Owner, Engineer, or third party. The Contractor hereby agrees to indemnify and hold the Owner, Engineer, and third parties harmless against any such liens or claims of lien and agrees to pay any judgment or lien resulting from any such action, lawsuit, or proceeding.

(2) The Owner shall release any payments withheld due to a lien or claim of lien if the Contractor obtains security acceptable to the Owner or a lien bond that is (i) issued by a surety acceptable to the Owner; (ii) in a form and substance satisfactory to the Owner; and (iii) in an amount not less than two hundred percent (200%) of such lien claim. By posting a lien bond or other acceptable security, however, the Contractor shall not be relieved of any responsibilities or obligations under this paragraph, including, without limitation, the duty to defend and indemnify the Owner and Engineer. The cost of any premiums incurred in connection with such bonds and securities shall be the responsibility of the Contractor and shall not be part of, or cause any adjustment to, the Contract Price.

(3) The Contractor agrees to waive any right that it may have to assert a mechanic's or other lien against the project site and any improvements thereon, including without limitation, the Work itself. Furthermore, the Contractor will cause a similar provision, waiving all rights to a mechanic's or other lien against the property, to be included in all of its subcontracts, any sub-subcontracts, and all contracts with material suppliers.

(4) Notwithstanding the foregoing, the Owner reserves the right to settle any disputed mechanic's or material supplier's lien claim by payment to the lien claimant or by such other means as the Owner, in the Owner's sole discretion, determines is the most economical or advantageous method of settling the dispute. The Contractor shall promptly reimburse the Owner, upon demand, for any payment so made.

14.04 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

B. Promptly after Contractor's notification, , Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will within 14 days after submission of the tentative certificate to Owner notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will within said 14 days execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to complete or correct items on the tentative list.

14.05 *Partial Utilization*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the

remainder of the Work, subject to the following conditions.

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. Application for Payment

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.7;

b. consent of the surety, if any, to final payment;

c. a list of all Claims against Owner that Contractor believes are unsettled; and

d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

e. Non-Use of Asbestos Affidavit (After Construction);

f. Affidavit that all payrolls, bills for materials and equipment, subcontracted Work, and all indebtedness connected with the Work, except as specifically noted, are paid or will be paid, or will be otherwise satisfied within the period of time required by Chapter 2251 of the Texas Government Code. Contractor's affidavit shall include documentation establishing payment or satisfaction of all such obligations such as receipts, releases, and waivers of claims and liens arising out of the Contract. The Contractor may not subsequently submit a claim on behalf of a subcontractor or vendor unless the Contractor's affidavit notes that claim as an exception; and

g. Other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or Owner's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. Engineer's Review of Application and Acceptance

1. If, on the basis of Owner's and Engineer's observation of the Work during construction

and final inspection, and Owner's and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Owner and Engineer are satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and, will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's disregard of the authority of Engineer; or

4. Persistent failure to prosecute the Work in accordance with the Contract, and to insure its completion within the time, or any approved extension thereof, specified in this Contract; and/or

5. Failure to remedy defective Work condemned by the Owner; and/or

6. Failure to pay subcontractors, laborers, and material suppliers pursuant to Tex. Gov't Code Chapter 2251; and/or

7. Persistent endangerment to the safety of labor or of the Work; and/or

8. Failure to supply or maintain statutory bonds or to maintain required insurance, pursuant to the contract; and/or

9. If the CONTRACTOR is adjudged a bankrupt, or makes a general assignment for the benefit of creditors, or if a receiver is appointed for the benefit of creditors, or if a receiver is appointed on account of CONTRACTOR's insolvency, or if CONTRACTOR has otherwise demonstrated financial inability to perform the Work; and/or

10. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion),

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B, and 15.02.C.

G. In the event that Owner's termination under Paragraph 15.02 is determined to be wrongful, the termination will automatically become a termination for convenience under Paragraph 15.03, and Contractor's remedy for wrongful termination shall be limited to recovery of payments permitted for termination for convenience under paragraph 15.03.

15.03 *Owner May Terminate For Convenience*

A. The Owner may, at any time, terminate the Contract in whole or in part for the Owner's convenience and without cause. Termination by the Owner under this paragraph shall be by a notice of termination delivered to the Contractor specifying the extent of termination and the effective date.

B. Upon receipt of a notice of termination for convenience, the Contractor shall immediately, in accordance with instructions from the Owner, proceed with performance of the following duties regardless of delay in determining or adjusting amounts due under this paragraph:

1. cease operations as specified in the notice;

2. place no further orders and enter into no further subcontracts for materials, labor, service, or facilities except as necessary to complete continued portions of the Contract;

3. terminate all subcontracts and orders to the extent they relate to the Work terminated;

4. proceed to complete the performance of the Work not terminated; and

5. take actions that may be necessary, or that the Owner may direct, for the protection and preservation of the terminated Work.

C. Upon such termination, the Contractor shall recover as its sole remedy payment of the percentage of the Contract Price equal to the percentage of the Work performed satisfactorily and not previously paid for as determined by the Engineer. The Contractor hereby waives and forfeits all other claims for payment and damages, including, without limitation, anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

D. The Owner shall be credited for (1) payments previously made to the Contractor for the terminated portion of the Work; (2) claims that the Owner has against the Contractor under the Contract; and (3) the value of the materials, supplies, equipment, or other items that are to be disposed of by the Contractor that are part of the Contract Price.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Claims shall be made by Written Notice delivered by the party making the Claim to the other party within thirty (30) calendar days after the start of the occurrence or event giving rise to the Claim and stating the general nature of the Claim. Notice of the amount of the Claim with supporting data shall be delivered within thirty (30) calendar days after Written Notice of Claim is delivered by claimant and shall represent that the adjustment claimed covers all known amounts to which claimant is entitled.

B. Within thirty (30) calendar days of receipt of notice of the amount of the Claim with supporting data, Owner and the Contractor shall meet to discuss the Claim, after which an offer of settlement or notification of no settlement offer will be made to claimant. If claimant is not satisfied with the proposal presented, claimant shall have thirty (30) calendar days in which to:

.1 submit additional supporting data requested by the other party;

.2 modify the initial Claim; or

.3 request Alternative Dispute Resolution.

16.02 *Alternative Dispute Resolution*

A. If a dispute exists concerning a Claim, the parties agree to use the following procedure prior to pursuing any other available remedies. The Owner reserves the right to include Engineer as a party.

B. Either party may give the other party written notification of any dispute not resolved in the normal course of business. Within fifteen (15) days after delivery of the notice, the receiving party shall submit to the other party a written response. The notice and response shall include (a) a statement of that party's position and a summary of arguments supporting that position, and (b) the name and title of the executive who will represent that party and of any other person will accompany that executive.

C. Within thirty (30) days after delivery of the initial notice, the executives of both parties shall meet in Georgetown, Texas at a mutually acceptable time and location, and thereafter as often as they deem reasonably necessary to attempt to resolve the dispute.

D. All reasonable requests for information made by one party to the other will be honored.

E. All negotiations are confidential and shall be treated as compromise and settlement negotiations for purpose of applicable rules of evidence.

F. Each party is required to continue to perform its obligations under the Contract Documents pending final resolution of any dispute arising out of or relating to the Contract Documents.

16.03 *Mediation*

A. If the procedure described in Paragraph 16.02 proves unsuccessful or is waived pursuant to its terms, the parties shall initiate the mediation process, as follows:

B. Any Claim arising out of or related to the Contract, shall be subject to mediation as a condition precedent to the institution of legal or equitable proceedings by either party.

C. The parties shall endeavor to resolve their Claims by mediation. Request for mediation shall be filed in writing with the other party. The request may be made concurrently with the filing of a lawsuit but, in such event, mediation shall proceed in advance of legal or equitable proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order.

D. The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in Georgetown, Texas, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

J. Claims not resolved by mediation shall be decided by litigation. Venue shall be proper only in

Williamson County, Texas.

16.04 *Contingent Fee Litigation*

A. Owner may choose to litigate matters under this Agreement in accordance with Section 2254 of the Texas Government Code.

ARTICLE 17 - MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

B. The following legal holidays are observed by the Owner:

Holiday	*Date Observed*
New Year's Day	January 1
Martin Luther King, Jr.'s Birthday	Third Monday in January
Memorial Day	Last Monday in May
Independence Day	July 4
Labor Day	First Monday in September
Thanksgiving Day	Fourth Thursday in November
Friday after Thanksgiving	Friday after Thanksgiving
Christmas Eve	December 24
Christmas Day	December 25

C. If a Legal Holiday falls on Saturday, it will be observed on the preceding Friday. If a Legal Holiday falls on Sunday, it will be observed on the following Monday. If Christmas Eve falls on a Saturday or a Sunday, the preceding Friday is observed as the Christmas Eve holiday. If Christmas Day falls on a Saturday or a Sunday, the following Monday is observed as the Christmas Day holiday.

17.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

B. The Contractor waives all Claims against the Owner for consequential damages arising out of or relating to this Contract; provided, however, that in no event shall this waiver be deemed to preclude an award of liquidated damages recoverable under the Agreement. This waiver is applicable, without limitation, to all consequential damages due to termination in accordance with this Contract.

17.04 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

A. This Contract is to be governed by the law of the State of Texas.

17.06 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

EXHIBIT 00800 – SUPPLEMENTARY CONDITIONS

GENERAL

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions will have the meanings indicated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings indicated below, which are applicable to both the singular and plural thereof.

SC-1.01 DEFINED TERMS

Add the following defined terms to Section 1.01:

53 *Calendar Day*: "Calendar Day" is any day of the week or month, no days being excepted.

54 *Working Day*: A "Working Day" is defined as any day not including Saturdays, Sundays or any legal holidays, in which weather or other conditions, not under the control of the CONTRACTOR, will permit construction of the principal units of the work for a period of not less than seven (7) hours between 7:00 a.m. and 6:00 p.m.

55 *Working Times*: Times of day(s) during which work may be performed. Unless authorized by the City of Georgetown, all Work shall be performed between 7:00am and 6:00pm on weekdays and, if previously authorized by as provided for in Section 6.02 herein, as applicable, between 9:00 am and 6:00 pm on Saturdays, Sundays, or Legal Holidays. When the CONTRACTOR has been authorized to perform Work during hours outside Working Times, such hours shall be considered time worked on Working days. Notwithstanding the preceding, emergency work may be done without prior permission only as provided in paragraph 6.16 herein.

56 *Proposal:* Proposal of Offeror, under Local Government Code section 271.113 providing for alternative project delivery methods, on prescribed forms setting forth prices for performing the Work described in the Contract Documents.

57 *Proposal Documents*: The advertisement or invitation for Proposals, Instruction to Offerors, the Proposal form, the Contract Documents and Addenda (NOTE: this definition only applies where proposals, rather than bids have been solicited and where allowed under the Local Government Code).

SC-4.01 AVAILABILITY OF LANDS

Add the following defined terms to Section 4.01:

A. The Site for this project shall include the temporary and permanent easements as indicated on the Drawings.

SC-4.02 SUBSURFACE AND PHYSICAL CONDITIONS

Add the following paragraph immediately after paragraph 4.02.B:

B. In the preparation of the Contract Documents ENGINEER relied upon the following reports of explorations and tests of subsurface conditions at the Site:

1. Report dated November, 17 2023 prepared by Terracon Consultants, Inc. entitled: "Geotechnical Engineering Report, City of Georgetown – Dove Springs WWTP Dewatering Improvements". The "technical data" contained in such report upon which the CONTRACTOR may rely includes the Log of Borings provided in the Appendix to CIP 4.

2. Copies of the report listed in SC-4.02.C.1 that are not included with the Proposal Documents may be examined at the offices of ENGINEER during regular business hours, or may be obtained from the ENGINEER. This report is not part of the Contract Documents, but the "technical data" contained therein upon which CONTRACTOR may rely as identified and established above are incorporated therein by reference. CONTRACTOR is not entitled to rely upon other information and data utilized by ENGINEER in the preparation of Drawings and Specifications.

3. CONTRACTOR represents that he has satisfied himself as to the subsurface conditions at the Site of the Work. The Contract Documents, including subsurface conditions, but excluding the "technical data" referenced in SC-4.02.C.2 above, are for information purposes only and are not warranted or represented in any manner to accurately show the conditions at the Site of the Work. All risks of differing site conditions shall be borne solely by the CONTRACTOR.

Delete paragraph 4.03.A.2 and replace with the following:

2. The Contractor further acknowledges that he has satisfied himself as to the character, quality, and quantity of surface and subsurface materials to be encountered from inspecting the Site and from evaluating information derived from exploratory work, if any, that has been presented in any geotechnical report, as well as from information presented in the Supplementary Conditions. Any failure by the Contractor to acquaint himself with all the available information will not relieve him from responsibility for properly estimating the difficulty or cost of successfully performing the Work. Neither the Owner nor the Engineer assume responsibility for any conclusion or interpretation made by the Contractor on the basis of the information made available by the Owner or the Engineer.

SC-5.02 LICENSED SURETIES AND INSURERS

Add the following to Section 5.02 A:

Surety and insurance companies from which the bonds and insurance for this Project are purchased shall have a Best's rating of no less than A:VII, in addition to other requirements specified herein.

SC-5.04 CONTRACTOR'S LIABILITY INSURANCE

Add the following to Section 5.04.B.1:

Include the following parties or entities as additional insured:

CDM Smith Inc.
8310-1 North Capital of Texas Hwy, Suite 250
Austin, TX 78731

SC-5.04 Contractor's Liability Insurance

Replace Paragraph 5.04 with the following SC-5.04

5.04 *Other Requirements: Bond and Insurance.*

A. General Requirements:

1. CONTRACTOR shall purchase and maintain insurance in the types and amounts indicated below for the duration of the Contract (unless a longer duration is specified), which shall include items owned by OWNER in the care, custody and control of CONTRACTOR prior to and during the term of the Contract and all warranty periods. Failure to purchase and maintain the required insurance shall be grounds for Termination of the Contract or Suspension of the Work by OWNER. Except for the Worker's Compensation policy, the other insurance policies required by the Contract to be obtained by CONTRACTOR must state that OWNER, its officials, directors, employees, representatives, and volunteers are added as additional insureds with regard to operations and activities by or on behalf of the named insureds performed under contract with OWNER. The additional insured status must cover completed operations as well, and the policy covering completed work must remain in effect until the expiration of the statue of repose.

2. CONTRACTOR must complete and forward the required Certificates of Insurance to OWNER before the Contract is executed as verification of coverage required below. CONTRACTOR shall not commence Work until the required insurance is obtained and until such insurance has been reviewed by OWNER. Approval of insurance by OWNER shall not relieve or decrease the liability of CONTRACTOR hereunder and shall not be construed to be a limitation of liability on the part of CONTRACTOR. CONTRACTOR must also complete and forward the required Certificates of Insurance to OWNER whenever a previously identified policy period has expired as verification of continuing coverage.

3. Contractor's insurance coverage is to be written by companies licensed to do business in the State of Texas at the time the policies are issued and shall be written by companies with A.M. Best ratings of B+VII or better, except for hazardous material insurance which shall be written by companies with A.M. Best ratings of A- or better.

4. All endorsements naming the OWNER as additional insured, waivers, and notices of cancellation endorsements as well as the Certificate of Insurance shall indicate: City of Georgetown, 113 E. 8th Street, Georgetown, Texas

78626, ATTN: Contract Manager.

5. The "other" insurance clause shall not apply to the OWNER where the OWNER is an additional insured shown on any policy. It is agreed that the CONTRACTOR's insurance shall be considered primary with respect to any insurance or self insurance carried by OWNER. The CONTRACTOR'S insurance shall apply separately to each insured against whom a claim is made and/or lawsuits brought, except with respect to the limits of insurer's liability.

6. If insurance policies are not written for amounts specified below, CONTRACTOR shall carry Umbrella or Excess Liability Insurance for any differences in amounts specified. If Excess Liability Insurance is provided, it shall follow the form of the primary coverage.

7. OWNER shall be entitled, upon request and without expense, to receive certified copies of policies and endorsements thereto and may make any reasonable requests for deletion or revision or modification of particular policy terms, conditions, limitations, or exclusions except where policy provisions are established by law or regulations binding upon either of the parties hereto or the underwriter on any such policies.

8. OWNER reserves the right to review the insurance requirements set forth during the effective period of this Contract and to make reasonable adjustments to insurance coverage, limits, and exclusions when deemed necessary and prudent by OWNER based upon changes in statutory law, court decisions, the claims history of the industry or financial condition of the insurance company as well as CONTRACTOR.

9. CONTRACTOR shall not cause any insurance to be canceled nor permit any insurance to lapse during the term of the Contract or as required in the Contract.

10. CONTRACTOR shall be responsible for premiums, deductibles and self-insured retentions, if any, stated in policies. All deductibles or self-insured retentions shall be disclosed on the Certificate of Insurance.

11. The policies must contain the following language: "This policy shall not be cancelled, materially changed, or not renewed until after thirty (30) days prior written notice has been given to OWNER." In addition, CONTRACTOR shall provide OWNER thirty (30) days written notice of erosion of the aggregate limits below occurrence limits for all applicable coverages indicted within the Contract.

12. If OWNER-owned property is being transported or stored off-Site by CONTRACTOR, then the appropriate property policy will be endorsed for transit and storage in an amount sufficient to protect OWNER's property.

13. The insurance coverages required under this contract are required minimums and are not intended to limit the responsibility or liability of CONTRACTOR.

14. Without limiting any of the other obligations or liabilities of the CONTRACTOR, the CONTRACTOR shall require each Subcontractor performing work under the Contract, at the Subcontractor's own expense,

to maintain during the term of the Contract, the same stipulated minimum insurance including the required provisions and additional policy conditions as shown above. As an alternative, the CONTRACTOR may include its Subcontractors as additional insureds on its own coverage as prescribed under these requirements. The CONTRACTOR's certificate of insurance shall note in such event that the Subcontractors are included as additional insureds and that CONTRACTOR agrees to provide Workers' Compensation for the Subcontractors and their employees. The CONTRACTOR shall obtain and monitor the certificates of insurance from each Subcontractor in order to assure compliance with the insurance requirements. The CONTRACTOR must retain the certificates of insurance for the duration of the Contract plus 5 years and shall have the responsibility of enforcing these insurance requirements among its subcontractors. The OWNER shall be entitled, upon request and without expense, to receive copies of these certificates.

B. Business Automobile Liability Insurance. Provide coverage for all owned, non- owned and hired vehicles in an amount not less than $1,000,000 combined single limit per accident for bodily injury and property damage. The policy shall contain the following endorsements in favor of OWNER:

Waiver of Subrogation endorsement TE 2046A;

30 day Notice of Cancellation endorsement TE 0202A; and

Additional Insured endorsement TE 9901 B.

Provide coverage in the following types and amounts:

A minimum combined bodily injury and property damage limit of $1,000,000 per occurrence. No aggregate shall be permitted for this type of coverage.

Such insurance shall include coverage for loading and unloading hazards.

C. Workers' Compensation and Employers' Liability Insurance. Coverage shall be consistent with statutory benefits outlined in the Texas Workers' Compensation Act (Section 401). CONTRACTOR shall assure compliance with this Statute by submitting two (2) copies of a standard certificate of coverage (e.g. ACCORD form) to Owner's Representative for every person providing services on the Project as acceptable proof of coverage. The required Certificate of Insurance must be presented as evidence of coverage for CONTRACTOR. Workers' Compensation Insurance coverage written by the Texas Workers Compensation Fund is acceptable to OWNER. CONTRACTOR's policy shall apply to the State of Texas and include these endorsements in favor of OWNER:

Waiver of Subrogation, form WC 420304; and

30 day Notice of Cancellation, form WC 420601.

The minimum policy limits for Employers' Liability Insurance coverage shall be the minimum amounts required to meet the statutory requirements of Texas Labor Code, Section 401.011(44), or the following, whichever is greater:

$1,000,000 bodily injury per accident, and

$1,000,000 bodily injury by disease policy limit; and

$1,000,000 bodily injury by disease each employee; and

$1,000,000 Employer's Liability.

D. Commercial General Liability Insurance. The Policy shall contain the following provisions:

Blanket contractual liability coverage for liability and indemnifications assumed under the Contract and all contracts relative to this Project.

Completed Operations/Products Liability until the end the statute of repose period.

Explosion, Collapse and Underground (X, C & U) coverage. Independent

Contractor's coverage.

Aggregate limits of insurance per project, endorsement CG 2503.

OWNER listed as an additional insured, endorsement CG 2010.

30 day notice of cancellation in favor of OWNER, endorsement CG 0205.

Waiver of Transfer of Recovery Against Others in favor of OWNER, endorsement CG 2404

Fully insuring CONTRACTOR'S or Subcontractor's liability for bodily injury and property damages with a combined bodily injury (including death) and property damage minimum limit of:

$1,000,000 per occurrence

$2,000,000 general aggregate

$2,000,000 products and completed operations aggregate

Coverage shall be on an "occurrence" basis.

E. Property Floater. Contractor shall obtain and maintain Property Floater in an amount sufficient to cover the replacement value of materials on site.

F. Umbrella Liability Insurance. The CONTRACTOR shall obtain, pay for, and maintain umbrella liability insurance during the contract term, insuring the CONTRACTOR (or subcontractor) for an amount not less than $2,000,000 that provides coverage at least as broad and applies in excess of and follows the form of the primary liability coverages required in Article 5. The policy shall provide "drop down" coverage where underlying primary insurance coverages limits are insufficient or exhausted.

G. Asbestos Abatement Liability Insurance. If the Work or the Project involves

asbestos containing materials, the CONTRACTOR shall obtain Asbestos Abatement Liability Insurance for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos containing materials. The combined single limit for bodily injury and property damage shall be a minimum of $1,000,000 per occurrence. If claims made, the claims-made, the claims made form shall provide that the period of coverage shall be: Continuous coverage for the term of the Contract plus the warranty period of at least one (1) year, and an extended discovery period for a minimum of five (5) years, which shall begin at the end of the warranty period.

H. Completed Work Insurance.

SC-5.045 Bonds.

A. *General.*

1. Bonds, when required by the Contract or by Chapter 2253 of the Texas Government Code, shall be executed on forms furnished by or acceptable to OWNER. All bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

2. If the surety on any bond furnished by CONTRACTOR is declared bankrupt or becomes insolvent or its right to do business is terminated in the State of Texas or it ceases to meet the requirements of the preceding paragraph, CONTRACTOR shall within ten (10) days thereafter substitute another bond and surety, both of which must be acceptable to OWNER.

3. When Performance Bonds and/or Payment Bonds are required, each shall be issued in an amount of one hundred percent (100%) of the Contract Amount as security for the faithful performance and/or payment of all CONTRACTOR's obligations under the Contract Documents. Performance Bonds and Payment Bonds shall be issued by a solvent surety company authorized to do business in the State of Texas, and shall meet any other requirements established by law or by OWNER pursuant to applicable law. Any surety duly authorized to do business in Texas may write Performance and Payment Bonds on a project without reinsurance to the limit of 10 percent of its capital and surplus. Such a surety must reinsure any obligations over 10 percent.

B. *Performance Bond.*

1. If the Contract Amount exceeds $100,000, CONTRACTOR shall furnish OWNER with a Performance Bond in the form set out by OWNER. The Performance Bond shall be effective for the Contract Time and through all warranty period(s).

2. If the Contract Amount exceeds $50,000 but is less than or equal to $100,000, CONTRACTOR shall furnish OWNER with a Performance Bond in the form set out by OWNER, unless the original Contract Time is 60 Calendar Days or less, in which case CONTRACTOR can agree to the following terms and conditions for payment in lieu of providing a Performance Bond: no money will be paid to CONTRACTOR until completion and acceptance of the Work by OWNER; CONTRACTOR shall be entitled to receive 95% of the Contract Amount following Final

Completion, and the remaining 5% of the Contract Amount following the one year warranty period.

3. If the Contract Amount is less than or equal to $50,000, CONTRACTOR will not be required to furnish a Performance Bond.

4. If a Performance Bond is required to be furnished, it shall extend for the one year warranty period, or longer if the warranty periods are longer.

C. Payment Bond.

1. If the Contract Amount exceeds $50,000, CONTRACTOR shall furnish OWNER with a Payment Bond in the form set out by OWNER.

2. If the Contract Amount is less than or equal to $50,000, CONTRACTOR will not be required to furnish a Payment Bond; provided that no money will be paid to CONTRACTOR until completion and acceptance of the Work by OWNER.

D. Power of Attorney. Each bond shall be accompanied by a valid Power of-Attorney (issued by the surety company and attached, signed and sealed with the corporate embossed seal, to the bond) authorizing the attorney in fact who signs the bond to commit the company to the terms of the bond, and stating any limit in the amount for which the attorney can issue a single bond.

E. Bond Indemnification. The process of requiring and accepting bonds and making claims thereunder shall be conducted in compliance with Tex. Gov't Code, Chapter 2253. IF FOR ANY REASON A STATUTORY PAYMENT OR PERFORMANCE BOND IS NOT HONORED BY THE SURETY, THE CONTRACTOR SHALL FULLY INDEMNIFY AND HOLD THE OWNER HARMLESS OF AND FROM ANY COSTS, LOSSES, OBLIGATIONS OR LIABILITIES IT INCURS AS A RESULT.

F. Furnishing Bond Information. OWNER shall furnish certified copies of the payment bond and the related Contract to any qualified person seeking copies who complies with Tex. Gov't Code, §2253.026.

G. Claims on Payment Bonds. Claims on payment bonds must be sent directly to the CONTRACTOR and his surety in accordance with Tex. Gov't Code § 2253.041. All Payment Bond claimants are cautioned that no lien exists on the funds unpaid to the CONTRACTOR on such Contract, and that reliance on notices sent to the OWNER may result in loss of their rights against the CONTRACTOR and/or his surety. The OWNER is not responsible in any manner to a claimant for collection of unpaid bills, and accepts no such responsibility because of any representation by any agent or employee.

H. Payment Claims when Payment Bond is not required. The rights of Subcontractors regarding payment are governed by Tex. Prop. Code, §§53.231 – 53.239 when the value of the Contract between the OWNER and the CONTRACTOR is less than $25,000.00. These provisions set out the requirements for filing a valid lien on funds unpaid to the CONTRACTOR as of the time of filing the claim, actions necessary to release the lien and

satisfaction of such claim.

I. Minimum Standards for Sureties. Sureties shall be listed on the US Department of the Treasury's Listing Approved Sureties stating companies holding Certificates of Authority as acceptable sureties on Federal Bonds and acceptable reinsuring companies (Department Circular 570).

SC-6.02 LABOR; WORKING HOURS

Add the following subparagraph 6.02.A.1:

1. The Engineer shall stake the wastewater improvements (centerline alignment, manholes, and begin and end of trenchless reaches with offset grade stakes), one time, on behalf of the Owner and at no expense to the Contractor. Any re-staking shall be at the expense of the Contractor.

Add the following defined terms to Paragraph 6.02:

C. Regular Working Hours shall be between 7 am and until 30 minutes prior to sunset or 6 pm whichever is earlier, and, if previously authorized in writing by the City of Georgetown, between 9:00 am and 6:00 pm on Saturdays, Sundays, or Legal Holidays.

D. The Contractor shall work Regular Working Hours on normal Working Days as defined in Section 1.01.

Add the following provision on prevailing wages to Paragraph 6.02:

E. PREVAILING WAGE RATES: This Contract is subject to Government Code Chapter 2258 concerning payment of Prevailing Wage Rates. The OWNER will determine the general prevailing rates in accordance with Government Code Chapter 2258. The applicable provisions include, but are not limited to the following:

§ 2258.021. Right to be Paid Prevailing Wage Rates

(a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:

(1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and

(2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.

(b) Subsection (a) does not apply to maintenance work.

(c) A worker is employed on a public work for the purposes of this section if the worker is employed by a contractor or subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

§ 2258.023. Prevailing Wage Rates to be Paid by Contractor and Subcontractor; Penalty

(a) The contractor who is awarded a contract by a public body or a subcontractor of the contractor shall pay not less than the rates determined under Section 2258.022 to a worker employed by it in the execution of the contract.

(b) A contractor or subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, $60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.

(c) A contractor or subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section 2258.022.

(d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.

(e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

§ 2258.024. Records

(a) A contractor and subcontractor shall keep a record showing:

(1) the name and occupation of each worker employed by the contractor or subcontractor in the construction of the public work; and

(2) the actual per diem wages paid to each worker.

(b) The record shall be open at all reasonable hours to inspection by the officers and agents of the public body.

§ 2258.025. Payment Greater Than Prevailing Rate Not Prohibited

This chapter does not prohibit the payment to a worker employed on a public work an amount greater than the general prevailing rate of per diem wages.

SC-6.13.B Trench and Shoring Safety

Add the following Paragraph 6.13.B.1.

As required by the Texas Health & Safety Code, Title 9, Subtitle A, Chapter 756, Subchapter C, Contractor is required to comply with the trench safety standards of the Occupational Safety and Health Administration, 29 C.F.R. 1926, Subpart P, Excavations, in effect during the period of construction of the Project. Contractor agrees to comply with, and Owner agrees to include in the Proposal Documents, a copy of any special shoring requirements, if any, required for the Project. Owner agrees to furnish to Contractor a copy of any geotechnical information that was obtained by the Owner for use by the Contractor in the design of the trench safety system, if any.

SC-6.17 Shop Drawings and Samples

Add the following new paragraphs immediately after Paragraph 6.17.E:

F. Contractor shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than two submittals (original submittal and one resubmission). Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, samples or other items requiring approval and Contractor shall reimburse Owner for Engineer's charges for such time.

G. In the event that Contractor requests a substitution for a previously approved item, Contractor shall reimburse Owner for Engineer's charges for such time unless the need for such substitution is beyond the control of Contractor.

H. The need for more than one resubmission or any other delay in obtaining Engineer's review of submittals will not entitle the Contractor to an extension of Contract Time.

SC-14.02 Article 14 - Payments To Contractor And Completion

Change the 1st sentence in Paragraph 14.02.C.1 from "Ten days after presentation of the Application for Payment to OWNER…" to "Thirty (30) days after presentation of the Application for Payment to OWNER…"

SC-17.02 Delete the second sentence of Paragraph 17.02.

SC-17.07 Independent Contractor

Add the following Paragraph 17.07:

The Contract shall not be construed as creating an employer/employee relationship, a partnership, or a joint venture. The Contractor's services shall be those of an independent contractor. The Contractor agrees and understands that the Contract does not grant any rights or privileges established for employees of the Owner.

SC-17.08 Prohibition of Gratuities

Add the following Paragraph 17.08:

The Owner may, by Written Notice to the Contractor, terminate the Contract without liability if is determined by the Owner that gratuities were offered or given by the Contractor or any agent or representative of the Contractor to any officer or employee of the Owner with a view toward securing the Contract or securing favorable treatment with respect to the awarding or amending or the making of any determinations with respect to the performing of such Contract. In the event the Contract is terminated by the Owner pursuant to this provision, the Owner shall be entitled, in addition to any other rights and remedies, to recover or withhold the amount of the cost incurred by the Contractor in providing such gratuities.

SC-17.09 Prohibition Against Personal Interest in Contracts

Add the following Paragraph 17.09

No officer, employee, independent consultant, or elected official of the Owner who is involved in the development, evaluation, or decision-making process of the performance of any solicitation shall have a financial interest, direct or indirect, in the Contract resulting from that solicitation. Any violation of this provision, with the knowledge, expressed or implied, of the Contractor shall render the Contract voidable by the Owner.

SC-18. Article 18 – Right to Audit

Add the following Article 18.

18.01 Whenever the Owner enters into any type of contractual arrangement with the Contractor, then the Contractor's "records" shall upon reasonable notice be open to inspection and subject to audit and/or reproduction during normal business working hours. The Owner's representative, or an outside representative engaged by the Owner, may perform such audits. The Contractor shall maintain all records relating to this Contract for four (4) years from the date of final payment under this Contract, or until pending litigation has been completely and fully resolved, whichever occurs later.

18.02 The Owner shall have the exclusive right to examine the records of the Contractor. The term "records" as referred to herein shall include any and all information, materials and data of every kind and character, including without limitation records, books, papers, documents, contracts, schedules, commitments, arrangements, notes, daily diaries, reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may, in the Owner's judgment, have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any contract document. Such records shall include (hard copy, as well as electronic data), written policies and procedures, time sheets, payroll registers, cancelled checks, personnel file data, correspondence, e-mail, general ledger entries, and any other record in the Contractor's possession which may have a bearing on matters of interest to the Owner in connection with the Contractor's dealings with the Owner (all of the foregoing are hereinafter referred to as "records"). In addition, the Contractor shall permit interviews of employees as well as agents, representatives, vendors, Subcontractors and other third parties paid by the Contractor to the extent necessary to adequately permit evaluation and verification of the following:

A. The Contractor's compliance with Contract Documents;

B. The Contractor's compliance with the Owner's business ethics policies; and

C. If necessary, the extent of the Work performed by the Contractor at the time of Contract termination.

18.03 The Contractor shall require all payees (examples of payees include Subcontractors, insurance agents, material suppliers, etc.) to comply with the provisions of this Article 17 by securing the requirements hereof in a written agreement between the Contractor and payee. Such requirements include a flow-down right of audit provision in contracts with payees that also apply to Subcontractors and Sub- subcontractors, material suppliers, etc. The Contractor shall cooperate fully and shall require Payees and all of the Contractor's Subcontractors to cooperate fully in furnishing or in making available to the Owner from time to time whenever requested, in an expeditious manner, any and all such information, materials, and data.

18.04 The Owner's authorized representative or designee shall have reasonable access to the Contractor's facilities, shall be allowed to interview all current or former employees to discuss matters pertinent to the performance of this Contract, and shall be provided adequate and appropriate work space in order to conduct audits in compliance with this Article 17.

18.05 If an audit inspection or examination in accordance with this Article 17 discloses overpricing or overcharges of any nature by the Contractor to the Owner in excess of one-half of one percent (0.5%) of the total contract billings, then the reasonable actual cost of the Owner's audit shall be reimbursed to the Owner by the Contractor. Any adjustments and/or payments, which must be made as a result of any such audit or inspection of the Contractor's invoices and/or records, shall be made within a reasonable amount of time (not to exceed 90 days) from presentation of the Owner's findings to the Contractor.

18.06 The Contractor shall take reasonable actions to prevent any actions or conditions which could result in a conflict with the Owner's best interests. These obligations shall apply to the activities of the Contractor's employees, agents, Subcontractors, etc. in their dealings and relations with the Owner's current and former employees and their relatives. For example, the Contractor's employees, agents or Subcontractors should not make or provide to be made any employment, gifts, extravagant entertainment, payments, loans or other considerations to the Owner's representatives, employees or their relatives.

18.07 It is also understood and agreed by the Contractor that any solicitation of gifts or any other item of value by anyone representing the Owner is to be reported within two (2) business working days to the Owner at the following telephone number: 512-930-3723. Failure to report any such solicitations or offers shall be deemed a material breach of contract entitling the Owner to pursue damages resulting from the failure to comply with this provision.

END OF SECTION

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SECTION 00800 HH
CITY OF GEORGETOWN
ADOPTED PREVAILING WAGE RATES

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"General Decision Number: TX20230023 01/06/2023

Superseded General Decision Number: TX20220023

State: Texas

Construction Types: Heavy (Sewer/Water Treating Plant and Sewer/Incid. to Hwy.)

Counties: Bell, Bosque, Coryell, Falls, Freestone, Hamilton, Hill, Lampasas, Leon, Limestone, McLennan, Milam, Mills, Navarro, Robertson and Williamson Counties in Texas.

WATER & SEWAGE TREATMENT PLANTS AND LIFT PUMP STATIONS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least $16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least $12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number | Publication Date
0 | 01/06/2023

SUTX1990-003 02/09/1990

	Rates	Fringes
CARPENTER	$ 9.00 **	
CEMENT MASON/CONCRETE FINISHER	$ 8.00 **	
ELECTRICIAN	$ 13.45 **	.80+8 1/2%
Form Builder	$ 7.25 **	
Form Setter	$ 7.25 **	
LABORER	$ 7.25 **	
Pipelayer	$ 7.50 **	
Power equipment operators:		
Bulldozers	$ 7.25 **	
Cranes, Clamshells, Backhoes, Derricks, Dragline, Shovels	$ 7.25 **	
Front End Loaders	$ 10.00 **	
Scrapers	$ 7.25 **	
Steel Setter	$ 9.50 **	
Steel Worker	$ 7.25 **	
Truck drivers:		
Tandem Axles	$ 7.25 **	
Transit Mix	$ 7.25 **	
Utility Laborer	$ 7.25 **	

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 ($16.20) or 13658 ($12.15). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is

like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a

new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISIO"

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CITY OF GEORGETOWN ADOPTED PREVAILING WAGE RATES

Position	Recommended hourly rate
Acoustic Ceiling Installer	Davis Bacon
Air Tool Operator	Davis Bacon
Asphalt Distributor Operator	Davis Bacon
Asphalt Paving Machine Operator	Davis Bacon
Asphalt Raker	Davis Bacon
Asphalt Shoveler	Davis Bacon
Boilermaker	Davis Bacon
Bricklayer/Stone Mason, Entry Level	9.00
Bricklayer/Stone Mason, Journeyman	14.00
Broom or Sweeper Operator	Davis Bacon
Bulldozer Operator, Over 150 HP	Davis Bacon
Bulldozer Operator, Under 150 HP	Davis Bacon
Carpenter Finisher, Journeyman	15.97
Carpenter, Entry Level	10.00
Carpenter, Intermediate Level	11.88
Caulker	Davis Bacon
Cement Finisher, Entry Level	Davis Bacon
Cement finisher, Journeyman	Davis Bacon
Cement Mason, Intermediate Level	Davis Bacon
Concrete Finisher-Paving	Davis Bacon
Concrete Finisher-Structures	Davis Bacon
Concrete Paving Curbing Machine Operator	Davis Bacon
Concrete Paving Finishing Machine Operator	Davis Bacon

Concrete Rubber	Davis Bacon
Construction and Building Inspectors	Davis Bacon
Crane, Clamshell, Backhoe, Derrick, Dragline, Shovel Operator	Davis Bacon
Drywall System Installer, Entry Level	10.00
Drywall System Installer, Journeyman	13.00
Earth Drillers, Except Oil and Gas	DB
Electrician, Apprentice	13.00
Electrician, Entry Level	9.00
Electrician, Journeyman (Certificate)	19.00
Electrician, Master/Certified	22.67
Elevator/Escalator Installer	Davis Bacon
Elevator/Escalator Mechanic	Davis Bacon
Equipment Operator, Crane	19.00
Equipment Operator, Heavy	11.75
Equipment Operator, Light	10.00
Explosive Workers, Ordnance Handling Experts and Blasters	Davis Bacon
Fireproofing Installer	Davis Bacon
First-line Supervisors/Managers of Construction Trades and Extraction Workers	Davis Bacon
Flagger	Davis Bacon
Floor Layer, Helper	Davis Bacon
Floor Layer, Resilient Floor Installer	Davis Bacon
Form Builder/Setter, Structures	Davis Bacon
Form Setter, Paving and Curb	Davis Bacon
Foundation Drill Operator, Crawler Mounted	Davis Bacon
Foundation Drill Operator, Truck Mounted	Davis Bacon

Front End Loader Operator	Davis Bacon
Gardener	Davis Bacon
Glazier	Davis Bacon
Ground Man	Davis Bacon
Hazardous Materials Removal Workers	Davis Bacon
Highway Maintenance Workers	Davis Bacon
HVAC Mechanic, Journeyman	16.25
HVAC Sheet Metal Worker, Intermediate Level	11.75
HVAC, Entry Level	9.00
Insulation Workers, Floor, Ceiling, Walls	Davis Bacon
Insulation Workers, Mechanical	Davis Bacon
Iron Worker, Entry Level	10.00
Iron Worker, Reinforcing, Intermediate Level	14.50
Iron Worker, Structural Journeyman	14.50
Irrigation Technician	Davis Bacon
Laborer, Common	8.50
Laborer, Utility	9.67
Landscape Foreman	Davis Bacon
Lather	Davis Bacon
Lineman	Davis Bacon
Mechanic	Davis Bacon
Mechanic Lead, Journeyman	15.67
Millwright	Davis Bacon
Mixer Operator	Davis Bacon
Mixer Operator, Concrete Paving	Davis Bacon

Motor Grader Operator, Fine Grade	Davis Bacon
Motor Grader Operator, Rough	Davis Bacon
Oiler	Davis Bacon
Painter, Sprayer	10.63
Painter, Structures	10.63
Painter, Wallcover	10.63
Pavement Marking Machine Operator	Davis Bacon
Pipefitter	Davis Bacon
Pipelayer	Davis Bacon
Piping/Duct Insulator	Davis Bacon
Planer Operator	Davis Bacon
Plumber (excluding HVAC), Intermediate Level	12.00
Plumber Lead, Journeyman	20.00
Powder Man	Davis Bacon
Reinforcing Steel Setter, Entry Level	10.00
Reinforcing Steel Setter, Journeyman	11.67
Reinforcing Steel Setter, Paving	Davis Bacon
Roller Operator, Pneumatic, Self-Propelled	Davis Bacon
Roller Operator, Steel Wheel, Plant Mix Pavement	Davis Bacon
Roofer, Metal	11.00
Roofing Foreman	Davis Bacon
Sandblaster	Davis Bacon
Scraper Operator	Davis Bacon
Servicer	Davis Bacon
Sheet Metal Mechanic, Journeyman	17.50

Sign Installer (PGM)	Davis Bacon
Slip Form Machine Operator	Davis Bacon
Spreader Box Operator	Davis Bacon
Structural Steel Worker	Davis Bacon
Tapers	Davis Bacon
Terrazzo Workers and Finishers	Davis Bacon
Tile and Marble Worker, Journeyman	Davis Bacon
Tile Setter, Intermediate Level	Davis Bacon
Tractor Operator, Crawler Type	Davis Bacon
Traveling Mixer Operator	Davis Bacon
Trenching Machine Operator, Heavy	Davis Bacon
Truck Driver Tandem Axle Semi-Trailer	13.00
Truck Driver, Lowboy-Float	Davis Bacon
Truck Driver, Single Axle, heavy	Davis Bacon
Truck Driver, Single Axle, Light	13.44
Wagon Drill, Boring Machine, Post hole Driller Operator	Davis Bacon
Waterproofer	Davis Bacon
Welder Apprentice	10.00
Welder Journeyman	18.00
Work Zone Barricade Servicer	Davis Bacon

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Change Order

No. _____

Date of Issuance: _____ Effective Date: _____

Project: Dove Springs WWTP Rehabilitation Improvements	Owner: City of Georgetown	Owner's Contract No.: 24-0043-CIP
Project No.: PRJ000261		Date of Contract:
Contractor:		Engineer's Project No.: 264953

The Contract Documents are modified as follows upon execution of this Change Order:

Description:

Attachments (list documents supporting change):

CHANGE IN CONTRACT PRICE:	**CHANGE IN CONTRACT TIMES:**
Original Contract Price: $_____	Original Contract Times: ☐ Working days ☐ Calendar days Substantial completion (days or date): _____ Ready for final payment (days or date): _____
[Increase] [Decrease] from previously approved Change Orders No. _____ to No. _____: $_____	[Increase] [Decrease] from previously approved Change Orders No. _____ to No. _____: Substantial completion (days): _____ Ready for final payment (days): _____
Contract Price prior to this Change Order: $_____	Contract Times prior to this Change Order: Substantial completion (days or date): _____ Ready for final payment (days or date): _____
[Increase] [Decrease] of this Change Order: $_____	[Increase] [Decrease] of this Change Order: Substantial completion (days or date): _____ Ready for final payment (days or date): _____
Contract Price incorporating this Change Order: $_____	Contract Times with all approved Change Orders: Substantial completion (days or date): _____ Ready for final payment (days or date): _____

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____	By: _____	By: _____
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable):

Change Order

Instructions

A. GENERAL INFORMATION

This document was developed to provide a uniform format for handling contract changes that affect Contract Price or Contract Times. Changes that have been initiated by a Work Change Directive must be incorporated into a subsequent Change Order if they affect Price or Times.

Changes that affect Contract Price or Contract Times should be promptly covered by a Change Order. The practice of accumulating Change Orders to reduce the administrative burden may lead to unnecessary disputes.

If Milestones have been listed in the Agreement, any effect of a Change Order thereon should be addressed.

For supplemental instructions and minor changes not involving a change in the Contract Price or Contract Times, a Field Order should be used.

B. COMPLETING THE CHANGE ORDER FORM

Engineer normally initiates the form, including a description of the changes involved and attachments based upon documents and proposals submitted by Contractor, or requests from Owner, or both.

Once Engineer has completed and signed the form, all copies should be sent to Owner or Contractor for approval, depending on whether the Change Order is a true order to the Contractor or the formalization of a negotiated agreement for a previously performed change. After approval by one contracting party, all copies should be sent to the other party for approval. Engineer should make distribution of executed copies after approval by both parties.

If a change only applies to price or to times, cross out the part of the tabulation that does not apply.

TECHNICAL SPECIFICATIONS

SECTION CIP1 – DEFINITION OF TERMS

CIP1.01 DEFINITIONS

A. Wherever in these specifications or in other contract documents, the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

1. CITY - The City of Georgetown, party of the First Part.

2. COUNCIL - The Georgetown City Council.

3. COUNTY - A political Subdivision of the State.

4. ENGINEER - Representative of the City.
*ENGINEER - Representative of the Contractor or the Developer.

5. INSPECTOR - The authorized representative of the City assigned to inspect any or all parts of the work and the materials to be used therein.

6. CONTRACTOR - The individual, firm or corporation or any combination thereof, Party of the Second Part, with which the contract is made by the City, Developer or Public Cooperation.

7. SUPERINTENDENT - The representative of the Contractor authorized to receive and fulfill instructions from the Engineer or representative of the City, and who shall supervise and direct the construction.

8. PAVEMENT DESIGN MANUAL - Texas Department of Transportation manual outlining procedure to be followed in the design and control of asphaltic concrete and portland cement concrete mixes for structures and pavements.

9. MANUAL OF TESTING PROCEDURES - Texas Department of Transportation Materials and Tests Division manual outlining testing methods and procedures.

10. PLANS - The drawings approved by the City, or true reproductions thereof, which show the location, character, dimensions, and details of the work and which are a part of the contract. Plans and specifications to be prepared by a Professional Engineer registered in the State of Texas.

11. SPECIFICATIONS - The directions, provisions and requirements contained herein or in the Special Provisions, supplemented by such "Special Provisions or Standards" as may be issued or made pertaining to the method and manner or performing the work or qualities of materials to be furnished. Where the phrases "or directed by the City", "ordered by the City", or "to the satisfaction of the City" occur, it is to be understood that the directions, orders, or instructions of which they relate are within the limitations of, and authorized by the contract. "Special Provisions" will cover work pertaining to a particular project included in the proposal but not covered by the specifications. Where reference is made to specifications of ASTM, AWWA, AASHTO or Bulletins and Manuals of the Texas Department of Transportation it shall be construed to mean the latest standard or tentative standard in effect on the date of the proposal.

12. RIGHT OF WAY - The land provided for a highway or street, owned by the City of Georgetown or the municipality in which the highway or street is in.

13. ROADWAY - The portion of the highway or street within the limits of construction.

14. ROADBED - The graded portion of the roadway between the intersection of top and side slopes upon which the base course, surface course, shoulders and median are constructed.

15. SUBGRADE - That portion of the roadbed upon which the subbase, base, or pavement structure is to be placed.

16. BRIDGES - Structures of over 20-foot span measured from face to face of abutments, or in case of copings, from face to face of copings, and multiple span structures of over 20-foot length, measured between inside of end walls along the centerline of the roadbed.

17. CULVERTS - All drainage structures not defined as bridges.

18. TEMPORARY STRUCTURES - All temporary bridges and structures required to maintain traffic during the construction of the work.

19. SUBSTRUCTURE - That part of the structure below the bridge seats or below the springing lines of arches. Parapets, back walls and wing walls of abutments shall be considered as parts of the substructure.

20. SUPERSTRUCTURE - The part of the structure above the bridge seats or above the springing lines of arches.

21. THE WORK - The work shall include the furnishing of all labor, materials, equipment, and other incidentals necessary or convenient to the successful completion of the project and the carrying out of all the duties and obligations imposed by the contract.

22. PROJECT - The specific section or sections of the highway or street together with all appurtenances and construction to be performed thereon under the contract.

23. ASTM - American Society for Testing Materials.

24. AASHTO - American Association of State Highway and Transportation Officials.

25. ANSI - American National Standards Institute.

26. API - American Petroleum Institute.

27. UL - Underwriters Laboratory, Inc.

28. SCREENS AND SIEVES - As defined by the ASTM.

29. HIGHWAY, STREET OR ROAD - A general term denoting a public way for purposes of vehicular travel, including the entire area within the right of way. Recommended usage in urban areas-highway or road.

30. ARTERIAL HIGHWAY OR STREET - A general term denoting a highway or street primarily for through traffic, usually on a continuous route.

31. MAJOR STREET OR MAJOR HIGHWAY - An arterial highway or street with intersections at grade and direct access to abutting property, and on which geometric design and traffic control measures are used to expedite the safe movement of through traffic.

32. THROUGH STREET OR THROUGH HIGHWAY - Every highway, street, or portion thereof at the entrance to which vehicular traffic from intersecting highways or streets is required by law to stop before entering or crossing the same and when stop signs are erected.

33. LOCAL STREET OR LOCAL ROAD - A street or road primarily for access to residence, business, or other abutting property.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP2 - ABBREVIATIONS

CIP2.01 SCOPE

A. Whenever in these Contract Documents or Specifications the following abbreviations are used, the intent and meaning shall be interpreted as follows:

1.	AA	Aluminum Association
2.	AAMA	Architectural Aluminum Manufacturers' Association
3.	AASHTO	American Association of State Highway and Transportation Officials
4.	ACI	American Concrete Institute
5.	AFBMA	Anti-Friction Bearing Manufacturers' Association
6.	AGA	American Gas Association
7.	AGMA	American Gear Manufacturers' Association
8.	AISC	American Institute of Steel Construction
9.	AISI	American Iron and Steel Institute
10.	AITC	American Institute of Timber Construction
11.	AMCA	Air Moving and Conditioning Association
12.	ANSI	American National Standards Institute
13.	APA	American Plywood Association
14.	API	American Petroleum Institute
15.	AREA	American Railway Engineering Association
16.	ASAE	American Society of Agricultural Engineers
17.	ASCE	American Society of Civil Engineers
18.	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
19.	ASME	American Society of Mechanical Engineers
20.	ASTM	American Society of Testing and Materials
21.	AWI	Architectural Woodwork Institute
22.	AWPA	American Wood Preservers' Association
23.	AWPB	American Wood Preservers' Bureau
24.	AWS	American Welding Society
25.	AWWA	American Water Works Association
26.	BHMA	Builders' Hardware Manufacturers' Association
27.	CBMA	Certified Ballast Manufacturers' Association
28.	CDA	Copper Development Association
29.	CISPI	Cast Iron Soil Pipe Institute
30.	CMAA	Crane Manufacturers' Association of America

31.	CRSI	Concrete Reinforcing Steel Institute
32.	Fed. Spec.	Federal Specifications
33.	HI	Hydraulic Institute
34.	HMI	Hoist Manufacturers' Institute
35.	ICBO	International Conference of Building Officials
36.	IEEE	Institute of Electrical and Electronics Engineers, Inc.
37.	IPCEA	Insulated Power Cable Engineer's Association
38.	MMA	Monorail Manufacturers' Association
39.	NACE	National Association of Coatings Engineers
40.	NBMA	National Builders' Hardware Association
41.	NEC	National Electrical Code
42.	NEMA	National Electrical Manufacturers' Association
43.	NESC	National Electric Safety Code
44.	NFPA	National Fire Protection Association
45.	NLMA	National Lumber Manufacturers' Association
46.	NWMA	National Woodwork Manufacturers' Association
47.	OECI	Overhead Electrical Crane Institute
48.	OSHA	Occupational Safety and Health Act (both Federal & State)
49.	PS	Product Standards Sections - U.S. Department of Commerce
50.	RMA	Rubber Manufacturers' Association
51.	SAE	Society of Automotive Engineers
52.	SSPC	Steel Structures Painting Council
53.	TCA	Tile Council of America
54.	TxDOT	Texas Department of Transportation
55.	TEMA	Tubular Exchanger Manufacturers' Association
56.	UBC	Uniform Building Code
57.	UL	Underwriter's Laboratories, Inc.
58.	WWPA	Western Wood Products Association

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP3 – SUMMARY OF WORK

CIP3.01 SCOPE OF WORK

A. This specification covers the requirements for constructing the *Dove Springs WWTP Rehabilitation* project as shown on the Drawings and specified herein.

B. The Work is located within the City of Georgetown as described in Section 00300 (Proposal Form) and as shown on the Location Plan included in the Drawings at Rock Dove Lane, Georgetown, TX 78626 (Dove Springs WWTP).

C. Substantial Completion and Final Completion shall be as defined in the General Conditions.

D. The Work for the Dove Springs WWTP Rehabilitation (as shown on the Drawings) includes, but is not necessarily limited to, the following:

1. Mobilization – Including move-in costs, insurance, bonds, etc.
2. Complete shop drawing submittal process.
3. Temporary sedimentation and erosion control.
4. Installation of a compacted gravel foundation, compacted gravel foundation off-set pad, temporary piping, and electrical distribution equipment, and new generator for a Temporary Wastewater Treatment Package Plant, which is being procured on a lease basis by the City under a separate solicitation. General Contractor to supply and install temporary piping to and from the temporary package plant, (2) sludge transfer submersible pumps, and all the electrical connections made ready for use by package plant manufacturer as shown on the Drawings.
5. Installation of on-grade and buried 12-inch Package Plant Influent (INF) piping, 14-inch on-grade Package Plant Effluent (EFF) piping, and on-grade and buried 4-inch Package Plant Sludge transfer (SLUDGE) piping.
    - Scope of work includes open trench construction.
    - Scope of work includes Delegated Design of pipe supports for all piping to, from, and inside Temporary Wastewater Treatment Package Plant, as required under Section 400507.
5. Installation of buried electrical ductbank, conduit, and wiring from new Electrical House and Generator to existing and new equipment as shown on the Drawings.
6. Scope of work for all new blower low pressure air (LPA) piping will be above grade with supports from grade as shown on the Drawings.
7. Testing of new piping systems.
8. Demolition of pumps, blowers, diffusers, and electrical equipment as shown on the Drawings.
9. Modification of existing concrete structures as shown on the Drawings.
10. Installation of new process equipment including pumps, blowers, diffusers, slide gate, and temporary package plant ancillary equipment as shown on the Drawings.
11. Installation of new process instrumentation and control system and modifications to the existing SCADA system.

12. Refurbishment and relocation of existing multistage blowers to temporary package plant blower pad per Specification 431117.
13. Replacement of programmable logic controller (PLC) and operator interface terminal (OIT) touchscreen for the ultraviolet (UV) disinfection system control panel.
14. Electrical and Instrumentation Equipment and Systems Modifications – Consists of power and instrumentation improvements for equipment being furnished.
15. Site Work – Includes site preparation, grading, seeding, new asphalt and concrete paving, and related work.
16. Re-vegetation, in accordance with the Edwards Aquifer vegetated filter strip requirements, and Site Restoration.
17. Demobilization and Clean-up.

CIP3.02 WORK SEQUENCE

A. Perform work in sequence as agreed upon at the Pre-Construction Conference and as noted below and herein.

B. Regulatory discharge requirements for the plant effluent mandate adequate treatment of discharged wastewater from the plant. The intent of this section is to provide a framework for the Contractor to perform the work in a sequence and manner such that continuous, uninterrupted treatment of wastewater and waste flows are maintained operational throughout the construction period.

C. Contractor shall coordinate all work sequencing and shutdowns with the Owner's representative and Engineer. Contractor shall provide a 72-hour notice to the Owner prior to any tie-ins and connections to existing system.

D. **The Temporary Package Plant must be fully operational including seeding of biomass and available for full treatment of up to 1 mgd of raw sewage before either of the Treatment Structures may be allowed to be removed from service to complete the work**. After Package Plant is operational, no more than one Treatment Structure (aeration basins and clarifiers) may be shut down at a given time to perform the Work.

1. In general, the maximum shutdown period will be for 4 hours. All outages will require approval from the Owner and coordination with operation staff.
2. Shutdowns of air service to the entire WWTP will be allowed on a temporary basis not to exceed 2 hours for various tie-ins and other construction requirements.
3. Any equipment necessary to complete the work shall be provided by the Contractor.

E. The following construction sequencing issues, critical tie-ins, and other considerations shall be taken into account by the Contractor in the development of the construction schedule. These items are presented to assist the Contractor and are not all-inclusive.

1. No site improvements, including yard piping installation, conduit installation, etc., shall commence until after the submittals for the proposed improvements have been approved.
2. Installation of Erosion/Sedimentation Controls shall be performed prior to any construction.
3. Any Electrical and instrumentation tie-ins and switchovers must be coordinated. Coordinate with Electric Utility for setting of new service and transformer.
4. Any piping tie-ins and switchovers must be coordinated.
5. Complete and receive approval for all applicable submittals.

6. Engage on-site field service technician to complete PLC and OIT replacement and programming for the UV control system per Section 466657.

7. Begin work to provide the following facility modifications which impact the Owner's use of the Dove Springs WWTP Treatment Structures:

    a. Coordinate with temporary package plant manufacturer (selected under separate City Contract) on schedule for delivery and installation of temporary wastewater treatment package plant tanks, equipment, pumps, interconnecting piping, and electrical gear to make the package plant operational and meeting performance requirements before taking a Treatment Structure out of service.

    b. Install compacted gravel pad and concrete blower pad for temporary package plant.

    c. Begin work to modify the headworks facility with new slide gate and wall penetration for 12-inch package plant influent piping.

        i. Coordinate with Owner and Engineer to maintain screened influent flow to Treatment Units 1 and 2.

        ii. Provide temporary bulkhead to allow for slide gate installation while headworks remains in service.

    d. After package plant is operational and successfully treating and conveying wastewater, work with Owner to drain Treatment Structure No. 2. Due to limitations of existing drain system, tank must be drained slowly over a period of **fourteen (14) days**.

        i. Haul off-site for disposal any debris, grit, and rags from the bottom of the tank in accordance with Section 460200. One of the Aeration Basins has not been drained for many years and several feet of debris, grit, and sludge accumulation might be found.

        ii. Install new fine bubble diffusers and piping manifolds in Aeration Basin No. 2.

    e. Install Treatment Unit No. 2 Multistage Blowers, concrete pads, pre-engineered canopy, sound-attenuating wall, and Low Pressure Air piping to existing pipe, as detailed on the Drawings for Aeration Basin No. 2. If the pipe tie-ins are not timed to coincide with outage of the Treatment Structure, then outage of existing blowers to allow for tie-in of new blower piping into existing piping must be limited to no longer than 2 hours.

    f. Bring Treatment Unit No. 2 back into service using air supply from the new multistage blowers. Assume a minimum of **twenty-one (21) days** in schedule to allow for seeding Treatment Unit No. 2 with WAS from Treatment Unit No. 1 and that Owner has been able to build up sufficient biomass inventory. Work may not proceed on Treatment Unit No. 1 until Owner and Engineer have confirmed in writing that Treatment Unit No. 2 is accepted and capable of operating at design capacity.

    g. Work with Owner to drain Treatment Structure No. 1. Due to limitations of existing filtrate lift station, tank must be drained slowly over a period **fourteen (14) days.**

        i. Haul off-site for disposal any debris, grit, and rags from the bottom of the tank in accordance with Section "460200". The Aeration Basins have not been drained for many years and several feet of debris, grit, and sludge accumulation might be found.

        ii. Install new fine bubble diffusers and piping manifolds in Aeration Basin No. 1

h. Concurrent with draining and modifications to Treatment Unit No. 1, Contractor to coordinate with owner on removing, packaging, and shipment of exiting blowers to Factory for performance testing and refurbishment with new motors.

i. Install Treatment Unit No. 1 Multistage Blowers, concrete pads, canopy, and Low Pressure Air piping to existing pipe connection, as detailed on the Drawings for Aeration Basin No. 1.

j. Bring Treatment Unit No. 1 back into service using air supply delivered from the new multistage blowers.

8. Begin work to provide the following facility modifications which impact the Owner's use of the On-Site Filtrate Lift Station:

   a. Outage of on-site pumping to complete lift station improvements may not exceed **3 days**. Outages longer than this duration will require temporary bypass pump and piping of BFP filtrate from a drain manhole upstream of the filtrate pump station either to the Package Plant or to the headworks depending on the timing of the filtrate lift station pump replacement work in Contractor's schedule relative to diffuser replacements. Refer to Section 331210 "Temporary Bypass Pumping Systems" for flow capacity requirements.

   b. Remove filtrate lift station pumps and install new pumps, piping, concrete, and hatching as shown on the Drawings.

   c. Bring new filtrate lift station pumps back into service and once accepted by Owner, remove temporary bypass pumping and piping.

9. Install new standby generators, electrical distribution, and associated SCADA programming for 750kW WWTP Generator and for 350-kW Package Plant Generator.
10. Complete and receive approval for all applicable O&M Manuals.
11. Complete startup of equipment and training of Owner's staff.
12. Complete finish grading.
13. Achieve Substantial Completion.
14. Complete seeding to establish grass at all sites.
15. Remove silt fence and other environmental controls at all sites.
16. Submit specified as-built topographic drawing for the site following completion of all site work.
17. Clean all sites.
18. Achieve Final Completion.

CIP3.03 PROGRESS OF THE WORK

A. The Work shall be started within 7 days following the effective date of the Notice to Proceed, and the Work shall be executed with such progress as may be required to prevent any delay to the general completion of the project. The Work shall be executed at such times and in or on such parts of the project, and with such personnel, materials, and equipment to assure completion of the Work in the time established by the Agreement.

B. If the Contractor, for his convenience and at his own expense, should desire to carry on his work at night or outside regular hours, he shall submit a written approval request to the City and he shall allow ample time for satisfactory arrangements to be made for inspecting the work in progress. The Contractor shall pay the expenses for extra inspection required for work

outside regular hours. Normal working hours for this purpose are Monday through Friday 7:00 a.m. to 5:00 p.m. Saturdays are only allowed with prior City approval. The Contractor shall light the different parts of the Project as required to comply with all applicable Federal and State regulations and with all applicable requirements of the City of Georgetown.

CIP3.04 CONSTRUCTION SCHEDULE

A. The Contractor shall, within five (5) days after the effective date of the Notice to Proceed, provide and submit to the City for approval, the Schedule for the project. A complete updated schedule shall be submitted with monthly pay requests. The Schedule shall account for all the work of the Contractor and his Subcontractors and suppliers. In addition to all reasonably important construction activities, the Schedule shall provide for the proper sequence of construction considering the various crafts, purchasing time, submittal approval, material delivery, equipment fabrication, and similar time-consuming factors.

B. The Schedule shall include, as a minimum, the earliest starting and finish dates, and latest starting and finish dates, and the total float for each task or item. The Contractor shall update (monitor) the schedule as necessary and shall submit to the City a copy of the updated schedule (monthly) at the same time the pay estimate is prepared. The schedule shall contain all of the items of the Periodic Estimate and Pay Schedule.

While the Contractor bears full responsibility for scheduling all phases and stages of the Work to ensure its successful prosecution and completion within the time specified in accordance with all provisions of these Specifications, the Contractor is specifically required to complete fully or complete such stages of work to enable his Subcontractors and suppliers to complete their work within the respective times specified.

C. If the City determines that operations are falling behind schedule at any time during the construction period, the City may require the Contractor to add to his plant, equipment and/or construction forces, including increases in working hours, in such quantities as are required to bring operations back on schedule. Upon receipt of written communication from the City requiring such addition, the Contractor shall furnish same at no additional cost to the City.

CIP3.05 PRECONSTRUCTION CONFERENCE

A. A Pre-Construction Conference shall be held as soon as possible after Award of Contract and before work is started. The conference will be held at a location selected by the City. The conference will be attended by:

1. Contractor's Office Representative.
2. Contractor's General Superintendent.
3. Any subcontractors' or suppliers' representatives whom the Contractor may desire to invite or the City may request.
4. Engineer's Representatives.
5. City’s Representatives.
6. Such other individuals that the City may invite.

B. A suggested format would include but not be limited to the following subjects:

1. Check of required bonds and insurance certifications.
2. Liquidated damages.
3. Shop drawing submittal and approval procedure.

4. Chain of command, direction of correspondence, and coordinating responsibility between Contractors.
5. Schedule of periodic job meetings for all involved.
6. Introduction of the key project personnel.
7. Equal opportunity requirements.
8. Laboratory testing of material requirements.
9. Inventory of material stored on site provisions.
10. Progress estimate and payment procedure.
11. Discussion of Contractor's Safety program.
12. Scheduled plan for work requiring interruption of existing operations.
13. Review of the construction Plans and Specifications.
14. Discussion of Contractor's storage facilities for the Project.

C. The City's Representative will preside at the conference, prepare the minutes of the meeting and distribute copies of same to all participants who so request by fully completing the attendance form to be circulated at the beginning of the conference.

CIP3.06 CONSTRUCTION MEETINGS

A. Periodic Construction meetings shall be held at intervals designated by the City, generally monthly to review the progress at the project, submittals, upcoming activities, pay requests, etc. The Contractor is expected to have at least the project Superintendent present for all meetings. Attendance at the meetings shall not be directly paid for but shall be considered subsidiary to the items of the Contract.

B. In the event the Contractor is 30 minutes late or more or fails to attend a Construction meeting without 48 hours prior notice, the Contractor shall be billed the time for the Engineer(s) to represent the City at $250.00 per hour up to one (1) hour.

CIP3.07 COORDINATION WITH CITY'S OPERATIONS AND EXISTING FACILITIES

A. Several parts of the proposed Work under this Contract connect with or into existing facilities. The Contractor shall plan carefully the schedule of that portion of the Work which will affect the existing facilities. Such plans and schedules shall be subject to the approval of the City of Georgetown.

B. Work which requires shutdown or in any way impedes the operations of existing facilities shall be closely coordinated with the City of Georgetown. A minimum of 72 hours written notice shall be given to the City of Georgetown for all shutdowns and work that will impede treatment operations.

C. Immediately after the award of a Contract for this Project, the Contractor shall outline and submit a scheduled plan for installation of the work, which requires interruption of operations.

CIP3.08 CONTRACTOR'S USE OF PREMISES

A. Contractor shall assume full responsibility for security of all materials and equipment stored on the site.

B. If directed by the City, move any stored items, which interfere with operations of the City, other contractors, or the public.

C. Obtain and pay for use of additional storage or work areas at no additional cost to the City if needed to perform the Work.

D. Contractor shall submit to the City for approval a plan of operations, designating proposed areas of the property to be used for his operations, material storage, equipment storage, employee's parking, offices and shops. The area shall effect minimal interference with the present operations.

E. Any damage to existing facilities, including contamination, which may be caused by Contractor's personnel, callers, visitors, materials or equipment, shall be repaired or corrected at the sole expense of the Contractor.

F. Any fence that is damaged or removed by the Contractor will be replaced at the Contractor's expense in like kind, and to the satisfaction of the City.

G. Contractor shall pick up any trash left by construction forces regularly to maintain a clean and orderly site.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP4 – SITE CONDITIONS

CIP4.01 SCOPE OF WORK

A. This specification covers the requirements for investigation and verification of site conditions for the Project.

CIP4.02 SUBSURFACE INFORMATION

A. Subsurface investigations have been made to indicate subsurface conditions at particular locations. A geotechnical test boring program and a geophysical investigation have been completed at the Dove Springs WWTP site. The boring logs and geophysical logs from those investigations are attached. The Contractor shall be familiar with the subsurface materials and conditions on the project and shall be knowledgeable of how they will affect the work.

B. Test borings have been made to indicate subsurface materials and conditions only at the particular locations of the borings at the time the borings were made. The same also applies to the geophysical investigation.

CIP4.03 SITE INVESTIGATION AND REPRESENTATION

A. The Bidder / Contractor acknowledges that he has satisfied himself as to the nature and location of the work; the general and local conditions, particularly those bearing upon availability of transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, river/stream stages, or similar physical conditions at the site; the conformation and conditions of the ground; the character of equipment and facilities needed preliminary to and during the prosecution of the work and all other matters which can in any way affect the work or the cost thereof under this Contract.

B. The Contractor further acknowledges that he has satisfied himself as to the character, quality, and quantity of surface and subsurface materials to be encountered from inspecting the site and from evaluating information derived from exploratory work, if any, that has been done by the City as presented in the attached geotechnical information, as well as from information presented herein as a part of these Contract Documents. Any failure by the Contractor to acquaint himself with all the available information will not relieve him from responsibility for properly estimating the difficulty or cost of successfully performing the work. Neither the City nor the Engineer assume responsibility for any conclusion or interpretation made by the Contractor on the basis of the information made available by the City or the Engineer.

C. Existing ground profiles shown on the Plans were plotted from field surveys and record documents.

CIP4.04 RESPONSIBILITY FOR UTILITY PROPERTIES AND SERVICE

A. Known utilities and structures adjacent to or encountered in the work are shown on the Plans. The locations shown are taken from existing records and the best information available from existing plans; however, it is expected that there may be some discrepancies and omissions in the locations and quantities of utilities and structures shown. Those shown are for the convenience of the Contractor only, and no responsibility is assumed by either the City or the Engineer for their accuracy or completeness.

B. Neither the City nor its officers or agents shall be responsible to the Contractor for damages as a result of the Contractor's failure to protect utilities encountered in the work.

C. The Contractor shall at all times provide unobstructed access to fire hydrants and structures as per Fire Code, underground conduit, manholes, and water or gas valve boxes.

D. Where the Contractor's operations could cause damage which might result in considerable expense, loss, or inconvenience when his operations are adjacent to or near railway, telegraph, telephone, television, power, oil, gas, water, sewer, irrigation, or other systems, no operations shall be commenced until the Contractor has made all arrangements necessary for the protection of these utilities and services.

E. The Contractor shall notify all utility offices that are affected by the construction operation at least 15 days in advance of commencing construction operations. The Contractor shall not expose any utility without first obtaining permission from the affected agency. Once permission has been granted, locate and, if necessary, expose and provide temporary support for all existing underground utilities in advance of operations.

F. The Contractor shall be solely and directly responsible to the City and operators of such utility properties for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of any injuries or damage that may result from the construction operations under this Contract.

G. In the event of interruption to domestic water, sewer, storm drain, or other utility services as a result of accidental breakage due to construction operations, the Contractor shall promptly notify the proper authority and cooperate with said authority in restoration of service as promptly as possible and bear all costs of repair.

H. The Contractor shall replace, at his own expense, any and all other existing utilities or structures removed or damaged during construction, unless otherwise provided for in these Contract Documents.

I. Where existing utility lines or structures are so located as to physically conflict with permanent structures to be constructed under this Contract, the conflicting utility line or structure shall be permanently relocated.

J. The Contractor shall give immediate notice to the Engineer, the City and the owner of the utility (where applicable) when a physical conflict is determined to exist.

    1. Contractor will not be charged contract time for delays caused by unanticipated conflicts.

    2. Contractor shall not charge the City of Georgetown for lost time or down time for unanticipated conflicts.

K. Where existing utility lines or structures are so located as to interfere with the Contractor's prosecution of the work, but do not physically conflict with completed manholes or other permanent structures to be constructed under this Contract, any modification, alteration, or relocation of interfering utility, either permanent or temporary, shall be accomplished at the expense of the Contractor.

CIP4.05 INTERFERING STRUCTURES

A. Take necessary precautions to prevent damage to existing structures whether on the surface, aboveground, or underground. An attempt has been made to show major structures on the Plans. While the information has been compiled from the best available sources, its completeness and accuracy cannot be guaranteed, and it is presented as a guide to avoid known possible difficulties.

B. Protect existing structures from damage, whether or not they lie within the right-of-way or the limits of the easements obtained by the City. Where existing structures must be removed to properly carry out the work, or are damaged during the work, they shall be restored at the Contractor's own expense to at least their original condition and to the satisfaction of the Engineer.

C. The Contractor may, with the approval of the Engineer and without additional compensation, remove and replace in a condition as good as or better than original, any small interfering structures such as fences and signposts that interfere with the Contractor's operations.

CIP4.06 FIELD RELOCATION

A. During the progress of the work, minor relocations of the work may be necessary. Such relocations shall be made only by direction of the Engineer or the City. If existing structures are encountered that will prevent construction as shown, notify the Engineer before continuing with the work in order that the Engineer may make such field revisions as necessary to avoid conflict with the existing structures. If the Contractor fails to notify the Engineer when an existing structure is encountered and proceeds with the work despite this interference, he shall be responsible for any damage that may occur.

CIP4.07 LAND MONUMENTS

A. The Contractor shall preserve or replace any existing Federal, State, County, City, and private land monuments encountered.

B. Any damaged or destroyed monuments shall be replaced at the sole expense of the Contractor as designated by the controlling authority of the Entity.

CIP4.08 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

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Geotechnical Engineering Report

City of Georgetown – Dove Springs WWTP Dewatering Improvements
Georgetown, Texas
November 17, 2023
Terracon Project No. 96215180A

Prepared for:
CDM Smith, Inc.
Houston, Texas

Prepared by:
Terracon Consultants, Inc.
Austin, Texas

Explore with us

November 17, 2023

CDM Smith, Inc.
11490 Westheimer Road, Suite 700
Houston, Texas 77077

Attn: Mr. Gerald Furrier, P.E. – Associate Engineer
P: 713-423-7337
E: FurrierG@cdmsmith.com

Re: Geotechnical Engineering Report
City of Georgetown – Dove Springs WWTP Dewatering Improvements
Turtle Dove Lane
Georgetown, Texas
Terracon Project No. 96215180A

Dear Mr. Furrier:

We have completed a subsurface exploration and Geotechnical Engineering evaluation for the above referenced project. This study was performed in general accordance with the supplemental Task Order dated May 13, 2022 based upon Terracon Proposal No. P96215180 dated July 17, 2021. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, subgrade preparation, and the design and construction of foundations, and site improvements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.
(TBPELS Firm Registration: TX-F3272)

11/17/2023

Larson M. Snyder, P.E.
Senior Project Manager

Bryan S. Moulin, P.E.
Senior Principal, Geotechnical Services

REPORT TOPICS

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Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

Note: Refer to each individual Attachment for a listing of contents

Geotechnical Engineering Report

City of Georgetown – Dove Springs WWTP Dewatering Improvements

Turtle Dove Lane

Georgetown, Texas

Terracon Project No. 96215180A

November 17, 2023

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed City of Georgetown – Dove Springs WWTP Dewatering Improvements project to be located at the existing Dove Springs WWTP at the dead end of Turtle Dove Lane in Georgetown, Texas. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Site preparation and earthwork
- Demolition considerations
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification
- Excavation retention system

The geotechnical engineering Scope of Services for this project included the advancement of one (1) test boring, designated B-1, to a depth of approximately 26½ feet below existing site grades. In addition, we reviewed borings conducted within the Dove Springs WWTP for Terracon Report No. 96055010 dated March 8, 2005.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at the dead end of Turtle Dove Lane in Georgetown, Texas. See **Site Location**
Existing Improvements	Existing wastewater treatment structures, with associated pavement sections and infrastructure improvements.

Item	Description
Current Ground Cover	Grass, asphalt, and crushed limestone base.
Existing Topography	Per a topographic plan provided, the site slopes from the highest elevation of EL ~742 feet along the northern perimeter to the lowest elevation of EL ~734 feet along the eastern perimeter.
Geology	Based on the available geologic information and the samples obtained, the subsurface profile consists of surficial fat clays and clayey gravels overlying limestone overlying shale.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	The project information and site plan were provided via e-mail on April 12th, 2022 from Mr. Gerald Furrier, P.E. with CDM Smith, Inc. Structural drawings were provided via e-mail on August 4th, 2022 from Ms. Alexandra Doody, P.E. with CDM Smith, Inc. Updated site plans and grading plans were provided via e-mail on August 24th, 2022 from Ms. Josey Mayer, E.I.T. with CDM Smith, Inc.
Proposed Structures and Improvements	The project includes the construction of the following: ■ Two, Blower Pads with canopy structures ■ One Blower Pad without canopy structure ■ Electrical House ■ Transformer pads ■ Generator pad ■ Miscellaneous electrical pads ■ New asphalt pavement sections ■ Gravel pads for temporary package plant
Building Construction	Blower Pad: Metal-framed canopy Electrical House: Metal-framed (assumed)

Item	Description
Finished Floor Elevation	Western Blower Pad FFE: 737.50 feet Eastern Blower Pad FFE: 737.50 feet Northern Blower Pad FFE: 737.50 feet Electrical House FFE: 739.00 feet Transformer Pads FFE: 738.50 feet (assumed) Generator Pad FFE: 737.50 feet
Maximum Loads	■ Columns: 200 kips maximum ■ Walls: 2 to 8 kips per linear foot (klf) maximum ■ Slabs: 100 to 150 pounds per square foot (psf) maximum
Grading/Slopes	Cuts and fills up to 3 feet are anticipated to develop the final grades.
Below-Grade Structures	Drainage Box up to 6 feet below existing grades.
Free-Standing Retaining Walls	None anticipated.
Pavements	Flexible (asphalt) pavement sections are being considered.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section.

Model Layer	Layer Name	General Description
1	**Upper Fat Clays**	Dark brown, stiff to hard, with gravel
2	**Lower Gravels**	Brown to light brown, medium dense, clayey, with sand
3	**Limestone Bedrock**	Light tan to pale brown, highly fractured, with clayey seams
4	**Clayey Shale**	Tan to gray, highly fractured

Groundwater

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was not observed in the borings while drilling, nor for the short duration the borings could remain open. However, this does not necessarily mean no groundwater may be present at the site as groundwater conditions can (and likely will) vary between the time of the geotechnical investigation and the timeframe of construction activities.

Groundwater seepage is possible at this site, particularly in the form of seepage traveling along pervious seams/fissures in the soil, along the soil/limestone interface, in fissures/fractures in the limestone, and/or along the limestone/shale interface. Due to the low permeability of the soils encountered in the borings, a relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers sealed from the influence of surface water are often required to define groundwater levels in materials of this type. Please contact us if this is desired. Groundwater conditions should be evaluated immediately prior to construction.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

The near surface, high plasticity fat clay could become problematic with typical earthwork and construction traffic, especially after precipitation events. Effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. Additional site preparation recommendations including subgrade improvement and fill placement are provided in the **Earthwork** section.

The subgrade soils for the floor slabs consist of high plasticity fat clay, therefore subgrade preparation is necessary in order to reduce post-construction movements to about 1-inch for the new structures.

The **Shallow Foundations** section addresses the support of the new structures and structure improvements on a monolithic slab-on-grade foundation or a spread/strip footing foundation bearing into select fill. The **Floor Slabs and Building Subgrade Preparation** section addresses slab support of the structures.

A temporary retention system may be necessary in order to construct the below-grade pre-cast concrete drainage box for this project. The **Below-Grade Structures** section addresses options for drainage of the temporary retention system and the earth pressures for design of the temporary and permanent systems.

Asphaltic concrete pavement systems are desired by the City of Georgetown for this site. The **Pavements** section addresses the design of pavement systems.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include demolition, clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

After demolition of the existing structure, construction areas should be stripped of all vegetation, concrete, asphalt, loose soils, fill soils, top soils, construction debris, and other unsuitable material currently present at the site. All remnants of existing foundations should be completely excavated and removed to at least 2 feet below finished grades. If any unusual items are unearthed during or after demolition, please contact us for further evaluation. Utilities to be abandoned should be completely removed from all proposed construction areas. If this is not feasible, then the abandoned utility piping should be filled with flowable fill (TxDOT Item No. 401) and plugged such that it does not become a conduit for water flow. We recommend that Terracon be retained to assist in evaluating exposed subgrades during earthwork so that unsuitable materials, if any, are removed at the time of construction.

Proof-Rolling

Once initial subgrade elevations have been achieved (i.e., after cuts but prior to fills), the exposed subgrade in all construction areas (except landscaping) should be carefully and thoroughly proof-rolled with a 20-ton pneumatic roller, fully-loaded dump truck, or similar equipment to detect weak zones in the subgrade. Weak areas detected during proof-rolling, zones containing debris or organics, and voids resulting from removal of tree roots, existing foundation elements, utilities, fill, boulders, etc. should be removed and replaced with soils exhibiting similar classification, moisture content, and density as the adjacent in-situ soils (or flowable fill). Proper site drainage should be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access.

Moisture-Conditioned Subgrade

After proof-rolling, and just prior to placement of fill, the exposed soil subgrade in all construction areas (except landscaping) should be evaluated for moisture and density through field density testing. If the moisture and/or density field test results do not meet the moisture and density requirements below, the subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned and compacted as per the fill compaction requirements.

As an alternative to evaluation of the existing soil subgrade through moisture-density testing in building areas, the subgrade may be over-excavated an additional 6 inches to allow for placement and compaction of an additional 6 inches of select fill. If this option is selected, the additional excavation should be made prior to proof-rolling.

Existing Fill

When the existing slabs of the belt filter press structure are removed, it is likely that the Earthwork Contractor will uncover building pad select fill. The Contractor should perform several test pit excavations (with Terracon observing) in the fill pad area to assess the thickness of the existing select fill. At that same time, Terracon should obtain samples for testing to ensure the existing select fill meets our plasticity requirements (PI≤20). If so, the existing select fill would be acceptable for re-use under the proposed structures; however, the Earthwork Contractor should be careful to not intermix the excavated select fill with the dark brown, Stratum 1 fat clays observed in the borings.

Temporary Groundwater Control

Although not encountered during our drilling operations, groundwater seepage might possibly be encountered during construction, especially after periods of wet weather Temporary groundwater control during construction would typically consist of perimeter gravel-packed drains sloping toward common sump areas for groundwater collection and removal. Placement of drain laterals within the excavation could be required to remediate isolated water pockets.

The volume of groundwater seeping/flowing into the excavation will vary based on rainfall patterns before and during construction, but we expect that there will be a need for temporary groundwater collecting and pumping. This could be accomplished by sloping the bottom of the excavation continually throughout construction such that water entering the excavation would flow towards one or more sump pits deeper than the excavation and then pumping the water out on a daily basis.

Fill Material Types

Fill required to achieve design grade should be classified as select/structural fill and general fill. Select/structural fill is material used below and within 5 feet of structures. General fill is material used to achieve grade in paving, non-reinforced earthen slopes, landscape, or other general areas (non-structural areas). Earthen materials used for select fill and general fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Specifications
Imported Select/Structural Fill [2,3]	CL, SC, and/or GC	■ TxDOT Item 247, Type A, Grade 3, OR ■ Percent Retained on No. 4 Sieve ≤ 40 percent with 5≤PI≤20 and rocks ≤ 4 inches in maximum dimensions, OR ■ Crushed concrete (TxDOT Item 247, Type D, Grade 3 or better)
Paving Fill and General Fill [4]	CH, CL, SC and/or GC	■ On-Site Soils: Rocks ≤ 4 inches in maximum dimension ■ Imported Soils: PI ≤ 40; Rocks ≤ 4 inches in maximum dimension

1. Structural and general fill should consist of approved materials free of organic matter and debris. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.
2. As an alternative to the Acceptable Specifications above, a low-plasticity granular material which does not meet these specifications may be used only if approved by Terracon.
3. Based on the laboratory testing performed during this exploration, the excavated on-site soils are not suitable for re-use as select fill. We do not recommend these soils be considered for re-use as select fill when planning budgets.
4. Excavated on-site soils (free of organics, debris, and rocks larger than 4 inches) may be considered for re-use as fill in pavement, landscape, or other general areas. Please note that the on-site soils exhibit high to very high shrink/swell potential. For economic reasons, expansive soils are often used in pavement and/or flatwork areas. The owner should be aware that the risk exists for future movements of the subgrade soils which may result in movement and/or cracking of pavement and/or flatwork. If paving fill is imported, the PI should not exceed 40.

Fill Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows.

Material Type		Minimum Compaction Requirement (%)[1]	Moisture Content Range (%)	Maximum Loose Lift Thickness (in) [2]
Select/Structural Fill		95 [3]	-3 to +3	8 inches
Moisture Conditioned Building Subgrade	**PI ≤25**	95	-3 to +3	
	PI > 25	95	Optimum to +4	
Paving Fill, Paving Subgrade and General Fill	**PI ≤25**	95	-3 to +3	
	PI > 25	95	Optimum to +4	
Crushed Limestone Base (beneath pavements)		100 [4]	-3 to +3	

1. Per the Standard Proctor Test (ASTM D 698).
2. Fill lift thickness must be reduced (typically 4 to 6 inches) if light compaction equipment is used, as is customary within a few feet of retaining walls and utility trenches.
3. **For fills greater than 5 feet in depth, if any, the compaction should be increased to at least 100 percent of the ASTM D 698 maximum dry unit weight.**
4. Per TEX-113-E.

Utility Trench Backfill

Leaking pipes underneath and/or near the foundations will increase the moisture content of the surrounding subgrade soils and will likely result in a PVR greater than discussed for these soils. For low permeability subgrades, utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. We recommend constructing an effective clay or flowable fill “trench plug” that extends at least 2 feet out from the face of the building exterior. The clay fill/flowable fill should be placed to completely surround the utility line and it should fill the utility trench completely in width and height, with the exception of topsoil at the surface. If clay plug is used, it should be fat clay with a minimum PI of 30 and should be compacted to comply with the water content and compaction recommendations for moisture conditioned building subgrade fill as specified in **Fill Compaction Requirements**. If flowable fill is used, it should be in accordance with TxDOT Item 401.

Grading and Drainage

The performance of the proposed improvements will not only be dependent upon the quality of construction, but also upon the stability of the moisture content of the near surface soils. Therefore, we highly recommend that site drainage be developed so that ponding of surface runoff near the improvements does not occur. Accumulation of water near the improvements may cause significant moisture variations in soils adjacent to the improvements, thus increasing the potential for structural distress.

Effective drainage away from the improvements must be provided during construction and maintained through the life of the proposed project. Infiltration of water into excavations should be prevented during construction. It is important that foundation soils are not allowed to become wetted. All grades must provide effective drainage away from the improvements during and after construction. The most effective way to achieve this would be to provide concrete aprons (i.e., concrete sidewalks/pavements directly abutting the building) around the exterior perimeter of the improvements for at least 6 feet (1 foot wider than the select fill overbuild). The concrete should be sloped to provide drainage away from the improvements and all joints should be sealed, particularly those directly abutting the improvements. In lieu of providing concrete aprons and if sloping unpaved ground is planned around the improvements, then the select fill overbuild (recommended 5 feet beyond the building limits) should be excavated to a depth of at least 2 feet below final grades, removed and replaced with a minimum of 2 feet of moisture conditioned and compacted on-site fat clay soils. The fat clay soils should be compacted and moisture conditioned as per the **Fill Compaction Requirements** section of this report. This procedure is recommended to reduce the possibility of surface runoff infiltrating into the more pervious select fill soils and ponding below the proposed building. We would be glad to discuss other measures (e.g., horizontal or vertical barriers) to reduce moisture infiltration in unpaved areas, if desired. Exposed (unpaved) ground should be sloped at a minimum of 5 percent away from the improvements for at least 10 feet beyond the perimeter of the improvements. Locally, flatter grades may be necessary to transition ADA access requirement for flatwork.

Roof runoff and surface drainage should be collected and discharged away from the improvements to prevent wetting of the foundation soils. Roof gutters should be installed and connected to downspouts and pipes directing roof runoff at least 10 feet away from the improvements or discharged on to positively sloped pavements.

After building construction, final grades should be verified to document effective drainage has been achieved. Grades around the improvements should also be periodically inspected and adjusted as necessary as part of the structure's maintenance program. Where paving or flatwork abuts the improvements, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration. Water permitted to pond next to the improvements can result in greater soil movements than those discussed in this report. Estimated movements described in this report are based on effective drainage for the life of the improvements and cannot be relied upon if effective drainage is not maintained.

Earthwork Construction Considerations

Based on our test borings, highly to very highly expansive soils that exhibit a potential for volumetric change during moisture variations are present at this site. These subgrade soils at the surface may experience expansion and contraction due to changes in moisture content. Based on FFE's and existing grades, the soils at this site could exhibit a Potential Vertical Rise (PVR) of up to about 4 inches, as estimated by the TxDOT Method TEX-124-E, if present in a dry condition.

Excavations, for the proposed structures and utilities, are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided as much as possible. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over, or adjacent to, construction areas should be removed. If the subgrade desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted, prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be documented under the direction of the Geotechnical Engineer. This should include documentation of adequate removal of vegetation and top soil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation and density/moisture testing of subgrade and fills. In the event that unanticipated conditions are encountered, the Geotechnical Engineer should be contacted to evaluate the conditions.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Fill should be tested for density and water content at a frequency of at least one test for every 5,000 square feet per lift of compacted fill in the building areas (with a minimum of 3 tests per lift) and 10,000 square feet per lift in pavement areas. A minimum of one density and water content test should be conducted for every 100 linear feet of compacted utility trench backfill in paving areas.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork** and **Floor Slabs and Building Subgrade Preparation**, the following design parameters are applicable for shallow foundations.

Design Parameters – Monolithic Slab-On-Grade

A monolithic slab-on-grade foundation system would be appropriate to support the proposed structures provided subgrade preparation as described in **Floor Slabs and Building Subgrade Preparation** is followed. The slab foundation design parameters presented in the tables below are based on the criteria published by the Building Research Advisory Board (BRAB), the Prestressed Concrete Institute (PCI), and the Wire Reinforcement Institute (WRI). These are essentially empirical design methods and the recommended design parameters are based on our understanding of the proposed project, our interpretation of the information and data collected as a part of this study, our area experience, and the criteria published in the BRAB, PCI, and WRI design manuals.

Conventional Slab and Beam System Parameters	
Description	**Design Parameter**
Minimum Embedment of Grade Beams below Final Grade [1]	18 inches
Bearing Stratum	Select Fill
Bearing Pressures (allowable) [2]	Net Dead plus Sustained Live Load – 1,700 psf Net Total Load – 2,500 psf
Subgrade Modulus (k) [3]	125 pci
Approximate Potential Vertical Rise (PVR)	About 1-inch [4,5]

1. Embedment is to reduce surface water migration below the foundation elements and to develop proper end bearing and is not based on structural considerations. The grade beam width and depth should be properly evaluated by the structural engineer. Grade beams may be thickened and widened at interior column locations to serve as spread footings at these concentrated load areas.
2. Grade beams should bear on compacted select fill
3. Several design methods use the modulus of subgrade reaction, k, to account for soil properties in design of flat, floor slabs. The modulus of subgrade reaction is a spring constant that depends on the kind of soil, the degree of compaction, and the moisture content. Based on our recommendations provided in **Floor Slabs and**

Conventional Slab and Beam System Parameters	
Description	**Design Parameter**

Building Subgrade Preparation, the above indicated subgrade modulus can be used for design of a flat, grade-supported floor slab.

4. Differential movements may result from variances in subsurface conditions, loading conditions and construction procedures. We recommend that measures be taken whenever practical to increase the tolerance of the building to post-construction foundation movements. An example of such measures would be to provide frequent control joints for exterior masonry veneers and interior sheetrock walls (particularly near doors and windows) to control cracking across such walls and concentrate movement along the joints.
5. The building subgrade should be properly prepared as described in **Floor Slabs and Building Subgrade Preparation**.

BRAB/WRI/PCI Parameters			
Description	**Design Parameter**		
Design Plasticity Index (PI) [1]	BRAB/WRI/PCI	Prepared Subgrade [2]	27
Climatic Rating (C_w)			17
Unconfined Compressive Strength			1.0 tsf
Soil Support Index (C) for BRAB		Prepared Subgrade [2]	0.87

1. The BRAB effective PI is equal to the near surface PI if that PI is greater than all of the PI values in the upper 15 feet. If the near-surface PI is not highest (i.e., after the building pad is prepared), then the effective PI is the weighted average of the upper 15 feet. The WRI/PCI effective PI is always the weighted average of the PI values in the upper 15 feet.
2. The building subgrade should be properly prepared as described in **Floor Slabs and Building Subgrade Preparation**.

Design Parameters – Footings

Principal column and wall loads for the proposed structures and interior improvements may be supported on isolated (spread) and/or continuous (strip) footings. Design parameters for spread/strip footing foundations are provided below.

Description	Design Parameter
Bearing Stratum [1]	Select Fill
Minimum Embedment Below Final Grade [2]	24 inches
Minimum Footing Dimensions	Spread – 3 feet by 3 feet square Strip – 18 inches wide
Allowable Bearing Pressures [3,4]	Net dead plus sustained live load – 1,700 psf Net allowable total load – 2,500 psf
Approximate Total Movement [5]	1-inch
Estimated Differential Movement [6]	½ to ¾ inch
Nominal (unfactored) Passive Resistance [7]	360 psf per foot of depth
Coefficient of Sliding Resistance [8]	0.35
Nominal (unfactored) Uplift Resistance [9]	Foundation Weight (150 pcf) & Soil Weight (120 pcf)

1. Unsuitable or soft soils must be over-excavated and replaced per the recommendations presented in **Earthwork** and the building area should be prepared as per **Floor Slabs and Building Subgrade Preparation**.
2. To bear within compacted select fill.
3. Whichever condition yields a larger bearing area.
4. Values provided are for maximum loads noted in **Project Description**.
5. The estimated post-construction settlement of the shallow footings is assuming proper construction practices are followed.
6. Differential settlements may result from variances in subsurface conditions, loading conditions and construction procedures. The settlement response of the footings will be more dependent upon the quality of construction than upon the response of the subgrade to the foundation loads.
7. Passive resistance should be neglected in the first 12 inches below finished grades. Care should be taken to avoid disturbance of the footing bearing area since loose material could increase settlement and decrease resistance to lateral loading. If the footing is formed during construction, the open space between the footings and the in-situ soils should be backfilled with concrete.
8. Lateral loads transmitted to the footings will be resisted by a combination of soil-concrete friction on the base of the footings and passive pressure on the side of the footings. We recommend that the allowable frictional resistance be limited to 500 psf.
9. The nominal values should be reduced by an appropriate factor of safety to compute allowable values. Backfill above the foundation should meet the requirements of **Earthwork**. Soil weight should be ignored in potential zones of disturbance and in areas where erosion control measures are not used, or soil might otherwise be removed.

Construction Within/Adjacent to Existing Building

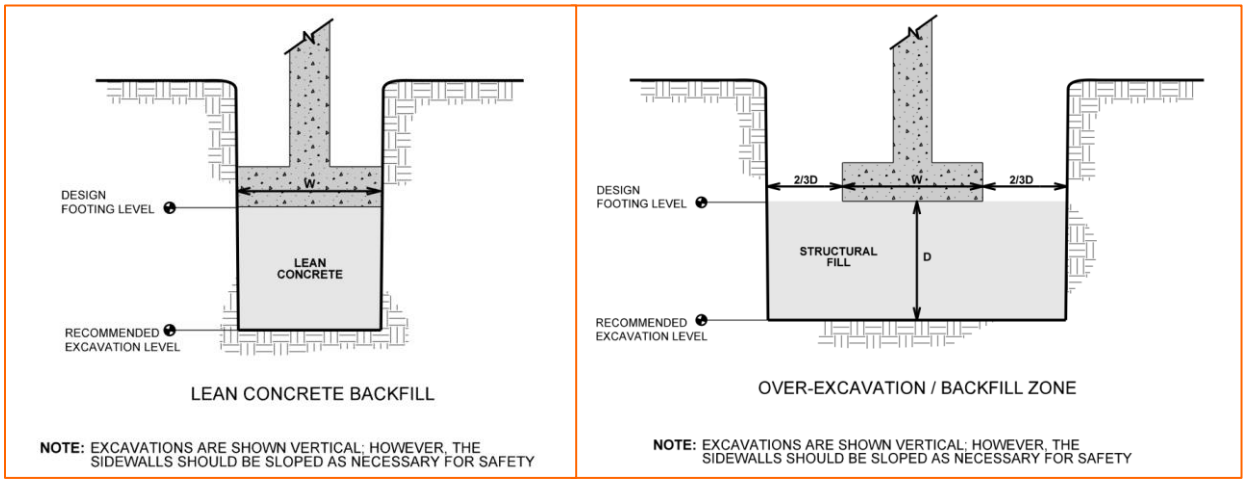
Differential settlement between the exterior/interior additions and the existing building is expected to approach the magnitude of the total settlement of the addition. Expansion joints should be provided between the existing building and the proposed addition to accommodate differential movements between the two structures. Underground piping between the two structures should be designed with flexible couplings and utility knockouts in foundation walls should be oversized, so minor deflections in alignment do not result in breakage or distress. Care should be taken during excavation adjacent to existing foundations, to avoid disturbing existing foundation bearing soils.

New footings or grade beams should bear at or near the bearing elevation of immediately adjacent existing foundations. Depending upon their locations and current loads on the existing footings, footings for the new addition could cause settlement of adjacent walls. To reduce this concern and risk, clear distances at least equal to the new footing widths should be maintained between the addition's footings and footings supporting the existing building.

Foundation Construction Considerations

Footings or grade beams should be neat excavated, if possible. If neat excavation is not possible, the foundation should be properly formed. If a toothed bucket is used, excavation with this bucket should be stopped approximately 6 inches above final grade of the footings and the footing excavation be completed with a smooth-mouthed bucket or by hand labor. Debris in the bottom of the excavation should be removed prior to steel reinforcement placement. The foundation excavation should be sloped sufficiently to create internal sumps for runoff collection and removal. If surface runoff water or groundwater seepage in excess of ½-inch accumulates at the bottom of the foundation excavation, it should be collected, removed, and not allowed to adversely affect the quality of the bearing surface.

If unsuitable bearing soils are encountered at the base of the planned footing excavation (such as low strength or disturbed soils), the footing excavations should be deepened to expose suitable bearing materials. The footings could then bear directly on these soils at the lower level, on lean concrete backfill placed in the excavations, or on compacted structural fill backfilled in the excavations and compacted as in **Earthwork**. This is illustrated in the figure below.



Concrete should be placed as soon as possible after excavation to reduce bearing soil disturbance. Soils at bearing level that become disturbed or saturated should be removed prior to placing reinforcing steel and concrete. Adequate water control/dewatering system will aid in minimizing the need for over-excavation and backfill of any soils disturbed by prolonged exposure. It is important that the foundation subgrade not be disturbed by construction activities (e.g., setting forms and placing reinforcing steel). If disturbance occurs, we recommend that the disturbed soils be removed and that the foundation subgrade be protected with the placement of a lean concrete "mud mat".

Foundation Construction Observation

The performance of the foundation system for the proposed structure will be highly dependent upon the quality of construction. Thus, we recommend that the foundation construction be monitored by Terracon to identify the proper bearing strata and depths and to help evaluate foundation construction. We would be pleased to develop a plan for foundation observation to be incorporated in the overall quality assurance program.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil and bedrock properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is C**. Subsurface explorations at this site were extended to a maximum depth of 25 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and

knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

FLOOR SLABS AND BUILDING SUBGRADE PREPARATION

The subgrade soils are comprised of high to very high plasticity clays exhibiting the potential to shrink/swell with changes in water content. Construction of the floor slabs and revising site drainage creates the potential for gradual increased water contents within the clays. Increases in water content will cause the clays to swell and potentially damage the floor slabs.

Due to the potential for significant moisture fluctuations of subgrade material beneath the select fill pad, the exposed final subgrade should be prepared as discussed in the first three sub-sections of **Earthwork**.

The post-construction performance of the foundation will likely be influenced more by post-construction volumetric changes of the subgrade due to in-situ moisture variations than upon settlement due to foundation loads. Settlement response of select fill supported slabs will be influenced as much by the quality of construction and fill placements as by soil-structure interaction. Therefore, it is essential that the recommendations for foundation construction be strictly followed during the construction phases of the building pad and foundation.

Based on information provided to us, a select fill pad combined with a moisture conditioned clay subgrade may be implemented in order to reduce post-construction shrink/swell movements to approximately 1-inch. The table below provides options for various preparation options depending on the amount of select fill desired below the bottom of the floor slab. The Owner should select the desired design PVR that can be tolerated and provide that decision to the Design/Construction Team.

Preparation Option	Select Fill Thickness, feet	Moisture Conditioned Clay Thickness (below select fill), feet	Total Building Pad Thickness, feet
1	7	1	8
2	6	3	9
3	5	5	10

1. As an example, if option 3 is selected, we recommend that the on-site clay soils be removed to a depth of 10 feet below the bottom of the floor slab. At least 5 feet of the excavated soils should be moisture conditioned as outlined in **Earthwork**. The moisture conditioned clay soils should not be allowed to dry out prior to subsequent lift placements. For option 3, select fill should be placed as outlined in **Earthwork** in order to provide a select fill pad of 5 feet below the floor slab.

When the existing slabs of the belt filter press structure are removed, it is likely that the Earthwork Contractor will uncover building pad select fill. The Contractor should perform several test pit excavations (with Terracon observing) in the fill pad area to assess the thickness of the existing

select fill. At that same time, Terracon should obtain samples for testing to ensure the existing select fill meets our plasticity requirements (PI≤20). If so, the existing select fill would be acceptable for re-use under the proposed structures; however, the Earthwork Contractor should be careful to not intermix the excavated select fill with the dark brown, Stratum 1 fat clays observed in the borings.

General Comments for Pad Preparation

The above building subgrade preparation recommendations should be applied to an area extending a minimum of 5 feet outside of building areas including attached walkways and any other architectural members. We suggest the use of crushed limestone base in the upper 6 inches of the select fill pad from a standpoint of construction access during wet weather, as well as from a standpoint of floor slab support.

For any flatwork (sidewalk, ramps, etc.) outside of the building area which will be sensitive to movement, subgrade preparation as discussed above should be considered to reduce differential movements between the flatwork and the adjacent building. If subgrade preparation as given above for building areas is not implemented in the exterior flatwork areas, those areas may be susceptible to post-construction movements in excess of that given above.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

The potential movement values indicated are based upon moisture variations in the subgrade due to circumstances such as moisture increases due to rainfall and loss of evapotranspiration. In circumstances where significant water infiltration beneath the floor slab occurs (such as a leaking utility line or water seepage from outside the buildings resulting from poor drainage), movements in isolated floor slab areas could potentially be in excess of those indicated in this report.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means. Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual.

Connections to Existing Structures

We understand that the proposed addition will be built adjacent to the existing structure. Due to the independence of the foundation systems of the existing and proposed structures, it is possible that differential movements may occur between the foundation systems. The magnitude of differential movements will be primarily dependent upon the quality of foundation construction utilized for the addition and the performance of the foundation system of the existing structure. Therefore, any members or connections of the addition which are common to the foundation of the existing structure should be designed such that they are tolerant to movement whenever possible. Any existing beams/footings adjacent to the excavation for the proposed addition should be properly braced/shored to insure minimal distress to the existing structure, when performing subgrade excavations immediately adjacent.

Floor Slab Construction Considerations

Design recommendations for floor slabs assume the requirements in **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the subgrade and select fill pad beneath the floor slab.

Finished subgrade within and for at least 10 feet beyond the floor slab should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

BELOW-GRADE STRUCTURES

We understand that precast concrete sump structure will be placed directly against the temporary retention system constructed within the on-site soils. Lateral earth pressure conditions are discussed in the following sections.

Excavation Retention System

Open cut sloped excavations are not expected at this site due the adjacent building. Thus, an excavation retention system will be required to maintain a stable excavation. Excavation retention systems are normally the responsibility of the general contractor and should be designed by a licensed professional engineer experienced in the design of such systems. The final decision on which wall pressures to use should be made by the temporary retention system designer and the permanent below-grade wall designer, depending on the exact system types used for this project and the interaction between the temporary and permanent systems.

Surcharge pressures for adjacent roads and/or buildings should be accounted for in the shoring and building designs using a uniform lateral stress distribution equal to the surcharge pressure multiplied by the appropriate lateral stress ratio for either at-rest or active case restraint. The lateral pressure due to surcharge(s) need only be applied within the Stratum 1 and 2 soils and may be based on the weighted average lateral stress ratio of the soils (0.63 for the at-rest case and 0.45 for the active case).

The following table provides the upper and lower earth pressure bounds to be considered for below-grade design, based on triangular pressure distributions for each layer above the Stratum 3 limestone.

Stratum	Lateral Earth Pressure Condition	Equivalent Fluid Density (pcf) [1]
Stratum 1 and 2 Soils	Active	55
	At-Rest	75

1. Represents nominal (unfactored) values. Appropriate safety factors should be applied.
2. Active earth pressures are typically used for walls that are flexible enough to allow sufficient movement to mobilize soil resistance. This is generally, but not always the case for temporary retention shoring systems. If the retention system is flexible enough to allow top of wall movements on the order of 0.2 to 0.4 percent of the wall height, then active earth pressures are appropriate for the design of the retention system and the design of the perimeter below-grade walls. If the system is rigid and does not yield to allow movement, then at-rest pressures should be used.

For the excavation, there are two design cases to be considered that are affected by lateral earth pressures: 1) the excavation shoring system and 2): the permanent structure walls. The lateral earth pressures applicable for design of the structure walls depend upon the shoring system design. We anticipate that the shoring system will likely consist of drilled solider piers or H-piles with reinforced shotcrete and/or periodic tie-back anchors installed as the mass excavation proceeds downward. The shoring system will be designed by others; thus, the exact type of shoring system is unknown at this time. We anticipate that this type of shoring system would be designed as a flexible system and would mobilize soil resistance, thus active earth pressures would be appropriate for the design of the temporary system. We anticipate that tie-backs may not be possible on one or more of the excavation sides due to the absence of enough space for tie-back anchors. Once final decisions have been made regarding temporary retention systems, we should be available to review and consult further on this matter.

Regarding worker safety, Occupation Safety and Health Administration (OSHA) Safety and Health Standards require the protection of workers in trench and “non-trench” excavation situations. The OSHA guidelines and directives should be adhered to by the Contractor during construction to provide a safe working environment.

PAVEMENTS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs, noted in this section, must be applied to the site, which has been prepared as recommended in the **Earthwork** section.

Pavement designs are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level the subgrade can support. Support characteristics of the subgrade for pavement design do not account for shrink/swell movements of an expansive clay subgrade, such as the Stratum 1 soils encountered on this project. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade. It is therefore important to minimize moisture changes in the subgrade to reduce shrink/swell movements. Proper site perimeter drainage should be provided so that infiltration of surface water from unpaved areas surrounding the pavement is minimized.

Pavement Design Parameters

Design of Asphaltic Concrete (HMAC) pavements are based on the procedures outlined in the 1993 Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO-1993).

Detailed traffic loads and frequencies were not available; however, we anticipate that traffic will consist primarily of passenger vehicles in the parking areas and passenger vehicles combined with City maintenance/service trucks, occasional emergency vehicles, garbage trucks, and delivery trucks in driveways. If heavier traffic loading is expected or other traffic information is available, Terracon should be provided with the information and allowed to review the pavement sections provided herein. Tabulated below are the assumed traffic frequencies and loads used to design pavement sections for this project.

Pavement Area	Traffic Design Index	Description of Daily Traffic
Secondary Driveways (non-Delivery or Loading Areas)	DI-2 [2]	Light to medium traffic – (5≤ESALs≤20) Passenger cars and pickup trucks with no more than 50 heavily loaded two-axle trucks or lightly loaded three axle trucks per day. No regular use by heavily loaded trucks with three or more axles.
Primary Driveways, Loading/Unloading Areas and Dumpster Enclosures	DI-3	Medium traffic – (20<ESALs≤75) No more than 300 heavily loaded two axle trucks or lightly loaded three axle trucks and no more than 30 heavily loaded three axle trucks per day.

Pavement Area	Traffic Design Index	Description of Daily Traffic

1. Daily 18-kip equivalent single axle load applications.
2. For Fire Lanes to withstand the occasional HS-20 loading of 32,000 pounds per axle and up to 90,000-pound gross truck weight, use DI-2 pavements or thicker.

Pavement Section Thicknesses

The following tables provides options for HMAC pavement sections.

Asphaltic Concrete Design		
Layer	**Thickness (inches)**	
	DI-2	**DI-3**
Asphaltic Concrete (HMAC)	2.5	3.0
Crushed Limestone Base	10.0	12.0
Moisture Conditioned Subgrade	6.0	

Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e., concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles. As an option, thicker sections could be constructed to decrease future maintenance.

Pavement Materials

Presented below are our recommended material requirements for the various pavement sections.

Item	Value
Hot Mix Asphaltic Concrete (HMAC) [1]	Plant mixed, hot laid Type D (Fine-Grade Surface Course) meeting the specifications in TxDOT Item 340.
Crushed Limestone Base [2]	TxDOT Item 247, Type A, Grade 1-2 compacted as outlined in **Earthwork**.
Moisture Conditioned Subgrade [3]	As outlined in **Earthwork**.

1. For acceptance and payment evaluation purposes, we recommend the use of the provisions in TxDOT Item 340.
2. Each lift of base should be thoroughly proof-rolled just prior to placement of subsequent lifts and/or asphalt. Particular attention should be paid to areas along curbs, above utility trenches, and adjacent to landscape islands, manholes, and storm drain inlets. Preparation of the base material should extend at least 18 inches behind curbs.

Item	Value
3.	Subgrade should not dry out or become saturated prior to pavement construction. The pavement subgrade should be thoroughly proof-rolled as outlined in **Earthwork**. Particular attention should be paid to areas along curbs, above utility trenches, and adjacent to landscape islands, manholes, and storm drain inlets. Preparation of the moisture conditioned subgrade should extend at least 18 inches behind curbs.

Presented below are our recommendations for the construction of the reinforced concrete pavements.

Item	Value
Reinforcing Steel	DI-2: #3 bars spaced at 18 inches on center in both directions. DI-3: #4 bars spaced at 18 inches (or #3 bars spaced at 12 inches) on center in both directions. Rebar should be placed at midpoint of concrete section and supported on chairs prior to concrete placement.
Control (i.e., Contraction) Joint Spacing	In accordance with ACI 330R, control joints should be spaced no greater than 12.5 feet for 5-inch-thick concrete and 15 feet for 6-inch thick or greater concrete. If sawcut, control joints should be cut within 6 to 12 hours of concrete placement. Sawcut joint should be at least ¼ of the slab thickness.
Expansion (i.e., Isolation) Joint Spacing	ACI 330R indicates that regularly spaced expansion joints may be deleted from concrete pavements, except adjacent to structures, manholes, inlets, light poles, etc. Therefore, the installation of expansion joints is optional and should be evaluated by the design/construction team. Expansion joints, if not sealed and maintained can allow infiltration of surface water into the subgrade.
Dowels at Expansion Joints	¾-inch smooth bars, 18 inches in length, with one end treated to slip, spaced at 12 inches on centers at each joint, and placed level at midpoint of concrete section.

Pavement Drainage

On most projects, rough site grading is accomplished relatively early in the construction phase. Fills are placed and compacted in a uniform manner. However, as construction proceeds, excavations are made into these areas, dry weather may desiccate some areas, rainfall and surface water saturates some areas, heavy traffic from concrete and other delivery vehicles disturbs the subgrade, and many surface irregularities are filled in with loose soils to temporarily improve subgrade conditions. As a result, the pavement subgrade should be carefully evaluated as the time for pavement construction approaches. This is particularly important in and around utility trench cuts. All pavement areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to paving. Thorough proof-rolling of

pavement areas should be performed no more than 36 hours prior to surface paving. Proof-rolling should be repeated if the site received rainfall prior to paving. Any problematic areas should be reworked and compacted at that time.

Openings in pavements, such as landscaped islands, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The civil design for the pavements with these conditions should include features to restrict or to collect and discharge excess water from the islands. Examples of features are self-contained planters, edge drains connected to the storm water collection system, longitudinal subdrains, or other suitable outlet, and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded sufficiently to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install perimeter pavement drainage systems (i.e., French drains) surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.

- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Construct curb, gutter and/or sidewalk directly on clay subgrade soils rather than on granular base course materials.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Location	Number of Borings	Boring Depth (feet) [1]
General Site Area	1	26½

1. Below ground surface.

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained by interpolation from the site plan provided to us. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: Our drilling subcontractor advanced the boring with a truck-mounted, rotary drill rig using continuous flight augers. Five samples were obtained in the upper 10 feet of the boring and at intervals of 5 feet thereafter. Soil sampling was performed using thin-wall tube (shelby tubes) and/or split-barrel sampling procedures and/or TxDOT Texas Cone Penetration (TxDOT cone) sampling procedures. The split-barrel samplers were driven in accordance with the standard test method for standard penetration test (SPT) and split-barrel sampling of soils. Bedrock was sampled with either split-barrel-sampling spoons or continuously cored using NX rock coring equipment. When sufficient bedrock was sampled, the borings were shallowed at the geotechnical engineer's discretion. Our drilling subcontractor observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil and rock strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D7012, Method C Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Rock classification was conducted using locally accepted practices for engineering purposes; petrographic analysis may reveal other rock types. Rock core samples typically provide an improved specimen for this classification. Boring log rock classification was determined using the Description of Rock Properties.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location Plan
Exploration Plan (2 Pages)

Note: All attachments are one page unless noted above.

SITE LOCATION

City of Georgetown – Dove Springs WWTP Dewatering Improvements ■ Georgetown, Texas
November 17, 2023 ■ Terracon Project No. 96215180A

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

City of Georgetown – Dove Springs WWTP Dewatering Improvements ■ Georgetown, Texas

November 17, 2023 ■ Terracon Project No. 96215180A

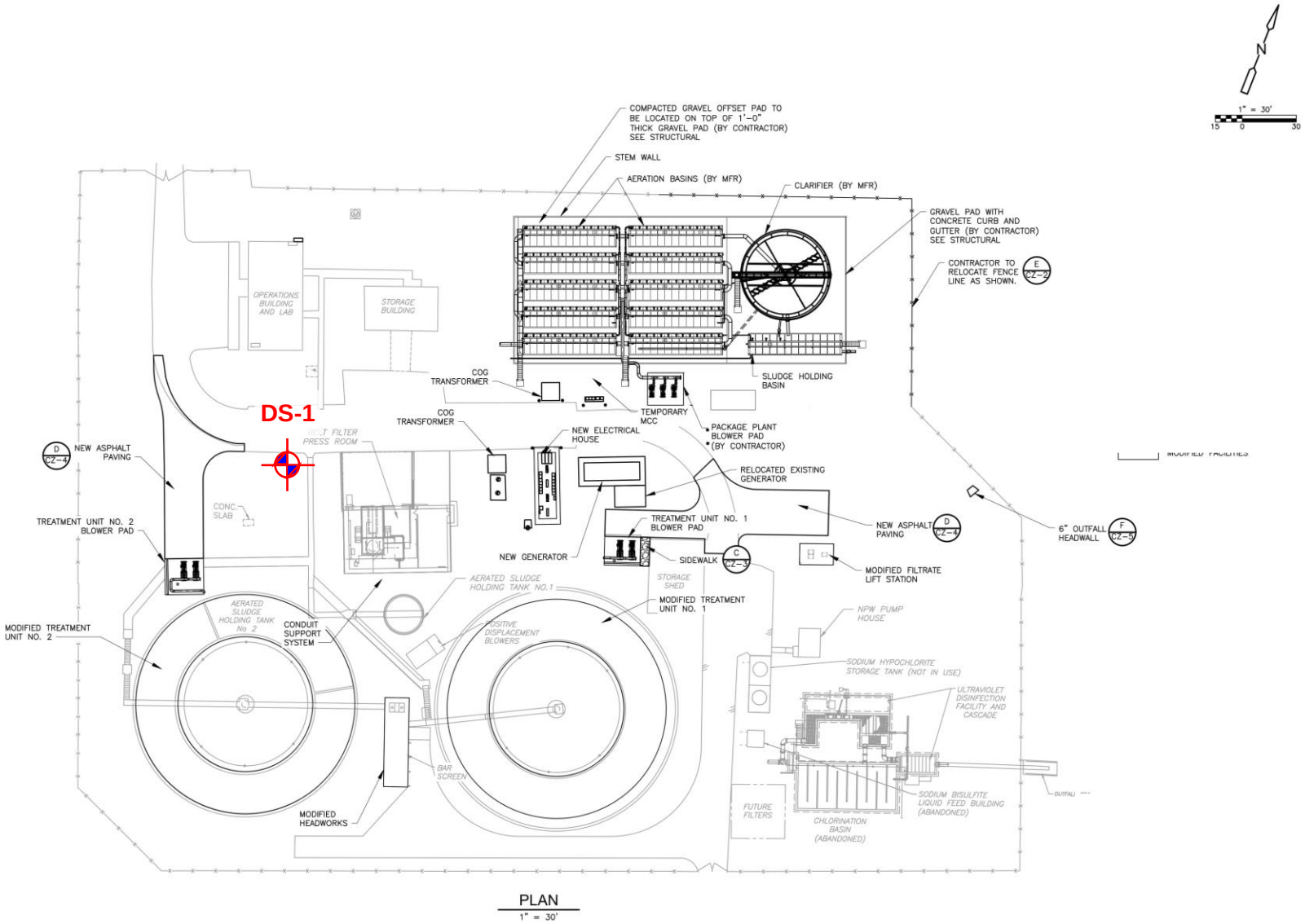


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Boring Log B-1
Grain Size Distribution
Atterberg Limits

Note: All attachments are one page unless noted above.

BORING LOG NO. DS-1

PROJECT: CoG Dove Springs WWTP Rehabilitation

CLIENT: CDM Smith Inc
Houston, TX

SITE: Turtle Dove Lane
Georgetown, TX

LOCATION See Exploration Plan

Latitude: 30.6310° Longitude: -97.6333°

Approximate Surface Elev.: 738.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	PERCENT FINES
1							4.5+ tsf (HP)					15.3		78-20-58	75
							6-6-7 N=13					23.7			
				5			3-4-6 N=10					23.0			
2		6.0	732+/-				13-12-17 N=29					5.8		62-16-46	14
		9.0	729+/-				50/2"					13.9			
3				10				100/48	UC	429.83		2.4	146		
				15				85/17							
		20.0	718+/-	20											
4								65/43	UC	16.27		15.2	116		
		26.5	711.5+/-	25			7-12-17 N=29					20.7		54-18-36	96

FAT CLAY WITH GRAVEL (CH), dark brown, stiff to hard

CLAYEY GRAVEL WITH SAND (GC), brown to light brown, medium dense

LIMESTONE, light tan to pale brown, highly fractured, with clayey seams

CLAYEY SHALE, tan to gray, highly fractured

Boring Terminated at 26.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered to 10½ feet; Air Rotary thereafter

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

WATER LEVEL OBSERVATIONS

No free water observed

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

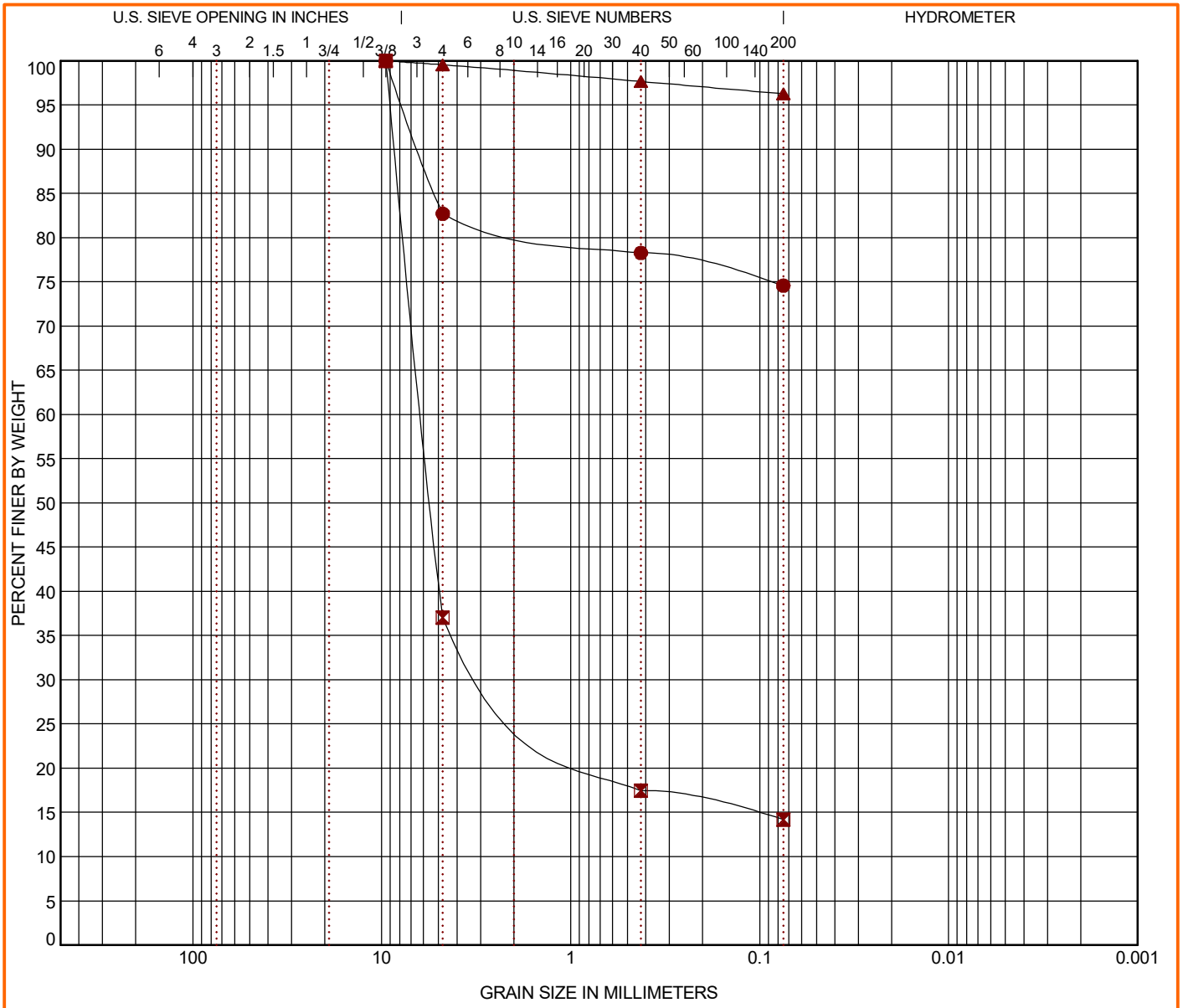
Boring Started: 07-13-2022 | Boring Completed: 07-13-2022

Drill Rig: CME 55 | Driller: Austin Geo-Logic

Project No.: 96215180A

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	DS-1	0 - 2	FAT CLAY with GRAVEL (CH)	15.3	78	20	58		
⊠	DS-1	6 - 7.5	CLAYEY GRAVEL with SAND (GC)	5.8	62	16	46		
▲	DS-1	25 - 26.5	FAT CLAY (CH)	20.7	54	18	36		

Boring ID		Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	DS-1	0 - 2	9.5				0.0	17.3	8.1		74.6	
⊠	DS-1	6 - 7.5	9.5	6.117	1.998		0.0	63.0	22.8		14.2	
▲	DS-1	25 - 26.5	9.5				0.0	0.4	3.3		96.3	

PROJECT: CoG Dove Springs WWTP Rehabilitation

SITE: Turtle Dove Lane
Georgetown, TX

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

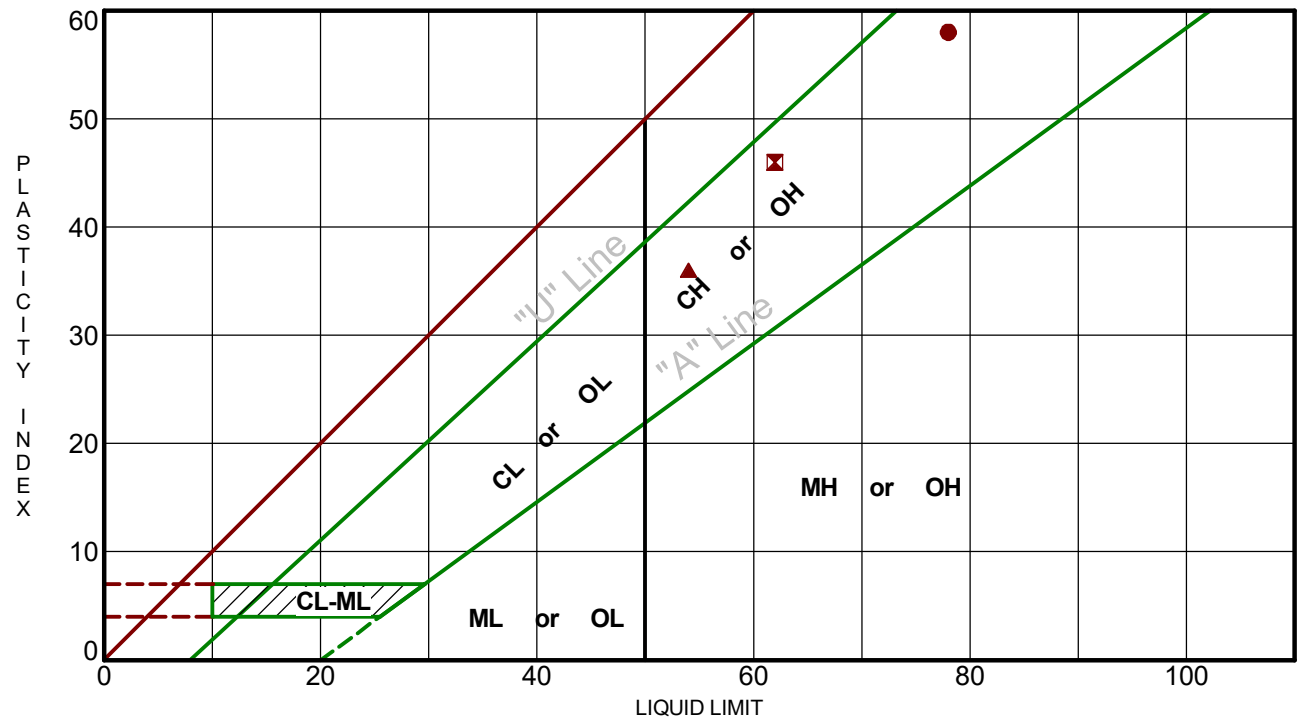
PROJECT NUMBER: 96215180A

CLIENT: CDM Smith Inc
Houston, TX

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 96215180A.COG DOVE SPRINGS WWTP.BORING INFO.GPJ TERRACON_DATATEMPLATE.GDT 8/2/22

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	DS-1	0 - 2	78	20	58	74.6	CH	FAT CLAY with GRAVEL
⊠	DS-1	6 - 7.5	62	16	46	14.2	GC	CLAYEY GRAVEL with SAND
▲	DS-1	25 - 26.5	54	18	36	96.3	CH	FAT CLAY

PROJECT: CoG Dove Springs WWTP Rehabilitation

PROJECT NUMBER: 96215180A

SITE: Turtle Dove Lane
Georgetown, TX

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

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LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 96215180A.COG DOVE SPRINGS WWTP.BORING INFO.GPJ TERRACON_DATATEMPLATE.GDT 8/2/22

SUPPORTING INFORMATION

Contents:

General Notes
Unified Soil Classification System
Description of Rock Properties

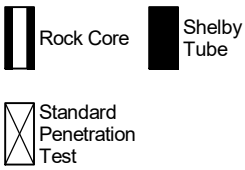
Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS
CoG Dove Springs WWTP Rehabilitation ■ Georgetown, TX
Terracon Project No. 96215180A

Terracon GeoReport

SAMPLING



WATER LEVEL

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Cave In Encountered

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	**Standard Penetration Test Resistance (Blows/Ft.)**
(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
UC	**Unconfined Compressive Strength**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			BEDROCK	
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1	< 20	Weathered
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4	20 - 29	Firm
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8	30 - 49	Medium Hard
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15	50 - 79	Hard
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30	>79	Very Hard
		Hard	> 4.00	> 30		

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or [$Cc<1$ or $Cc>3.0$] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or [$Cc<1$ or $Cc>3.0$] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

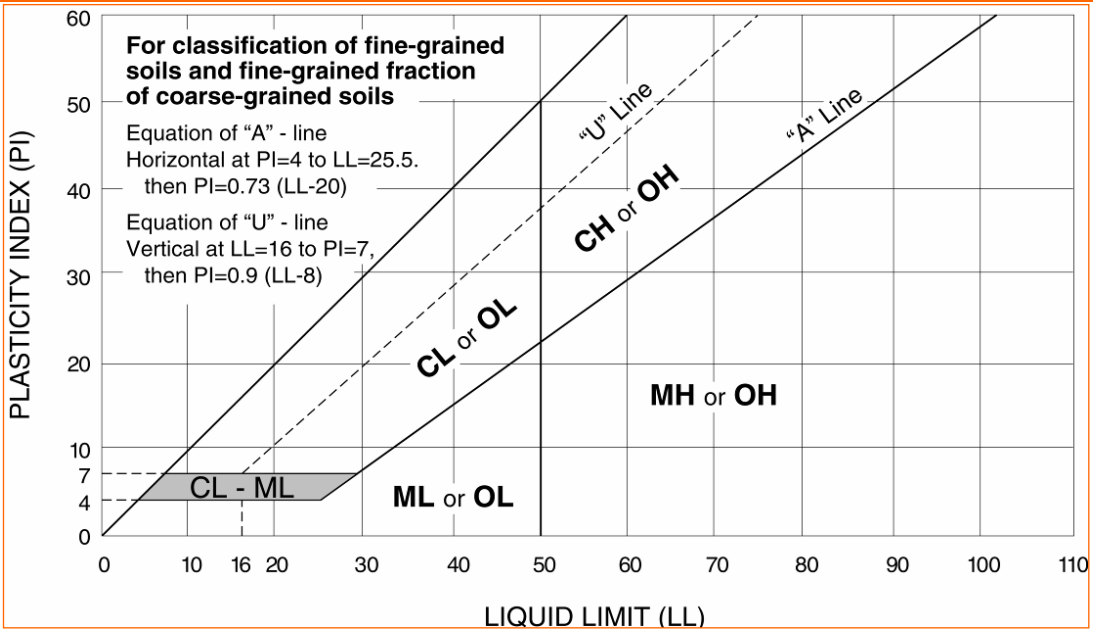
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



DESCRIPTION OF ROCK PROPERTIES

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (tsf)**
Extremely weak	Indented by thumbnail	40-150 (3.9-10.8)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (10.8-50.4)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (50.4-288)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (288-504)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (504-1,080)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (1,080-2,592)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>2,592)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009
Technical Manual for Design and Construction of Road Tunnels – Civil Elements

TECHNICAL SPECIFICATIONS

SECTION CIP6 – CONTROL OF WORK

CIP6.01 SCOPE OF WORK

A. This specification covers the requirements for exercising control of work performed on the Project.

CIP6.02 AUTHORITY OF ENGINEER OR INSPECTOR

A. The work will be done in accordance with the Contract, Plans and Specifications. The Engineer or Inspector will decide all questions which may arise as to the quality or acceptability of materials furnished and work performed and the interpretations of the Plans and Specifications. His decisions will be final, and he will have executive authority to enforce and make effective such decisions and orders.

CIP6.03 CONFORMITY WITH PLANS, SPECIFICATIONS AND SPECIAL PROVISIONS

A. All work performed and all materials furnished shall be in reasonable close conformity with the lines, grades, cross sections, dimensions, details, gradations, physical and chemical characteristics of materials in accordance with tolerances shown on the Plans or indicated in the Specifications and Special Provisions. The limits establishing reasonable close conformity will be as defined in these items of the contract.

B. In the event the City finds that the work performed or the materials used are not within reasonable close conformity with the Plans, Specifications and Special Provisions, the affected material or product shall be removed and replaced or otherwise satisfactorily corrected by and at the expense of the Contractor.

C. Deviations from the Plans and approved working drawings as may be required will in all cases be determined by the City and authorized in writing. Before final acceptance of the project is issued by the City, the Contractor shall provide the City with a set of record drawings for the project certified by the Engineer of record.

CIP6.04 COORDINATION OF PLANS, SPECIFICATIONS AND SPECIAL PROVISIONS

A. The Specifications, accompanying Plans, Special Provisions, and Supplemental Agreements are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be cooperative and to describe and provide for a complete work. In cases of disagreement, figured dimensions shall govern over scaled dimensions, the Plans shall govern over Specifications, and Special Provisions shall govern over both Specifications and Plans.

CIP6.05 AUTHORITY AND DUTIES OF INSPECTORS

A. Inspectors will be authorized to inspect all work done and all materials furnished. Such inspection may extend to all or to any part of the work and to the preparation or Manufacturer of the materials to be used. Such inspection will not relieve the Contractor from any obligation to perform the work in accordance with the requirements of the Specifications. In case of any dispute arising between the Contractor and the Inspector as to materials furnished or the manner of performing the work, the Inspector will have authority to reject materials or suspend work until the question at issue can be referred to and decided by the City. The Inspector will not be authorized to revoke, alter, enlarge, or release any requirement of these

Specifications, nor to approve or accept any portion of work, nor to issue instruction contrary to the Plans and Specifications. He will in no case act as foreman or perform other duties for the Contractor nor interfere with the management of the work.

CIP6.06 PROJECT

A. The Contractor shall furnish plant and/or equipment which will be efficient, appropriate and large enough to secure a satisfactory quality of work and a rate of progress which will insure the completion of the work within the time stipulated in the Contract Documents. If at any time such plant or equipment appears to the Engineer to be inefficient, inappropriate or insufficient for securing the quality of work required or for producing the rate of progress aforesaid, he may order the Contractor to increase the efficiency, change the character or increase the plant and equipment, and the Contractor shall conform to such order. Failure of the Engineer to give such order shall in no way relieve the Contractor of his obligations to secure the quality of work and rate of progress required.

CIP6.07 PRIVATE LAND

A. The Contractor shall not enter or occupy private land outside of easements, except by written permission of the respective landowner.

CIP6.08 PIPE LOCATIONS

A. Pipelines shall be located substantially as indicated on the Plans, but the Engineer and the City reserve the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Plans, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

CIP6.09 OPEN EXCAVATIONS

A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access during construction shall be removed when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street, and requiring that the trench shall not remain open overnight. The Contractor shall take precautions, such as fences and barricades, to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles, which could be dangerous to the public, shall be well lighted at night. All trenches shall conform to the requirements of OSHA.

CIP6.10 TEST PITS

A. Test pits for the purpose of locating underground pipelines or structures in advance of the construction shall be excavated and backfilled by the Contractor at the direction of the Engineer or the City. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Engineer and the City.

CIP6.11 MAINTENANCE OF TRAFFIC

A. Unless permission to close a street is received in writing from the proper authority, all excavated material shall be placed so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards; Contractor shall prepare and submit a traffic control plan, shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the Engineer and the City.

B. Detours around construction will be part of the Contractor's traffic control plan and is subject to the approval of the City and the Engineer. Where detours are permitted, the Contractor shall provide all necessary barricades and signs as required to divert the flow of traffic. While traffic is detoured, the Contractor shall expedite construction operations and periods when traffic is being detoured will be strictly controlled by the City.

C. The Contractor shall take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress. The Contractor shall be fully responsible for damage or injuries whether or not police protection has been provided.

CIP6.12 BLASTING

A. No blasting shall be allowed unless approved in writing by the City of Georgetown.

CIP6.13 CARE AND PROTECTION OF PROPERTY

A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition equal or better than existing before the damage was done, or he shall make good the damage in some other manner acceptable to the Engineer and the City.

CIP6.14 MAINTENANCE OF FLOW

A. The Contractor shall, at his own cost, provide for the flow of sewers, drains and water courses interrupted during the progress of the work, and shall immediately cart away and remove all offensive matter. The entire procedure of maintaining existing flow shall be fully discussed with the Engineer and the City well in advance of the interruption of any flow.

CIP6.15 COOPERATION WITHIN THIS CONTRACT

A. The Contractor shall cooperate with Subcontractors or trades, and shall assist in incorporating the work of other trades where necessary or required.

B. Cutting and patching, drilling and fitting shall be carried out where required by the Contractor and his Subcontractor having jurisdiction, unless otherwise indicated herein or directed by the Engineer or the City.

CIP6.16 CLEANUP

A. During the course of the work, the Contractor shall keep the site of his operations in as clean and neat a condition as is possible. The Contractor shall dispose of all rubbish resulting from the construction work and, at the conclusion of the work, he shall remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other

refuse remaining from the construction operations, and shall leave the entire site of the work in a neat and orderly condition.

CIP6.17 FINAL INSPECTION

A. Whenever the work provided for in, and contemplated under, the contract has been satisfactorily completed, the City will make the "Final Inspection". If the work is found to be satisfactory, the Contractor will be notified in writing of the acceptance of the same. The City will require a Certificate of Completion and Final Acceptance from the Inspector before any building, electric or plumbing permits will be issued or any City utilities provided. No such Certificate will be issued until all monuments have been set and record drawings reviewed by the Engineer of Record are provided to the City. If items are found in need of repair or completion, a final punch list will be generated and the items shall be completed by the Contractor. The City will inspect the punch list items one time following their completion. Any subsequent inspections due to inadequate repair or completion of the punch list items shall be paid for by the Contractor or Developer at $200.00 per inspection, up to two (2) hours. Any additional time will be paid by the Contractor or Developer at a rate of $200.00 per hour.

B. Final acceptance of the Project or Development does not relieve the Contractor or Developer of the responsibility of insuring all work shown on the Plans has been completed. If any portion of the work is found at a later date to be inferior or incomplete, the Contractor or Developer shall replace or complete the work at no expense to the City.

CIP6.18 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP7 – CONTROL OF MATERIALS

CIP7.01 SCOPE OF WORK

A. This specification covers the requirements for exercising control of materials used on the Project.

CIP7.02 SOURCES OF SUPPLY AND QUALITY OF MATERIALS

A. The source of supply of each of the materials shall be approved by the City before any deliveries and at the option of the City, may be sampled and tested for determining compliance with the governing Specifications by the City before delivery begins. If it is found after trial that sources of supply previously approved do not produce uniform and satisfactory products, or if the product from any source proves unacceptable at any time, the Contractor shall furnish materials from other approved sources. Only materials conforming to the requirements of these Specifications and approved by the City shall be used in the work. All materials being used are subject to inspection or test at any time during their preparation or use. Any materials which have been tested and accepted at the source of supply may be subjected to a check test after delivery and all materials which, when retested, do not meet approval or have in any way become unfit for use shall not be used in the work.

B. Throughout these Specifications where reference is made to ASTM, AASHTO or bulletins of the Texas Department of Transportation for the quality of materials or sampling and testing, the most current standard, tentative standard or bulletin issued prior to the date of the proposal shall govern.

CIP7.03 SAMPLES AND TEST

A. All materials, before being incorporated in the work, shall be inspected, tested and approved by the City and any work in which materials are used without prior test and approval or written permission of the City may be ordered removed and replaced at the Contractor's expense. The Contractor shall be responsible for and pay for all charges of testing laboratories for services in conjunction with initial tests made on all imported materials to the project site including but not limited to embedment materials, fill materials, backfill materials, select material, crushed limestone base, sub-base, concrete, steel, wood forms, liquid asphalt, aggregate, water, cement, guard rail etc. Sampling and testing of all materials, on the project site will be coordinated by the Contractor and paid for by the City. The selection of the method of test shall be designated by the City. Where tests are required, other than those made in the laboratory, for the purpose of control in the manufacture of a construction item, the Contractor will be required to furnish such facilities and equipment as may be necessary to perform the tests and inspection and shall be responsible for calibration of all test equipment required. When requested, the Contractor shall furnish a complete written statement of the origin, composition, and/or manufacture of any or all materials that are to be used in the work. Testing of all materials and work shall conform to the Texas Department of Transportation "Manual of Testing Procedures" which outlines testing methods and procedures. Other Texas Department of Transportation Bulletins shall apply.

CIP7.04 PAYMENT

A. No separate payment will be made for work performed under this section of the specifications and the cost thereof shall be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP8 – LEGAL RELATIONS AND RESPONSIBILITIES TO THE PUBLIC

CIP8.01 SCOPE OF WORK

A. This specification covers the requirements for complying with all Federal, State, and local laws, ordinances, and regulations, which in any manner affect the conduct of the work on the Project.

CIP8.02 LAWS TO BE OBSERVED

A. The Contractor shall make himself familiar with and at all times shall observe and comply with all Federal, State, and local laws, ordinances, and regulations which in any manner affect the conduct of the work and shall indemnify and save harmless the City and its representatives against any claim arising from the violation of any such law, ordinance, or regulation, whether by himself or by his employees.

CIP8.03 PERMITS, LICENSES AND TAXES

A. The Contractor shall procure all permits and licenses, pay all charges, fee and taxes, and give all notices necessary and incident to the due and lawful prosecution of the work.

CIP8.04 RESTORATION OF SURFACES OPENED BY PERMIT

A. The Contractor shall not allow any party to make an opening in the highway or street unless a duly authorized permit signed by the owner of the facility is presented. Until the acceptance of the work, the Contractor shall make all necessary repairs in the roadway where openings have been made by due authority.

CIP8.05 PUBLIC SAFETY AND CONVENIENCE

A. The safety of the public and the convenience of traffic shall be regarded as of prime importance. Unless otherwise shown on the Plans or except as herein provided, all portions of the highway and street shall be kept open to traffic. It shall be the entire responsibility of the Contractor to provide for traffic along and across the highway and streets as well as for ingress and egress to private property all as specified herein, as shown on the Plans or as directed by the City.

B. The Contractor shall plan and execute his operations in a manner that will cause the minimum interference with traffic. The Contractor shall secure the City's approval of his proposed plan of operation, sequence of work and methods of providing for the safe passage of traffic before it is placed into operation. If at any time during construction, the approved plan does not accomplish the intended purpose, due to weather or other conditions affecting the safe handling of traffic, the Contractor shall immediately make necessary changes in accordance with the latest version of the Texas Manual on Uniform Traffic Control Devices (TMUTCD) to correct the unsatisfactory conditions.

C. If due to rains or other reasons, the shoulders, slopes and ditches become unsatisfactory for handling traffic, construction operations shall be suspended and the base course or surface area shall be opened to traffic. Where the Specifications require that traffic be carried over or along

the proposed work, construction operations shall be so prosecuted and new material so kept that placement and spreading will allow the passage of traffic in comfort and safety.

D. Where an Asphalt Surface Treatment is placed for the full width in an operation, traffic shall be carried on the shoulder slopes and ditches where appropriate. During the operation of placing asphalt and aggregate, the surface or pavement shall not be closed to traffic for a period of more than 45 minutes.

E. During construction of proposed structures, unless otherwise shown on the Plans, the Contractor shall provide and maintain detours including temporary structures or crossovers of adequate structural design as may be required for the safety and convenience of the traffic.

F. At night or otherwise, all equipment not in use shall be stored in such manner and such locations as not to interfere with the safe passage of traffic. The Contractor shall provide and maintain flagmen at such points and for such periods of time as may be required to provide for the safety and convenience of public travel and Contractor's personnel, and as directed by the City. Flagmen shall have a sense of responsibility for the safety of the public and the workers, adequate training in safe temporary traffic control practices, average intelligence, good physical condition, including sight, mobility, and hearing, mental alertness and the ability to react in an emergency, courteous but firm manner, and a neat appearance. When directing traffic, flagmen shall use the standard attire, flags and signals and follow the flagging procedure set forth in "Instructions to Flagmen" published by the Texas Department of Transportation.

CIP8.06 BARRICADES AND DANGER, WARNING AND DETOUR SIGNS

A. The Contractor shall place and maintain in good condition, standard barricades and warning signs at each end of the project and at other locations therein as called for on the Plans or as called for in the Contractor's approved plan of operation. The signs shall be of standard design as shown on the Plans and in accordance with Texas Department of Transportation Standards.

B. All barricades and signs remaining in place at night and all points of hazard to traffic shall be either retro-reflective with a material that has a smooth, sealed outer surface or illuminated by lights to show the same shape and similar color both day and night. Signs which refer to construction operations which do not apply after work has ended for the day, shall be moved to points out of the clear zone that are not visible to traffic until construction is resumed.

C. The Contractor may provide special signs not covered by the Plans to protect the traveling public against special conditions or hazards, provided however, that such signs are first approved by the City.

D. Upon completion of the work, all signs and evidences thereof shall be removed by the Contractor.

CIP8.07 PROJECT IDENTIFICATION SIGNAGE

A. Project identification signage shall be in accordance with Section CIP15 - PROJECT IDENTIFICATION SIGNAGE. This does not apply to private development Projects.

CIP8.08 USE OF EXPLOSIVES

A. When the use of explosives is necessary for the prosecution of the work, the Contractor shall use the utmost care not to endanger life or property. All explosives shall be stored in a secure manner, and all storage places shall be marked clearly, "DANGEROUS - EXPLOSIVES". The method of storing and handling explosives and highly flammable materials shall conform with Federal and State laws and regulations. **The use of explosives must be approved in writing by the City prior to any use.**

B. In advance of doing any blasting work, involving the use of electric blasting caps within 200 feet of any railroad track, the Contractor shall give at least 24 hours advance notice to the nearest Roadmaster, Section Foreman, Agent, Signal Maintainer or Telegraph Operator with the request that his Superintendent be advised immediately of the pending use of explosives.

CIP8.09 PROTECTION OF ADJOINING PROPERTY

A. The Contractor shall take proper measures to protect the adjacent or adjoining property which might be damaged by any process of construction, and in case of any injury or damage resulting from any act or omission on the part of or on behalf of the Contractor, he shall restore at his own expense the damaged property to a condition equal or better than that existing before such injury or damage was done, or he shall make good such injury or damage in an acceptable manner.

CIP8.10 RESPONSIBILITY FOR DAMAGE CLAIMS

A. The Contractor shall save harmless the City from all suits, actions or claims brought on account of any injuries or damages sustained by any person or property in consequence of any neglect in safeguarding the work by the Contractor, or from any claims or amounts arising or recovered under the "Workmen's Compensation Laws" or any other laws. He shall be responsible for all damage or injury to property of any character occurring during the prosecution of the work resulting from any act, omission, neglect, or misconduct on his part in the manner or method of executing the work; or from his failure to properly execute the work; or from defective work or materials. He shall not be released from such responsibility until all claims have been settled and suitable evidence to that effect furnished the Council.

B. The Contractor's attention is directed to the fact that pipelines and other underground installations as may be shown on the Plans have been taken from the best available information. There may be other pipelines or installations. The Contractor shall save harmless the City from any and all suits or claims resulting from damage by his operations to any pipeline or underground installation.

CIP8.11 CONTRACTOR'S RESPONSIBILITY FOR WORK

A. Until the final acceptance of the work by the City as evidenced in writing, it shall be under the charge and care of the Contractor. Contractor shall rebuild and make good at his own expense all injuries and damages to the work occurring before its completion and acceptance. In case of suspension of work for any cause, the Contractor shall be responsible for the preservation of all materials. He shall provide suitable drainage of the roadway and shall erect temporary structures where required. The Contractor shall maintain the roadway in good and passable condition until final acceptance.

B. Wherever, in the opinion of the City, any roadway or portion thereof is in suitable condition for travel, it shall be opened to traffic, as may be directed, and such opening shall not be held

to be in any way the final acceptance of the roadway or any part of it or as a waiver of any of the provisions of the Contract. Where it is considered by the City to be in the public interest, any substantially completed roadway or portion thereof may be opened to traffic.

CIP8.12 PERSONAL LIABILITY OF PUBLIC OFFICIALS

A. In carrying out the provisions of the contract or in exercising any power or authority granted thereunder, there shall be no liability upon the City or its authorized assistant, either personally or otherwise, as they are agents and representatives of the City.

CIP8.13 PROSECUTION OF WORK

A. Prior to beginning construction operations, the Contractor shall submit to the City a chart or brief outlining the manner of prosecution of the work that he intends to follow in order to complete the Contract. Before any work is started on the project or development, a Pre-Construction Conference, shall be held between the City, Contractor, Developer and any other interested parties.

CIP8.14 PAYMENT

A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP9 – ENVIRONMENTAL PROTECTION PROCEDURES

CIP9.01 SCOPE OF WORK

A. This specification covers the requirements for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations under this Contract. For the purpose of this specification, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.

B. The control of environmental pollution requires consideration of air, water and land, and involves management of noise and solid waste, as well as other pollutants.

C. Schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the work. Provide erosion control measures such as diversion channels, sedimentation or filtration systems, berms, seeding, mulching or other special surface treatments as are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion control measures shall be in place in an area prior to any construction activity in that area. Specific requirements are specified in Section G6 - SEDIMENTATION AND TEMPORARY EROSION CONTROL.

D. These Specifications are intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.

E. All phases of sedimentation and erosion control shall comply with and be subject to the approval of the Texas Commission on Environmental Quality (TCEQ), and U.S. EPA.

CIP9.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including descriptions of any special operations required, temporary roads and embankments, and all other pertinent data to illustrate conformance to the specification found within.

CIP9.03 APPLICABLE REGULATIONS

A. Comply with all applicable Federal, State and local laws and regulations concerning environmental pollution control and abatement.

CIP9.04 NOTIFICATIONS

A. The Engineer and/or City will notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the Contractor in writing, through the Engineer, of any non-compliance with State or local requirements. The Contractor shall, after receipt of such notice from the Engineer or from the regulatory agency through the Engineer,

immediately take corrective action. Such notice, when delivered to the Contractor or his/her authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the City may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

CIP9.05 IMPLEMENTATION

A. Prior to commencement of the work, the Contractor shall meet with the City to develop mutual understandings relative to compliance with this provision and administration of the environmental pollution control program. All environmental and pollution control features shall be in place prior to any construction.

B. Remove temporary environmental control features, when approved by the Engineer, and incorporate permanent control features into the Project at the earliest practical time.

CIP9.06 PROTECTION OF WATERWAYS

A. The Contractor shall observe the rules and regulations of the State of Texas and agencies of the U.S. Government prohibiting the pollution of any lake, stream, river, or wetland by the dumping of any refuse, rubbish, dredge material, or debris therein.

B. Contractors are specifically cautioned that disposal of materials into any waters of the State must conform with the requirements of the TCEQ, and an applicable permit from the U.S. Army Corps of Engineers.

C. The Contractor shall be responsible for providing holding ponds or an approved method which will handle, carry through, or divert around his work all flows, including storm flows and flows created by construction activity, so as to prevent silting of waterways or flooding damage to the property or adjacent properties.

D. The Contractor is responsible for researching the need for a U.S. EPA NPDES permit for the construction site. If one is required, the Contractor is responsible for obtaining the permit and for monitoring the site per the permit requirements until final completion.

CIP9.07 DISPOSAL OF EXCESS EXCAVATION AND OTHER WASTE MATERIALS

A. Excess excavated material not required or suitable for backfill and other waste material must be disposed of at sites approved by the City and Engineer.

B. Unacceptable disposal sites include, but are not limited to, sites within a wetland or critical habitat and sites where disposal will have a detrimental effect on surface water or groundwater quality.

C. The Contractor may make his own arrangements for disposal subject to submission of proof to the Engineer that the Owner(s) of the proposed site(s) has a valid fill permit issued by the appropriate governmental agency and submission of a haul route plan including a map of the proposed route(s).

D. The Contractor shall provide watertight conveyance of any liquid, semi-liquid, or saturated solids which tend to bleed or leak during transport. No liquid loss from transported materials will be permitted whether being delivered to the construction site or being hauled away for

disposal. Fluid materials hauled for disposal must be specifically acceptable at the selected disposal site.

CIP9.08 USE OF CHEMICALS

A. All chemicals used during project construction or furnished for project operation whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must show approval of the U.S. Environmental Protection Agency or the U.S. Department of Agriculture or any other applicable regulatory agency. Use of all such chemicals and disposal of residues shall be in conformance with the Manufacturer's instructions.

B. Any oil or other hydrocarbon spilled or dumped during construction must be excavated and completely removed from the site prior to final acceptance. Soil contaminated by the Contractor's operations shall become the property of the Contractor, who will bear all costs of testing and disposal.

C. Before a Contractor commences work, the following steps shall be completed:

1. The City will inform the Contractor of his rights under the Texas Hazards Communication Act.

2. The City will provide a copy of the Chemical List giving the hazardous chemicals to which the Contractor, his employees and agents may be exposed to on the Project site.

3. The City will provide copies of all Material Safety Data Sheets (MSDSs) to the Contractor for the hazardous chemicals which he may be exposed to on the Project site.

4. The City will inform the Contractor of his obligation to inform his employees and agents of each of the above requirements.

5. The Contractor shall provide MSDSs for all hazardous chemicals he may bring onto the project site that the City’s employees may be exposed to.

6. The Contractor shall sign a Contractor Acknowledgment certifying that he/she has received the information provided by the City on hazardous chemicals and maintain the Acknowledgment with the original Contract.

CIP9.09 EROSION CONTROL

A. Provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion control measures such as siltation basins, silt fences, rock berms, hay check dams, mulching, jute netting and other equivalent techniques, shall be used as appropriate. Flow of surface water into excavated areas shall be prevented. Ditches around the construction area shall also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches shall be backfilled and the ground surface restored to original condition.

CIP9.10 PROTECTION OF STREAMS

A. Care shall be taken to prevent, or reduce to a minimum, any damage to any stream from pollution by debris, sediment or other material, or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the water in the stream, shall not be directly returned to the stream. Such waters will be diverted through a settling basin or filter before being directed into the streams.

B. The Contractor shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.

C. All preventative measures shall be taken to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a Contingency Action Plan approved by the TCEQ. Contractor shall submit two (2) copies of approved contingency plans to the Engineer.

D. Water being flushed from structures or pipelines after disinfection, with a chlorine residual of 2 mg/l or greater, shall be treated with a dechlorination solution, in a method approved by the Engineer, prior to discharge.

CIP9.11 PROTECTION OF LAND RESOURCES

A. Land resources within the project boundaries and outside the limits of permanent work shall be restored to a condition, after completion of construction, that will appear to be natural and not detract from the appearance of the Project. Confine all construction activities to the appropriate areas shown on the Plans.

B. Outside of areas requiring earthwork for the construction of the new facilities, the Contractor shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.

C. Where trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment, dumping or other operations, protect such trees by placing boards, planks, or poles around them in accordance with Section G6 - SEDIMENTATION AND TEMPORARY EROSION CONTROL. Monuments and markers shall be protected similarly before beginning operations near them.

D. Any trees or other landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition. The Engineer or the City will decide what method of restoration shall be used and whether damaged trees shall be treated and healed or removed and disposed of.

E. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than one inch in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.

F. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer or the City, shall be immediately removed and replaced.

G. The locations of the Contractor's storage, and other construction buildings, required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as shown on the Plans and shall require written approval of the Engineer and shall not be within wetlands or floodplains. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Plans showing storage facilities shall be submitted for approval of the Engineer or the City.

H. If the Contractor proposes to construct temporary roads or embankments and excavations for plant and/or work areas, he/she shall submit the following for approval at least 10 days prior to scheduled start of such temporary work.

1. A layout of all temporary roads, excavations and embankments to be constructed within the work area.

2. Details of temporary road construction.

3. Plans and cross sections of proposed embankments and their foundations, including a description of proposed materials.

4. A landscaping drawing showing the proposed restoration of the area. Removal of any trees and shrubs outside the limits of existing clearing area shall be indicated. The drawing shall also indicate location of required guard posts or barriers required to control vehicular traffic passing close to trees and shrubs to be maintained undamaged. The drawing shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the Contractor's approved drawings shall be made only with the written approval of the Engineer. No unauthorized road construction, excavation or embankment construction including disposal areas will be permitted.

G. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess waste materials, or any other vestiges of construction as directed by the Engineer or the City. It is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be prepared and seeded as described in Section G7- LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL, or as approved by the Engineer or the City.

H. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

CIP9.12 PROTECTION OF AIR QUALITY

A. Burning. The use of burning at the project site for the disposal of refuse and debris will not be permitted.

B. Dust Control. The Contractor will be required to maintain all excavations, embankment, subgrade, road bed, base course stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas within or outside the project boundaries free from dust which could

cause the standards for air pollution to be exceeded, and which would cause a hazard or nuisance to others.

C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides may be permitted with approval from the Engineer or the City.

D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Engineer or the City.

CIP9.13 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

A. During the life of this Contract, the Contractor shall maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

CIP9.14 NOISE CONTROL

A. The Contractor shall make every effort to minimize noises caused by his/her operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with State and Federal regulations.

CIP9.15 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP11 – TRENCH SAFETY REQUIREMENTS

CIP11.01 SCOPE OF WORK

A. This specification covers the requirements to plan, design, construct, install, maintain, monitor, modify as necessary, and remove upon completion, a Trench Safety System as specified herein.

B. The requirements of this Section apply to all trenches which equal or exceed a depth of five (5) feet, measured from the ground surface at the highest side of the trench to the trench bottom.

C. All applicable and non-conflicting portions of Section G4- TRENCHING, BACKFILLING AND COMPACTION apply as appropriate.

CIP11.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, but not less than 10 calendar days prior to execution of any trench excavation operations, the Contractor shall submit a site specific Trench Safety System Conformance Affidavit stating that operations will be conducted in full conformance with the OSHA Standards.

1. The Conformance Letter shall also describe the Trench Safety System techniques proposed to be used on the Project.

2. Specific references to the applicable OSHA Standards sections shall be included for each technique to be used.

B. The Trench Safety System Plan shall be in writing, site specific and sufficiently detailed and clear to be understandable and usable by all personnel who will be executing, supervising and witnessing the trenching operations. A copy of the Trench Safety System Plan shall be available at the site of trenching operations at all times.

C. If borings and/or detailed geotechnical analyses are required to develop the Trench Safety System Plan, they shall be executed by the Contractor at his cost.

D. For trenches having depths greater than the various limits given in the OSHA Standards (8, 12 or 20 feet, depending on the techniques used), a site specific protective system shall be designed by a Registered Professional Engineer, registered in the State of Texas experienced in soil mechanics and structural design. The design shall be signed, sealed and dated by the Professional Engineer, and it shall identify those specific locations where the design is applicable.

CIP11.03 GENERAL

A. All materials and products incorporated into the Trench Safety System shall be suitable for their intended uses; shall meet all design criteria and parameters used by the Trench Safety System designer; and shall meet all applicable requirements of OSHA Standards.

CIP11.04 METHODS OF PROVIDING FOR TRENCH SAFETY

A. Protective systems referenced in this Section shall be as defined and described in 29 CFR 1962.652, "Requirements for Protective Systems."

B. It is the duty, responsibility and prerogative of the Contractor to determine the specific applicability of a proposed Trench Safety System for each field condition encountered on the Project. Contractor specifically holds the City, Engineer, and any of their designated representatives harmless in any actions resulting from the failure or inadequacy of the Trench Safety System used to complete the Project.

C. Unless otherwise noted on the drawings or excluded below, Sloping/Benching, Trench Shielding with

trench boxes, and/or Sheeting/Shoring/Bracing protective systems may be used on this Project.

D. Restrictions on the use of the various protective systems for this Project are as follows:

1. Sloping or Benching. Allowed with prior approval from the City.

2. Trench Shields/Boxes. No restrictions.

3. Sheeting/Shoring/Bracing. No restrictions.

CIP11.05 INSPECTION DUTIES OF CONTRACTOR

A. Provide a Competent Person, as defined in the OSHA Standards, to make frequent inspections of the trenching operations and the Trench Safety System in full conformance with the OSHA Standards.

B. If evidence of a possible cave-in or landslide is apparent, all work in the trench shall immediately cease and not be resumed until all necessary precautions have been taken to safeguard personnel entering the trench.

C. In an emergency situation, which may threaten or affect the safety or welfare of any persons or properties, the Contractor shall act at his discretion to prevent possible damage, injury or loss. Any additional compensation or time extension claimed for such actions shall be considered in view of the cause of the emergency and in accordance with the General Conditions.

CIP11.06 MEASUREMENT AND PAYMENT

A. Payment for the Trench Safety Plan shall be on a Lump Sum price basis, the Lump Sum price being as given in the Bid Proposal.

B. Payment for the Trench Safety Plan Implementation shall be on a unit price basis, the unit price being as given in the Bid Proposal, and the unit of measure being linear feet of trench and/or square foot of bore pit or structure, without regard to whether specific trench safety precautions are required or used for the trench reach being measured.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP12 – TESTING OF PIPELINES AND MANHOLES

CIP12.01 SCOPE OF WORK

A. This specification covers the requirements to perform ex-filtration testing and deflection testing of gravity pipelines and to perform pressure and leakage testing of pressure pipelines.

CIP12.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including a description of the deflection test procedure for flexible pipe greater than 27-inches in diameter, video inspection of gravity wastewater lines, and all other pertinent data to illustrate conformance to the specification found within.

CIP12.03 GENERAL

A. The entire length of the installed gravity line and the force main shall be field tested for water tightness. Gravity wastewater lines shall be video taped by camera.

B. Hydrostatic pressure and leakage tests shall be made on all pressure pipelines carrying wastewater or water.

C. All labor and equipment, including, but not limited to test pump with regulated by-pass meters and gauges required for conducting pipeline tests, shall be furnished by the Contractor. The Contractor shall furnish equipment and necessary piping as required to transport water used in testing from source to test location.

D. Time and sequence of testing shall be scheduled by the Contractor, subject to observation and approval by the City. The Contractor shall provide adequate labor, tools and equipment to operate valves and to locate and repair any leaks discovered during the initial filling of the pipeline prior to actual testing or during the course of the tests.

CIP12.04 CLEANING

A. At the conclusion of the work, thoroughly clean all pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered the pipes during the construction period. Debris cleaned from the lines shall be removed from the low end of the pipeline. If after this cleaning, obstructions remain, they shall be removed. After the pipelines are cleaned and if the groundwater level is above the pipe or following a heavy rain, the Engineer will examine the pipes for leaks. If any defective pipes or joints are discovered, they shall be repaired, and/or replaced by the Contractor at his expense.

CIP12.05 TEST PROCEDURES FOR GRAVITY PIPELINES, FORCE MAINS AND MANHOLES

A. Scope: After sewers and manholes have been installed and backfilled, subject newly laid gravity lines and manholes to a leakage test. Contractor to furnish all labor, materials, tools and equipment to test lines. Take such precautions as required to prevent damage to lines and appurtenances being tested. Repair any damage resulting from test at Contractor's expense. Conduct test in presence of Engineer or designated City Representative.

B. Test Procedures for Leakage Test of Gravity Sewer: Contractor, at his option, may test lines by hydrostatic or low pressure air test as specified below. However, the Engineer may direct a specific test be performed in specified areas of the Project.

C. Infiltration or Exfiltration Test (for Gravity Sewer)

1. Preparation: Seal ends of line section being tested with water tight plugs, equipped with pipe

riser inserted and braced in the inlet of the manholes. Fill section with water 24-hours prior to start of test. Fill slowly from downstream manhole in test section so that no air is trapped in the line. Leave outlets of stacks and service lines exposed and unplugged until after exfiltration test has been made. Outlets terminating below level of test water surface to be temporarily extended upward by installing additional lengths of pipe. After completion of satisfactory test, remove lengths of pipe added for test.

2. Duration of Test: Test for 24-hours. Minimum head of either two (2) feet measured above the crown, inside pipe at upper end of section or four (4) feet measured above trench water table, whichever is higher, so that a net positive of two (2) feet TCEQ is used for testing.

3. Allowable Leakage: Allowable leakage or exfiltration in any individual section under construction shall not exceed 10 gallons per inch of inside diameter per mile of pipe per 24 hours.

D. Low Pressure Air Test

1. Preparation: Clean pipe to be tested by propelling snug fitting inflated rubber ball through the pipe with water or by use of water jet cleaning equipment. After manhole to manhole reach of pipe has been backfilled and cleaned, pneumatic plugs shall be placed in the line at each manhole and inflated to 25 psig. Add air slowly to the section under test until the internal pressure of 4.0 psig is obtained. Allow at least two (2) minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.

2. Duration of Test and Allowable Leakage

Decrease pressure to 3.5 psig and start stopwatch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. Minimum permissible pressure holding times are indicated in seconds and shall be computed by the following equation:

$T= (0.085xDxK)/Q$

T = time for pressure to drop 1.0 pound per square inch gauge in seconds
K = 0.000419xDxL, but not less than 1.0
D = average inside diameter in inches
L = length of line of same pipe size being tested, in feet
Q = rate of loss assume 0.0015 cubic feet per minute per square foot internal surface shall be used

Since K value of less than 1.0 shall not be used, there are minimum times for each pipe diameter as outlined below:

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
(inches)	(seconds)	(feet)	(seconds)
6	340	398	0.855(L)
8	454	298	1.520(L)
10	567	239	2.374(L)
12	680	199	3.419(L)
15	850	159	5.342(L)
18	1020	133	7.693(L)
21	1190	114	10.471(L)
24	1360	100	13.676(L)
27	1530	88	17.309(L)

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
30	1700	80	21.369(L)
33	1870	72	25.856(L)
36	2040	66	30.771(L)

The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined above or until failure. Lines with a 27-inch average inside diameter and larger may be air tested at each joint. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 psi gauge to 2.5 psi gauge shall be 10 seconds.

E. Test Procedures for Hydrostatic Test for Manholes

1. Manholes shall be tested for leakage separately and independently of the wastewater lines by hydrostatic exfiltration testing, or other methods acceptable to the City. If a manhole fails a leakage test, the manhole must be made water tight and retested. The maximum leakage for hydrostatic testing shall be in accordance with TCEQ §217.57 Testing Requirements for Installation of Gravity Collection System Pipes. Alternative test methods must ensure compliance with the above allowable leakage. Hydrostatic exfiltration testing shall be performed as follows: all wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one (1) hour. For concrete manholes a wetting period of 24-hours may be used prior to testing in order to allow saturation of the concrete.

F. Test Procedures for Vacuum Testing Manholes

1 In lieu of the hydrostatic exfiltration test, manholes may be tested by vacuum. Manholes tested by vacuum shall be performed by the Contractor in compliance with these specifications.

2. Manholes shall be tested after installation of all connections (existing and/or proposed) in place. All lift holes shall be plugged with an approved non-shrink grout and all drop connections and gas sealing connections shall be installed prior to testing. The lines entering the manhole shall be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole. The plugs shall be installed in the lines beyond the drop-connections, gas sealing connections, etc. The test head shall be placed inside the frame at the top of the manhole and inflated in accordance with the manufacturer's recommendations. A vacuum of 10-inches of mercury shall be drawn, and the vacuum pump shall be turned off. With the valve closed, the level of vacuum shall be read after the required test time as shown in the following table. If the drop in the level is less than one (1) inch of mercury (final vacuum of nine (9) inches of mercury), the manhole will have passed the vacuum test. The required test time shall be 120-seconds.

3. Manholes which have a final vacuum of nine (9) inches of mercury after the time indicated will be accepted. Any manhole which fails the vacuum test as described above shall be repaired with an approved non-shrink grout or other material acceptable to the Engineer and the City based on the material from which the manhole is constructed. The manhole shall be retested as described above until a successful test is made.

G. Exfiltration Test

1. Preparation: Seal ends of manhole being tested with watertight plugs. Fill manhole 24-hours prior to start of test. Manholes to be filled to top of manhole cone section.

2. Duration of Test: The test shall be performed for a 24-hour duration.

3. Allowable Leakage: No leakage is allowed. The water elevation shall be the same at beginning and end of test period.

H. Deflection Testing

1. Deflection tests shall be performed on all flexible pipes. For pipes with inside diameters less than 27-inches, a rigid mandrel shall be used to measure deflection. For pipelines with an inside diameter of 27-inches and greater, the Contractor shall submit to the Engineer the proposed method, with which shall provide a precision of ± two tenths of one percent (0.2%) deflection, for review and approval by the Texas Commission on Environmental Quality. The test shall be conducted after final backfill has been in place at least 30 days in the presence of a representative of the City's Utilities Department. No pipe shall exceed a deflection of five percent (5%). If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. Test shall be performed without mechanical pulling devices.

2. Mandrel Sizing: The rigid mandrel shall have an outside diameter (O.D.) equal to 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter of the pipe minus two minimum wall thickness for O.D. controlled pipe and the average inside diameter for the I.D. Controlled pipe, all dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

3. Mandrel Design: The rigid mandrel shall be constructed of a metal or rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.

4. Method Options: Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test. A deflectometer may be approved provided the Contractor notifies the Engineer in a timely manner and submits adequate information for the Engineer to submit to the Texas Commission on Environmental Quality for review and approval. Mandrels with removable legs or runners may also be approved provided the Contractor notifies the Engineer in a timely manner and submits adequate information for the Engineer to submit to the Texas Commission on Environmental Quality for review and approval.

I. Repairs of Lines: Remove and replace or make approved corrective repairs to any section of line or manhole which has leakage that exceeds above amounts. Repair any individual leaks that may appear whether or not overall section meets leakage requirements. Individual leaks will ordinarily be revealed by looking through sewer with a light while groundwater level is over sewer, during water tamping operations or immediately after water leakage is emptied from sewer.

J. Retest: Sewers and/or manholes failing to meet requirements of leakage test will, after repair by Contractor, be tested again for leakage. No sewer or manhole will be accepted until leakage is less than allowable amount.

K. Video Inspection

1. The use of a television camera for inspection prior to placing the sewer in service will be required. Video inspection is at the cost of the Contractor, and copies of the DVD will be presented to the City prior to final acceptance. One (1) copy of the DVD shall be submitted to the City.

2. Post construction video of the gravity wastewater lines will be evaluated on a case-by-case basis for acceptance. Preparation for video taping of wastewater line shall be as follows:

a. Flush and clean the gravity wastewater line prior to video taping.
b. The videotape shall display the station, in accordance with the Plans and Standards, and counter on the screen. Manhole numbers and stations shall correspond to the contract documents.
c. If debris is evident in the line during the video, the line will be flushed and cleaned to allow a clean video.
d. All manholes will be identified at the beginning and end of the video corresponding to contract documents with upstream and downstream ends identified.
e. Additional video inspections shall be performed prior to completion of one-year warranty period and submitted on DVD.

L. Force Main

1. Force main testing shall be in accordance with TCEQ §217.68 Force Main Testing.

CIP12.06 TEST PROCEDURES FOR PRESSURE PIPELINES

A. General

1. After the pipe has been laid and backfilled and the backfill has been otherwise consolidated, all newly laid pipe, or any valved section thereof, shall be subjected to the hydrostatic pressure specified below for that particular type of pipe. The duration of the hydrostatic test shall be at least two (2) hours. Unless otherwise specified or noted on the Plans. All meters, fixtures, devices or appliances which are connected to the pipeline system and which might be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped during the testing procedures.

2. Each valved (capped or plugged) section of pipe shall be filled slowly with water and all air shall be expelled. If permanent air vents are not located at all high points, the Contractor shall install, at his own expense, corporation or blow-off cocks at such points so that air can be expelled as filling takes place. After verification that all air has been expelled, the cocks shall be closed and the pipe kept filled until tested. All exposed pipe, fittings, valves, hydrants and joints shall be examined while under test pressure and all visible leaks shall be stopped. Any cracked or defective pipe, fittings, valves or hydrants discovered during testing shall be removed and replaced by the Contractor. Replacement shall be with sound material and the test shall be repeated until satisfactory to the City.

B. Special Requirements: Where any section of pipeline is provided with concrete reaction blocking, the hydrostatic pressure shall not be made until at least five (5) days have elapsed after installation of the blocking. However, if high-early-strength cement is used in the concrete, two (2) days shall have elapsed prior to testing.

C. Leakage Test: A Leakage Test will be conducted on each valved section over the entire Project. The leakage test shall be at 150 psi for at least four (4) hours. Fire lines shall be tested at 200 psi for two (2) hours with 0 loss.

D. Allowable Leakage

1. The allowable hydrostatic leakage rate shall be based on the following formula:
Fire lines 0 loss
$L = SD\sqrt{P}/148{,}000$
L = testing allowance in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of the pipe in inches
P = average test pressure during the hydrostatic test in pounds per square inch (gauge)

Table 6A
Hydrostatic testing allowance per 1,000 ft of pipeline* - *gph*†

Average Test Pressure		Nominal Pipe Diameter, in.															
psi	(kPa)	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54	60
300	(2,070)	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21	4.92	5.62	6.32	7.02
275	(1,900)	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03	4.71	5.38	6.05	6.72
250	(1,720)	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85	4.49	5.13	5.77	6.41
225	(1,550)	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65	4.26	4.86	5.47	6.08
200	(1,380)	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59	5.16	5.73
175	(1,210)	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22	3.75	4.29	4.83	5.36
150	(1,030)	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98	3.48	3.97	4.47	4.97
125	(860)	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72	3.17	3.63	4.08	4.53
100	(690)	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43	2.84	3.24	3.65	4.05
75	(520)	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.05	1.17	1.40	1.76	2.11	2.46	2.81	3.16	3.51
50	(340)	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.96	1.15	1.43	1.72	2.01	2.29	2.58	2.87

* *If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size.*

† *Calculated on the basis of Eq. 1.*

a. These formulas are based on a testing allowance of 11.65 gpd/mi/in. (1.079 L/d/km/mm) of nominal diameter at a pressure of 150 psi (1,034 kPa).

b. 5.2.1.6.1 Testing allowance at various pressures is shown in Tables 6A and 6B.

c. 5.2.1.6.2 When testing against closed metal-seated valves, an additional testing allowance per closed valve of 0.0078 gal/h/in. (1.2 mL/h/mm) of nominal valve size shall be allowed.

d. 5.2.1.6.3 When hydrants are in the test section, the test shall be made against the main valve in the hydrant.

e. 5.2.1.7 Acceptance of installation. Acceptance shall be determined on the basis of testing allowance. If any test of laid pipe discloses a testing allowance grater than that specified in Sec. 5.2.1.6, repairs or replacements shall be accomplished in accordance with the specifications.

f. 5.2.1.7.1 All visible leaks are to be repaired regardless of the allowance used for testing.

2. If such testing discloses leakage in excess of this specified allowable, the Contractor, at his expense, shall locate and correct all defects in the pipeline until the leakage is within the specified allowance. All known leaks, irregardless of this test, shall be repaired.

E. Pressure Test: After satisfactorily completing the leakage test, each valved section over the entire project, shall be tested at 200 psi for a sufficient period (approximately 10 min) to discover all leaking or defective materials and/or workmanship.

F. Disinfecting Water Mains: The Contractor shall disinfect all water mains before the new facilities are placed into service. Disinfection must be performed in accordance with AWWA C651, latest revision and water samples must be submitted to a laboratory approved by the Texas Department of Health. Sample must be collected by the Contractor or his representative in the presence of the City or his representative. The Contractor shall be responsible for delivering the samples to an approved laboratory for testing. Sample results must indicate the facility is free of microbiological contamination before it is placed into service. It shall be the Contractor's responsibility to obtain a current copy of AWWA C651 to determine the correct forms of chlorine for disinfection, the basic disinfection procedure, preventive and corrective measures during construction, methods of chlorination, final flushing procedures, procedures for bacteriological tests, procedures for redisinfection and disinfection procedures when cutting into existing mains. The Contractor, at its expense, will supply the concentrated chlorine disinfecting material, the City's personnel will supervise and direct the overall sterilization procedure. The Contractor, at his own expense, shall provide all other equipment, supplies and necessary labor to perform the sterilization under general supervision by the City.

G. General

1. All valves shall be arranged to prevent the strong disinfecting dosage from flowing back into the existing water supply piping. The new pipeline shall then be completely filled with disinfecting solution by feeding the concentrated chlorine and approved water from the existing system uniformly into the new piping in such proportions that every part of the line has a minimum concentration of chlorine as prescribed in AWWA C651.

2. Unless otherwise identified, all quantities called for herein refer to measurements by the testing procedures in the current edition of "Standard Methods of Examination of Water and Wastewater". The chlorine concentration of each step in the sterilization procedure shall be verified by chlorine residual determinations. This disinfecting solution shall be retained in the piping for at least twenty-four (24) hours, and all valves, hydrants, etc., shall be operated to disinfect all their parts. After this retention period, the water shall contain no less than the chlorine residual prescribed in AWWA C651 throughout the treated section of the pipeline.

3. This heavily chlorinated water shall then be carefully flushed from the line until the chlorine concentration is not higher than the residual generally prevailing in the existing distribution system, or approximately 1.0 parts per million. Proper planning and appropriate preparations to handle, dilute and dispose of this strong chlorine solution without causing injury or damage to the public, the water system, the environment must be approved by the City before flushing of the line may begin, and the flushing shall be witnessed by an authorized representative of the City.

H. Bacteriological Testing

1. After final flushing of the strong disinfecting solution, water samples from the line shall be tested for bacteriological quality, at the Contractor's expense, and must be found free of coliform organisms before the pipeline may be placed in service. One (1) test sample shall be drawn from the end of the main and additional samples collected at intervals of not more than one-thousand (1,000) feet along the pipeline. A minimum of three (3) samples must be collected.

2. The Contractor, at his own expense, shall install sufficient sampling taps at proper locations along the pipeline. Each sampling tap shall consist of a standard corporation cock installed in the line and extended with a copper tubing gooseneck assembly. After samples have been collected, the gooseneck assembly shall be removed and retained for future use.

3. Samples for bacteriological analysis shall be collected only from suitable taps, in sterile bottles. Collection of the test samples shall be made in the presence of City personnel. If the initial disinfection fails to produce acceptable sample tests, the disinfection procedure shall be repeated (without extra compensation) until satisfactory test results have been obtained, before the piping may be placed in service.

CIP12.07 FINAL ACCEPTANCE

A. No pipe installation will be accepted until all known leaks have been repaired whether or not leakage is within allowable limits. Locating and repairing of leaks shall be performed by the Contractor at no additional cost to the City.

B. The City will certify that all required pressure and leakage tests have been successfully completed before the pipeline is accepted.

CIP12.08 PAYMENT

A. No separate payment will be made for work completed in accordance with this specification,

and the cost thereof will be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP13 – SUMMARY OF TESTING (MISCELLANEOUS)

CIP13.01 SCOPE OF WORK

A. This specification covers the requirements to perform testing of various work items for this Project.

CIP13.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature and all other pertinent data to illustrate conformance to the specification found within.

CIP13.03 TESTING FOR ROADS

A. Testing for roads shall be in accordance with Table 13-1.

Table 13-1

Item	Test Method	Passing Criteria	Comments
Hot Mix Asphaltic Concrete (HMAC)	Tex-200-F	See SD1.06 A	Sieve Analysis of Fine and Coarse Aggregate
	Tex-207-F	94.5%-97.5%Lab Density; 91.0%-96.0%In-PlaceField Density	Determining Density of Compacted Bituminous Mixtures
	Tex-210-F	See SD 1.06 B	Determining Asphalt Content of Bituminous Mixtures by Extraction
	Tex-227-F		Max. Specific Gravity of Bituminous Mixtures
	Tex-208-F	Max 35	Stability
Trench Backfill	Applicable Tex Testing Method	See Section G4.05	Minimum of one test every 250 linear feet of trench length for each lift.
Embankment	Tex-114-E		Test every 2,000 SY of roadbed surface
Flexible Base	Tex-107-E, Part II Tex-411-A Tex-110-E	2% shrinkage	Bar Linear Shrinkage Magnesium Soundness Sieve Analysis
	Tex-113-E	100% Density	Moisture Density
	Tex-115-E		Roadway Density
	Tex-116-E	40 Max.	Wet Ball Mill
	Tex-117-E	45 psi @ 0 psi lateral & 175 psi @ 15 psi lateral Max. increase ≤ 20	Triaxial Test (Part I or II)
	Tex-460-A	Plasticity Index ≤ 10	Particle Count (Part I)
	Tex-106-E	Liquid Limit ≤35	Plasticity Index
	Tex-104-E	±2% Optimum	Liquid Limit
	Tex-103-E		Moisture Content

Table 13-1 (continued)

Item	Test Method	Passing Criteria	Comments
Striping	Tex-828-B	10 or more stripes visible (day) 6 or more stripes visible (night) 0.060-inches minimum thickness for edgeline markings	Glass Beads: If criteria is not met, check Tex-828-B for scheduling replacement of striping.
	Tex-854-B	0.090-inches minimum thickness for stop bars, legends, symbols, gore and centerline/no passing barrier line markings 0.180-inches maximum thickness for all markings	The average of the readings across each sample must be equal to or above the specified minimum thickness. No reading should be more than 10-mils below the specified minimum thickness.

CIP13.04 TESTING FOR WATER/WASTEWATER

A. Testing for water/wastewater shall be in accordance with Table 13-2.

Table 13-2

Item	Test Method	Passing Criteria	Comments
Valves, Hydrants and Appurtenances	Manufacturer's Recommendations	Manufacturer's Recommendations	Functional field test of each valve, including actuators and valve control equipment.
Water and Wastewater Lines			As described in Section CIP12: Testing of Pipelines and Manholes

CIP13.05 TESTING FOR CONCRETE

A. Testing for concrete shall be in accordance with Table 13-3.

Table 13-3

Item	Test Method	Passing Criteria	Comments
Asphalt Board	Tex-524-C	Deflection from horizontal <1:3 1/2	
Concrete Slump			See Table 13-4 for Slump
Coarse Aggregate	Tex-413-A	0.25% by weight clay lumps 1.00% by weight shale 5.00% by weight laminated and/or friable particles	See Table 13-5 for Gradation
	Tex-410-A	40% wear	
	Tex-411-A	12% loss Sodium Sulfate 18% loss Magnesium Sulfate	Soundness Test

Table 13-3 (continued)

Item	Test Method	Passing Criteria	Comments
Fine Aggregate	Tex-612-J	60% by weight acid insoluble residue subject to direct traffic.	
	Tex-408-A	Color shall not be darker than Organic Color No. 3 (Gardner No. 11)	Color Test
	Tex-401-F		See Table 13-6 for Gradation
	Tex-203-F	Not less than 80	Sand Equivalent
	Tex-402-A	Between 2.3 & 3.1 for Non-Class K Between 2.6 & 2.8 for Class K	Fineness Modulus
Membrane Curing	Tex-219-F	2% loss for 24-hour test 4% loss for 72-hour test	Water Retention Test

Table 13-4

Concrete Designation	Slump	Maximum Slump
1. All drill shaft	6	7
2. Uncased drill shafts, thin walled sections (<9") and pre-stressed concrete members	4	5
3. Slabs, caps, columns, piers, wall sections over 9", etc.	3	4
4. Underwater or seal concrete	6	7
5. Riprap, curb, gutter and other miscellaneous concrete.	As specified by City.	

Table 13-5

Aggregate Grade No.	Nominal Size (in)	Amount Retained (%)								
		2 1/2 in	2 in	1 1/2 in	1 in	¾ in	½ in	3/8 in	No 4	No 8
1	2	0	0-20	15-50		60-80			95-100	
2 (467)*	1 1/2			0-5		30-65		70-90	95-100	
3	1 1/2			0-5		10-40	40-75		95-100	
4 (57)*	1				0-5		40-75		90-100	95-100
5 (67)*	¼					0-10		45-80	90-100	95-100
6 (7)*	½							30-60	85-100	95-100
7	3/8							5-30	75-100	
8	3/8							0-5	35-80	90-100

Table 13-6

Aggregate Grade No.	Amount Retained (%)							
	3/8 in	No 4	No 8	No 16	No 30	No 50	No 100	No 200
1	0	0-5	0-20	15-50	35-75	65-90	90-100	97-100

CIP13.06 PAYMENT

A. No separate payment will be made for work completed in accordance with this specification, and the cost thereof will be included in the appropriate items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP14 – PROJECT CLOSEOUT

CIP14.01 SCOPE OF WORK

A. This specification covers the administrative and procedural requirements for Project closeout, including but not limited to:

1. Closeout procedures.
2. Final cleaning.
3. Adjusting.
4. Project record documents.
5. Spare parts and maintenance materials.

CIP14.02 RECORD DOCUMENTS

A. Maintain on site, one set of the following documents; actual revisions to the Work shall be recorded in these documents:

1. Contract Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other Modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.

B. Store Record Documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and Modifications.

E. Contract Drawings and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to finish floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

4. Field changes of dimension and detail.

5. Details not on original Contract Drawings.

F. Submit documents to City with claim for final Application or Payment. Retention monies will not be released until complete record documents have been submitted.

CIP14.03 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's and/or City's inspection.

B. Provide submittals to the City that are required by governing or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

CIP14.04 FINAL CLEANING

A. At the completion of work and immediately prior to final inspection, cleaning of the entire project shall be accomplished according to the following provisions:

1. The Contractor shall thoroughly clean, sweep, wash, and polish all work and equipment provided under the Contract, including finishes. The cleaning shall leave the structures and site in a complete and finished condition to the satisfaction of the City.

2. All Subcontractors shall similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their contracts.

3. The Contractor shall remove all temporary structures and all debris including all dirt, sand, gravel, rubbish and waste material.

4. Should the Contractor not remove rubbish or debris, or not clean the buildings and site as specified above, the City reserves the right to have the cleaning done at the expense of the Contractor.

B. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning material manufacturers.

D. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces and of concealed spaces.

E. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.

F. Repair, patch, and touch up marred surfaces to specified finish to match adjacent surfaces.

G. Replace air-handling filters if units were operated during construction.

H. Vacuum clean all interior spaces, including inside cabinets. Broom clean paved surfaces, mow

any areas planted with grass which are in excess of two (2) inches high, and rake clean other surfaces of grounds.

I. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.

J. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly-painted surfaces.

CIP14.05 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

CIP14.06 FINAL INSPECTION

A. After final cleaning and restoration and upon written notice from the Contractor that the work is completed, the Engineer and/or City will make a preliminary inspection with the Contractor present. Upon completion of this preliminary inspection, the Engineer and/or City will notify the Contractor, in writing, of any particulars in which this inspection reveals that the work is defective or incomplete.

B. Upon receiving written notice from the Engineer and/or City, the Contractor shall immediately undertake the work required to remedy deficiencies and complete the work to the satisfaction of the City.

C. When the Contractor has corrected or completed the items as listed in the Engineer's/City's written notice, he/she shall inform the City in writing that the required work has been completed. Upon receipt of this notice, the Engineer and/or City and the Contractor, will make the final inspection of the Project.

D. Should the Engineer and/or City find all work satisfactory at the time of his inspection, the Contractor will be allowed to make application for final payment in accordance with the provisions of the Standard Form of Agreement. Should the Engineer and/or City still find deficiencies in the work, the Engineer and/or City will inform the Contractor of the deficiencies and will deny the Contractor's request for final payment until such time as the Contractor has satisfactorily completed the required work. Additional inspections of deficiencies shall be paid for by the Contractor at $200.00 per inspection.

CIP14.07 ACCESSORY ITEMS

A. The Contractor shall provide to the City, upon acceptance of the equipment, all special accessories required to place each item of equipment in full operation. These special accessory items include, but are not limited to, the specified spare parts, adequate oil and grease as required for the first lubrication of the equipment, initial fill-up of all chemical tanks and fuel tanks, light bulbs, fuses, hydrant wrenches, valve wrenches, valve keys, handwheels, and other expendable items as required for initial start-up and operation of all equipment.

CIP14.08 GUARANTEES, BONDS, AND AFFIDAVITS

A. No application for final payment will be accepted until all guarantees, bonds, certificates, licenses, and affidavits required for work or equipment as specified are satisfactorily filed with the Engineer.

CIP14.09 RELEASE OF LIENS OR CLAIMS

A. No application for final payment will be accepted until satisfactory evidence of release of liens has been submitted to the City as required by the Standard Form of Agreement.

CIP14.10 FINAL PAYMENT

A. Final payment will be made to the Contractor in accordance with Item 47 - "Payment Procedures", Standard Form of Agreement. Final payment and release of retention monies will not be made until the Contractor has submitted one set of as-built plans to the City for the Project.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP15 – PROJECT IDENTIFICATION SIGNAGE

CIP15.01 SCOPE OF WORK

A. This specification covers the requirements for furnishing, fabricating and erecting Project Signs on Capital Improvement Projects (CIPs) and for project identification at other construction sites when required on the Plans or by the City.

CIP15.02 MATERIALS

A. Sign Face: The sign face shall be manufactured on standard exterior waterproof plywood sheets or other suitable material approved by the Engineer or the City. Unless indicated otherwise on the Plans, the thickness of the plywood sheet shall be a minimum of $^{3}/_{4}$-inches.

B. Posts: Plastic post, of the size indicated on the Plans, shall be pressure treated with pentachlorophenol.

C. Paint: Exterior oil base paint shall be used and colors shall be as indicated on the Plans.

D. Signs for Capital Improvements Projects: City seals shall be provided by the City.

CIP15.03 INSTALLATION

A. The signs shall be erected at each major entrance to the project for maximum public identification and exposure. At locations where construction is confined to an adequate area defined by the City, the installed sign size shall be four feet by eight feet (4’ x 8’). At locations where roadway construction is in progress, such as a street paving or construction of a sidewalk, the sign shall be two feet by three feet (2’ x 3’). The signs shall be posted on portable wood frames or stanchions and will be located in the proximity of the work area as construction progresses. All lumber shall be painted with two (2) coats of paint as indicated on the Plans.

B. In special cases, the size of the sign may be changed to meet special requirements but general proportions shall be maintained.

C. It shall be the responsibility of the Contractor to maintain and relocate signs, if necessary, during the progression of the project. Care shall be exercised to assure that placement of the signs does not interfere with or cause sight obstruction to vehicular and pedestrian traffic.

D. The Contractor may install, at his own expense, company signs to identify the Contractor, Developer, etc. Signs are to be securely attached to the posts at locations indicated on the Plans and shall not be larger than 18-inches by 36-inches.

CIP15.04 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION CIP16 – WARRANTY

CIP16.01 SCOPE OF WORK

A. This specification covers the requirements of the Contractor's or Developer's two (2) year warranty period for all work performed on the Project.

B. Individual specification sections may require warranty periods greater than one year on certain pieces of equipment or construction. When so specified, the longer warranty periods as specified will take precedent over the one year warranty specified below.

CIP16.02 WARRANTY

A. Upon final acceptance by the City of Georgetown, the Contractor warrants for a period of two (2) years, the construction of the Project according to Plans and Specifications as they may be modified in accordance with the Contract Documents, and further warrants the proper operation of mechanical, electrical, and other devices or other equipment, if any, included in the project for a period of two (2) years. The Contractor or Developer warrants to the City that all materials and equipment furnished under this Contract shall be new unless otherwise approved by the City's Representative and that all work will be of good quality, free from faults and defects, and in conformance to these requirements, including substitutions not properly approved and authorized, may be considered defective.

B. This warranty is in addition to any rights or warranties expressed or implied by law and consumer protection claims arising from misrepresentations by the Contractor or Developer. This warranty obligation shall be covered by any performance or payment bonds tendered in compliance with the Contract Provisions.

C. If within two (2) years after the date of substantial completion of the work or designated portion thereof, or within two (2) years after acceptance by the City of the designated Project, or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents, any of the work is found or determined to be defective, including obvious defects, or otherwise not in accordance with the Contract Documents, the Contractor or Developer shall correct it promptly.

D. If within 10 days after the City has notified the Contractor or Developer of a defect, failure, or abnormality in the work, the Contractor or Developer has not started to make the necessary repairs or adjustments, the City is hereby authorized to make the repairs or adjustments, or to order the work to be done by a third party. The cost of the work shall be paid by the Contractor or Developer. The cost of all materials, parts labor, transportation, supervision, special tools, and supplies required for the replacement or repair of parts and for correction of defects, shall be paid by the Contractor, Developer or by the surety. This guarantee shall be extended to cover all repairs and replacements furnished under the guarantee, and the period of the guarantee for each repair or replacement shall be two (2) years after the installation or completion. The two (2) year warranty shall cover all work equipment, and materials that are part of this project, whether or not a warranty is specified in the individual section prescribing that particular aspect of the work. Where more than a two (2) year warranty is specified in the individual section, that warranty shall govern.

E. After receipt of written notice from the City to begin corrective work, the Contractor or Developer shall promptly begin the corrective work, unless the City's Representative has previously given the Contractor a written acceptance of such condition. This obligation shall survive the termination of the Contract. This guarantee shall not constitute the exclusive remedy of the City, nor shall other remedies be limited to either the warranty or guarantee period.

CIP16.03 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION CIP17 – INSPECTION OF PROJECTS

CIP17.01 INSPECTION

A. All Projects, whether by a private development or the City of Georgetown, shall be inspected by the City or a designated representative of the City.

B. The time that the City of Georgetown or its designated representative will be available for inspection is from 8:00 a.m. to 12:00 p.m. and 1:00 p.m. to 5:00 p.m. on working days. Working days shall be defined as Monday through Saturday (excluding all holidays observed by the City of Georgetown). All inspections shall be scheduled with the City a minimum of two (2) working days prior to the inspection.

C. If the Contractor, for his convenience and at his own expense, should desire to carry on his work at night or outside regular hours, he shall submit a written approval request to the City and he shall allow ample time for satisfactory arrangements to be made for inspecting the Work in progress. The Contractor shall pay the expenses for extra inspection required for work outside regular hours at a rate of $50.00/hour. Normal working hours for this purpose are Monday through Saturday, 7:00 a.m. to 6:00 p.m. The Contractor shall light the different parts of the Project as required to comply with all applicable Federal and State regulations and with all applicable requirements of the City of Georgetown.

CIP17.02 AUTHORITY AND DUTIES OF INSPECTORS

A. Inspectors will be authorized to inspect all work done and all materials furnished. Such inspection may extend to all or to any part of the Work and to the preparation or Manufacturer of the materials to be used. Such inspection will not relieve the Contractor from any obligation to perform the Work in accordance with the requirements of the Specifications. In case of any dispute arising between the Contractor and the Inspector as to materials furnished or the manner of performing the Work, the Inspector will have authority to reject materials or suspend work until the question at issue can be referred to and decided by the City. The Inspector will not be authorized to revoke, alter, enlarge, or release any requirement of these Specifications, nor to approve or accept any portion of the Work, nor to issue instruction contrary to the Plans and Specifications. He will in no case act as foreman or perform other duties for the Contractor nor interfere with the management of the Work.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION G2 – SITE PREPARATION

G2.01 SCOPE OF WORK

A. This specification covers the requirements for performing all clearing, grubbing and stripping of topsoil complete as shown on the Plans and as specified herein.

G2.02 SUBMITTALS

A. None required unless specifically called for in the Plans, Standards or requested by the City or the Engineer.

G2.03 CLEARING AND GRUBBING

A. Except as otherwise directed, cut, grub, remove and dispose of all trees, stumps, brush, shrubs, roots and any other objectionable material within the limits defined on the Plans.

B. All trees, stumps, brush, shrubs, roots and other objectionable material shall be cut, grubbed, removed and disposed of from areas to be occupied by buildings, structures, roads, pipelines and any other areas to be stripped. Trees and brush shall be removed to a depth at least three (3) feet below the finished grade.

C. In addition, heavy growths of weeds or other plants shall be stripped from the surface in order to provide clear access to the work site and to prevent their inclusion in stockpiled soil which is to be reused later. Trees, stumps, surface plants and all debris removed from the site shall be disposed of off-site by the Contractor at his own expense.

D. Before the start of construction, protect trees or groups of trees, designated by the Engineer to remain, from damage by all construction operations by erecting suitable barriers, or by other approved means. Clearing operations shall be conducted in a manner to prevent falling trees from damaging trees designated to remain.

E. Areas outside the limits of clearing shall be protected from damage and no equipment or materials shall be stored in these areas.

F. No stumps, trees, limbs, or brush shall be buried in any fills or embankments.

G2.04 STRIPPING

A. Strip topsoil from all areas to be occupied by buildings, structures, roadways and all areas to be excavated or filled. Avoid mixing topsoil with subsoil and stockpile topsoil in areas on the site as approved by the Engineer. Topsoil shall be free from brush, trash, large stones and other extraneous material and protected until it is placed as specified under Section G7-LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL. Dispose of any remaining topsoil as directed by the City. All excess topsoil shall remain property of the City at its option, and Contractor shall place extra materials at a site designated by the City.

G2.05 DISPOSAL OF MATERIALS

A. All tree trunks, limbs, roots, stumps, brush, foliage, other vegetation and objectionable material shall be removed from the site and disposed of in a permitted disposal site in a manner satisfactory to the Engineer.

B. Burning of cleared and grubbed materials will not be permitted.

C. Disposal of Excavated Materials

1. Suitable excavated materials may be stockpiled to be used for backfilling. Excess excavated materials and unsuitable backfill materials shall be disposed of by the Contractor in the following manner:

a. Clays, sands and gravel in excess of project requirements shall be disposed of by the Contractor at such locations and under consideration arranged by the Contractor at his expense.

b. Limestone and other rock excavation shall be disposed of by the Contractor at such locations and under consideration arranged by the Contractor at his expense.

2. The classification of clays, sands, gravel, limestone and rock shall be made in accordance with the Unified Soil Classification System, U.S. Army Corps of Engineers, T.M. 3-357.

3. Desirable topsoil, sod, or area fill shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such a manner as to cause a minimum of inconvenience to the City's operations, and to permit safe and convenient access to private and public property adjacent to the work

G2.06 UNAUTHORIZED EXCAVATION

A. Whenever the excavation is carried beyond or below the lines and grades as shown on the plans, except as specified above, all such excavated space shall be refilled with such material and in such a manner, as may be directed by the City, so as to insure the stability of the affected structure. Beneath all structures, space excavated without authority shall be refilled by the Contractor, at his own expense, with Class "C" concrete, crushed stone or selected fill materials, as directed by the City.

G2.07 PAYMENT

A. Payment will be made for work performed in accordance with this specification by the unit quantity for the item for right-of-way preparation in the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION G3 – SITE CLEARING

G3.01 SCOPE OF WORK

A. This specification covers the requirements for site clearing operations for this Project.

G3.02 SUBMITTALS

A. None required unless specifically called for in the Plans, Standards, or requested by the City or the Engineer.

G3.03 TRAFFIC

A. Conduct site-clearing operations to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

G3.04 PROTECTION

A. Provide temporary fences, barricades, coverings, or other protection to preserve existing items indicated to remain and to prevent injury or damage to persons or property. Provide protection for adjacent properties as required.

B. Restore damaged work to condition existing prior to start of work.

C. Protect existing trees and vegetation that are indicated to remain from physical damage. Do not store materials or equipment within tree drip line. Replace damaged trees that cannot be restored to full growth, as determined by arborist, unless otherwise acceptable to the Engineer or the City.

D. Protect existing property and easement corners and pins. In the event that property or easement corners or pins are moved disturbed or destroyed the Contractor shall replace them at his own expense. They shall be replaced by a Registered Professional Land Surveyor registered in the State of Texas.

G3.05 EXISTING SERVICES

A. Locations indicated are approximate; determine exact location before commencing work. Coordinate with local utility service requirements and comply with their instructions.

G3.06 SITE CLEARING

A. Remove trees, shrubs, grass and other vegetation, improvements, or obstructions as indicated or that interfere with new construction. Removal includes digging out stumps and roots, together with subsequent off-site disposal.

B. Strip and stockpile topsoil that will be reused in the Work.

C. Remove existing improvements, both above-grade and below-grade, to extent indicated or as otherwise required to permit new construction.

G3.07 SALVAGEABLE ITEMS

A. Carefully remove items indicated to be salvaged and store on the City's premises where indicated or directed.

G3.08 AIR POLLUTION

A. Control air pollution caused by dust and dirt; comply with governing regulations.

G3.09 REGRADING

A. Fill depressions and voids resulting from site-clearing operations. Using satisfactory soil materials, place in maximum six (6) inch deep horizontal layers and compact each layer to density of surrounding original ground.

B. Grade ground surface to conform to required contours and to provide surface drainage.

G3.10 DISPOSAL OF MATERIAL

A. Dispose of waste materials including trash, debris and excess topsoil. No waste material shall remain on the City's property.

B. Burning waste materials on site is not permitted.

G3.11 PAYMENT

A. No separate payment will be made for work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION G4 - PIPE EXCAVATION, TRENCHING, EMBEDMENT, ENCASEMENT AND BACKFILLING

G4.01 SCOPE OF WORK

A. This specification covers the requirements for furnishing all labor, equipment and material and performing all work necessary, in connection with excavation, trenching, embedment, encasement, and backfilling, for the installation of wastewater lines in this Project.

G4.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including a Trench Safety Plan (which shall be sealed by a Professional Engineer registered in the State of Texas, if required) embedment material (source, gradation and type), backfill material (source, gradation and type), encasement material (if required), equipment and all other pertinent data to illustrate conformance to the specification found within.

G4.03 EXCAVATION

A. General

1. Excavation shall include the removal of any trees, stumps, brush, debris, or other obstacles that may obstruct the line of work, and the excavation and removal of all earth, rock or other materials to the extent necessary to install the pipe and appurtenances in conformance with the line and grades shown in the Plans, or as specified.

B. Maximum and Minimum Width of Trenches

1. The sides of all trenches shall be cut as nearly vertical as possible. Unless otherwise specified on the Plans, the minimum width of trench in which the pipe may be installed shall not be less than 12-inches plus the outside diameter of the pipe, and the maximum width shall not be more than 24-inches plus the outside diameter of the pipe, measured at an elevation in the trench which is 12-inches above the top of the pipe when it is laid to grade.

2. Wherever the prescribed maximum trench width is exceeded, the Contractor shall use the class embedment or encasement required by the Engineer to provide the load carrying capacity for the trench width as actually cut, and the additional cost incurred will be borne by the Contractor.

C. Sheeting and Shoring

1. Where required in the Contractor's Trench Safety System, or where required for other reasons in caving ground, or in wet, saturated or flowing materials, the sides of all trenches and excavations shall be adequately sheeted and braced so as to maintain the excavation free from slides or cave-ins.

2. Sheeting and shoring shall not be left in place unless its removal is impractical.

D. Dewatering Excavations

1. There shall be sufficient pumping equipment, in good working order, available at all times to remove any water that accumulates in excavations. Where the pipeline crosses natural drainage channels, the work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the work will be prevented. Provisions shall be made for the satisfactory disposal of surface water pumped so as to prevent damage to public or private property. The Contractor shall be responsible for maintaining safe working conditions and suitable construction techniques.

E. Disposal of Excavated Materials

1. Suitable excavated materials may be piled adjacent to the work to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the Contractor. Desirable topsoil, sod, etc. shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such a manner as to cause a minimum of inconvenience to public travel. Suitable selected bedding or backfill material shall be provided at no additional cost to the City.

F. Trench Depth

1. Excavation for the pipeline shall be removed to a depth below the pipe barrel and pipe bell as shown in the Plans for the type of embedment specified, and the bottom of the trench brought to true subgrade with the embedment or encasement shown in the Plans.

G. Soft Subgrade

1. Where soft or spongy material is encountered in the excavation at subgrade level, it shall be removed to such a depth that a stable foundation is achieved by replacing the unsuitable material with tamped gravel, brought to the level of the bottom of bedding.

2. Gravel used shall be washed gravel or crushed stone and may fit any gradation of size up to three (3) inches. The particular gradation shall take into consideration the actual field conditions.

H. Excavated Materials

1. Excavated materials shall be piled adjacent to the work to be used for backfilling as required. After the trench has been refilled, topsoil shall be replaced to the extent that rock excavated from the trench will be completely covered and the area is returned to its original condition.

2. Where required on the Plans or when otherwise specified, desirable topsoil shall be piled separately in a careful manner and replaced in its original position.

3. Where a trench is required to cross a paved area, the asphalt or concrete shall be saw cut and removed for a total width that is two (2) feet greater than the trench width. The Contractor shall dispose of all excavated concrete, asphalt and subgrade material that is unsuitable for backfilling or in excess of that required for backfilling.

I. Damage to Existing Utilities

1. Where existing utilities are damaged, they shall be replaced immediately with material equal to or better than the existing material. Such work shall be at the entire expense of the Contractor.

G4.04 EMBEDMENT AND ENCASEMENT

A. General

1. Embedment shall be as required in the Plans or Standards. All embedment materials shall be free of grass, roots, vegetation, and other deleterious materials. Embedment Standards are shown on the Plans or Standards.

2. When the pipe has been checked for line and grade, the trench shall be backfilled with enough granular material or concrete on both sides to hold the pipe firmly in position. When placing granular material or concrete around the pipe, care shall be taken to fill all voids around the pipe. The pipe shall not be floated. The embedment or encasement material shall be carefully tamped to assure uniform pipe support and density.

B. Embedment Materials

1. Material for embedment shall conform to the following sieve analysis:

Sieve Size	3/8" F % Retained	½" D % Retained
½"	0	0
3/8"	0-2	5-25
4m	40-85	80-100
10m	95-100	96-100

C. Concrete Embedment and Encasement

1. Concrete embedment and encasement and cap shall have a minimum compressive strength of 2,000 pounds per square inch at 28 days.

2. Dry mix will not be permitted. The concrete cushion portion of the embedment or encasement will be mixed moist or damp to give a slump of not more than one inch. Concrete for the sides and top, if specified, shall be mixed to obtain a slump of not less than one inch or more than three (3) inches.

3. After pipe joints are completed, the voids at the joints in the embedment section shall be filled with concrete, and the embedment shall be brought up to proper grade. Where concrete is placed over or along the pipe, it shall be placed in such a manner as not to damage or injure the joints or displace the pipe. Care shall be taken in the placement of concrete to assure that a uniform pad, free of voids and of specified thickness, is constructed under the entire pipe section.

4. A cleavage line between the base concrete and the side embedment concrete will not be allowed. Backfilling shall be done in a careful manner and at such time, after concrete embedment or encasement has been placed, as not to damage the concrete in any way.

G4.05 BACKFILLING

A. General

1. Backfilling shall include the refilling and consolidating of the fill in trenches and excavations up to the surrounding ground surface or road grade at crossings. No backfill shall be placed until the Engineer, the City or his authorized Inspector has inspected the trench and pipe in place and has authorized the placing of backfill.

2. Backfilling shall be done with select material or concrete backfill as described hereafter and shown on the Plans. No material of a perishable, spongy or otherwise unsuitable nature shall be used in backfilling.

B. Select Backfill Material

1. Unless otherwise shown on the Plans, or approved by the Engineer, the select material backfill shall be Specification Section SD4 Flexible Base, Type A Grade 1.

2. If approved by the Engineer, good, sound earth may be used as select material for backfill over the pipe. Good, sound earth as defined as gravel, sandy loam or loam, free from excessive clay. Select material shall not have rocks with an average dimension larger than one inch, and no dimension greater than two (2) inches.

3. An alternative to the flexible base as select backfill will be on-site or imported select material so long as it is properly moisture-conditioned, placed and compacted.

4. It shall be the full responsibility of the Contractor to explore the project and subsurface materials to determine if the trench excavation will be suitable for use as select materials and to follow as closely as possible this Specification to insure a good, sound pipeline when completed.

C. Concrete Trench Cap

1. Where 36-inch minimum cover cannot be obtained or due to potential surface loading, the City may require a cap to be installed.

D. Concrete Backfill

1. Where shown on the Plans, concrete backfill shall consist of selected rock material or granular sand material mixed with a minimum of three sacks of cement per cubic yard. All material shall be mixed in a concrete mixer or transit mixed unless otherwise approved by the City.

E. Backfilling Operation

1. Backfilling operation outside of pavement shall be compacted to the required density without damaging the pipe or bedding. Backfill under non paved areas, two (2) feet outside of any structure or utilities and excluding lines within a floodplain, streams and watercourses shall be compacted to 90% of the maximum dry density in accordance Tex-114-E. Areas within two (2) feet of structures or existing utilities and areas within a floodplain, streams and water courses shall be compacted to 95% in accordance with Tex-114-E. Prior to any compaction, moisture shall be within +3% of the optimum moisture content.

2. All trenches under proposed or existing concrete roadways, driveways and sidewalks, paved waterways, brick roadways, asphaltic roadways with concrete base, gravel

roadways, and roadways with gravel base and asphalt surface, shall be backfilled to the required density in six (6) inch maximum lifts without damaging the pipe or bedding except the first lift over the pipe bedding will be 12 inches in depth. Swelling soils (soils with a plasticity index of 20 or more) shall be sprinkled as required to provide not less than optimum moisture nor more than 3% over the optimum moisture content to the extent necessary to provide not less than 95% nor more than 102% of the maximum dry density as determined in accordance with Tex-114-E. Non-swelling soils (soils with a plasticity index less than 20) shall be sprinkled as required and compacted to the extent necessary to provide not less than 95% of the optimum dry density with the moisture within +3% of the optimum moisture content in accordance with Tex-114-E. Jetting with water will not be permitted. Flexible base used as select backfill shall be compacted to 95% of Tex-113E at +3% of the optimum moisture content.

3. After the trench has been refilled, topsoil shall be replaced to the extent that rock excavated from the trench will be completely covered or removed and the area is returned to its original condition, except that in cultivated areas a minimum of six (6) inches of topsoil shall be replaced.

G4.06 PAYMENT

A. For all piping, there shall be no separate payment made for work performed under this Specification for excavating, trenching, embedment, and backfilling. All costs incurred shall be included in the contract price for the appropriate items in the Proposal and Bid Schedule.

B. Separate payment, if authorized by the City, will be made for crushed stone or washed gravel as described in these specifications under Section G4.02(G), SOFT SUBGRADE, at the contract unit price per cubic yard as provided in the Proposal and Bid Schedule (if applicable).

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION G5 – GRANULAR FILL MATERIALS

G5.01 SCOPE OF WORK

A. This specification covers the requirements for the use of granular fill materials for this Project.

G5.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to Engineer or the City for approval, technical product literature including the source of the material, gradation, type of material, and all other pertinent data to illustrate conformance to the specification found within.

G5.03 GENERAL

A. Granular fill materials are specified in this Section, but their use for bedding pipe, pavement base, are specified in detail in sections G4 – PIPE EXCAVATION, TRENCHING, EMBEDMENT, ENCASEMENT AND BACKFILLING and SD4 – FLEXIBLE BASE. The Engineer may respectively order the use of fill materials for purposes other than those specified in other Sections if, in his/her opinion, such use is advisable.

G5.04 MATERIALS

A. Common fill shall consist of mineral soil, substantially free of clay, organic material, loam, wood, trash, and other objectionable material which may be compressible, or which cannot be compacted properly. Common fill shall not contain stones larger than six (6) inches in any dimension, broken concrete, masonry, rubble, asphalt pavement, or other similar materials. It shall have physical properties, as approved by the Engineer, such that it can be readily spread and compacted.

B. Select common fill shall be as specified above for common fill except that the material shall contain no stones larger than two (2) inches in its largest dimension.

C. Crushed Stone Backfill shall consist of hard, durable, particles of proper size and gradation, free from sand, loam, clay, excess fines and deleterious materials. The size of the particles shall be uniformly graded such that the following bedding specifications are met:

Sieve Size	3/8" F % Retained	½" D % Retained	Washed Gravel % Retained
½"	0	0	0
3/8"	0-2	5-25	---
4m	40-85	80-100	---
10m	95-100	96-100	---
¾"	---	---	100

D. Crushed Stone Base shall consist of sound, durable stone, free of any foreign material, angular in shape, free from structural defects and comparatively free of chemical decay. This material shall comply with Texas Department of Transportation Item 248, Type "A", Grade 1 unless otherwise shown on the Plans or Standards. The stone shall have a maximum size of 7/8-inch.

E. Cement Stabilization Sand Backfill shall consist of a mixture of ASTM C33 fine aggregate and Type I cement. The mix shall be proportioned of two (2) sacks of cement per cubic yard.

G5.05 PAYMENT

A. No separate payment will be made for work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION G6 – SEDIMENTATION AND TEMPORARY EROSION CONTROL

G6.01 SCOPE OF WORK

A. This specification covers the requirements necessary to perform all installation, maintenance, removal and area cleanup related to sedimentation control work as shown on the Plans and as specified herein.

G6.02 SUBMITTALS

A. Within 10 days after Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature for all commercial products to be used for sedimentation and erosion control.

G6.03 GENERAL

A. The work shall include, but not necessarily be limited to: triangular filter dike, rock berm, silt fence, curb inlet protection, stabilized construction entrance, tree protection, excelsior matting, and temporary mulching, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching, excelsior matting installation and final cleanup. All sedimentation and erosion control shall be installed prior to the start of any construction activities.

G6.04 QUALITY ASSURANCE

A. The Contractor shall be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to off site areas or into the stream system via surface runoff or underground drainage systems. Measures in addition to those shown on the Plans necessary to prevent the movement of sediment off site shall be installed, maintained, removed, and cleaned up at the expense of the Contractor. No additional charges to the City will be considered.

B. Sedimentation and erosion control measures shall conform to the requirements outlined in the Texas Commission on Environmental Quality (TCEQ) Chapter 213.

G6.05 MATERIALS

A. Triangular Filter Dike

1. Triangular filter dike sections shall be either 10-feet or 20-feet in length.

2. Geotextile fabric shall extend to 12-inches upstream of triangular filter dike structure.

3. Triangular filter dike structure shall be 18-inches in length on all three (3) faces.

4. Three (3) inch to five (5) inch open graded rock shall be placed over skirt to anchor it on the upstream side.

5. Structure shall be formed by six (6) gauge six inch by six inch (6” x 6”) welded wire mesh.

6. Geotextile fabric shall be non-woven, 4.5 oz. minimum and 36-inches wide.

B. Rock Berm

1. Woven wire sheathing shall be 20-gauge with one inch openings.

2. Rock shall be three inches to five inches (3" - 5") open graded.

C. Silt Fence

1. Steel posts shall be a minimum of four (4) feet in length, heavy weight T-Post.

2. Welded wire fabric shall be two-inch by four-inch (2" x 4") mesh of 12-gauge by 12-gauge galvanized wire mesh.

3. Silt fence fabric shall be a 4.5 oz minimum non-woven geotextile filter fabric 36-inches wide.

4. Tie wires for securing silt fence fabric to wire mesh shall be light gauge metal clips (hog rings), or $^{1}/_{32}$-inch diameter soft aluminum wire.

5. Prefabricated commercial silt fence may be substituted for built-in-field fence. Prefabricated silt fence shall be "Envirofence" as manufactured by Mirafi Inc., Charlotte, NC or equal.

D. Curb Inlet Protection

1. 4.5 oz. minimum non-woven geotextile filter fabric shall be used.

2. Sand bags shall be used to hold the filter fabric in place.

E. Stabilized Construction Entrance

1. Stabilized construction entrance shall have a minimum width of 12-feet and a minimum length of 50-feet.

2. An eight (8) inch high diversion ridge shall be constructed 15-feet from the edge of the existing roadway.

3. Stabilized construction entrance shall be graded to drain towards the existing roadway at a two-percent (2%) slope.

4. Rock shall be four-inches to eight-inches (4" - 8") coarse aggregate.

5. Rock shall be placed to a depth of at least eight (8) inches.

F. Tree Protection – Chain Link Fence

1. Chain link fence shall be five (5) feet in height.

2. Fence shall be installed around the driplines of the trees to be protected.

G. Tree Protection – Wood Slats

1. Where any exceptions result in a fence being closer than four (4) feet to a tree trunk, protect the trunk with strapped-on-planking two inches by four inches (2" x 4") wood slats to a height of eight (8) feet, or to the limits of lower branching in addition to the reduced fencing provided.

2. Trees most heavily impacted by construction activities should be watered deeply once a week during periods of hot, dry weather. Tree crowns should be sprayed with water periodically to reduce dust accumulation on the leaves.

3. Any trenching required for the installation of landscape irrigation shall be placed as far from existing tree trunks as possible.

4. No landscape topsoil dressing greater than four (4) inches shall be permitted within the dripline of a tree. No soil is permitted on the root flare of any tree.

5. No vehicles or equipment shall be allowed to park within the dripline of an existing tree.

H. Soil Retention Blankets

1. Soil retention blankets shall be installed in all seeded drainage swales and ditches as shown on the Plans or as directed by the Engineer. Only soil retention blankets included on TxDOT's Approved Products List will be considered acceptable for use on this Project.

2. Contractor is to include this item in their erosion controls as required by the City and by the Contractor's Stormwater Pollution Prevention Plan (SWPPP). The Blankets must meet the expected velocities in the area to prevent erosion of the soil of the post-constructed area. Contractor is to submit the proposed material prior to construction for Engineer's and City's approval.

I. Temporary Mulch

1. Temporary mulch shall be applied to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days of the completion of rough grading.

G6.06 INSTALLATION

A. Triangular Filter Dike

1. Layout the filter dike following as closely as possible to the contour.

2. Clear the ground of debris, rocks, and plants that will interfere with installation.

3. Place the filter dike sections one at a time, with the skirt on the uphill side towards the direction of flow anchoring each section to the ground before the next section is placed.

4. Anchors should be placed on two (2) foot centers alternating from front to back so that there is actually only one foot in between anchors.

5. Securely fasten the skirt from one section of filter dike to the next.

6. Filter dikes must maintain continuous contact with the ground.

7. After the site is completely stabilized, the dikes and any remaining silt should be removed. Silt should be disposed of in a manner that will not contribute to additional siltation.

B. Rock Berm Installation

1. Layout the rock berm following as closely as possible to the contour.

2. Clear the ground of debris, rocks or plants that will interfere with installation.

3. Place woven wire fabric on the ground along the proposed installation with enough overlap to completely encircle the finished size of the berm.

4. Place the rock along the center of the wire to the designated height.

5. Wrap the structure with the previously placed wire mesh secure enough so that when walked across, the structure retains its shape.

6. Secure with tie wire.

7. The ends of the berm should be tied into existing upslope grade and the berm should be buried in a trench approximately four (4) inches deep to prevent failure of the control.

8. The rock berm should be left in place until all upstream areas are stabilized and accumulated silt removed.

C. Silt Fence Installation

1. Lay out the silt fence following as closely as possible to the contour.

2. Clear the ground of debris, rocks, and plants (including grasses taller than two (2) inches) to provide a smooth flow approach surface. Excavate four-inches deep by four-inches wide (4" x 4") trench on upstream side of face per Plans.

3. Drive the heavy duty T-post at least 12-inches into the ground and at a slight angle towards the flow.

4. Attach the two-inches by four-inches (2" x 4") 12-gauge welded wire mesh to the T-post with $11^{1}/_{2}$-gauge galvanized T-post clips. The top of the wire shall be 24-inches above ground level. The welded wire mesh shall be overlapped six (6) inches and tied at least six (6) times with hog rings.

5. The silt fence shall be installed with a skirt a minimum of 11-inches wide placed on the uphill side of the fence inside excavated trench. The fabric to overlap the top of the wire by one inch.

6. Anchor the silt fence by backfilling with excavated dirt and rocks.

7. Geotextile splices should be a minimum of 18-inches wide attached in at least six (6) places.

D. Curb Inlet Protection Installation

1. Clear the pavement of debris, rocks, etc. to provide a smooth surface for installation.

2. Place the filter fabric over the inlet and extend to five (5) feet beyond inlet opening, upstream of inlet. Terminate fabric in street gutter with sand bags placed in gutter flowline.

3. Place sandbags on top of filter fabric around the perimeter of the protected area to secure the filter fabric.

4. Care shall be taken insure that the inlet protection will remain in place during periods of heavy runoff and that severe ponding will not occur in the street.

E. Stabilized Construction Entrance Installation

1. Clear the area of debris, rocks or plants that will interfere with installation.

2. Grade the area for the entrance to flow back on to the construction site. Runoff from the stabilized construction entrance onto a public street will not be allowed except for the first 15 feet connecting to the public street.

3. Place geotextile fabric (if required).

4. Place rock (as required).

F. Tree Protection – Chain Link Fence

1. Tree protection fences shall be installed prior to the commencement of any site preparation work (i.e., clearing, grubbing or grading).

2. Fences shall completely surround the tree, or clusters of trees; will be located at the outermost limit of the tree branches (dripline); and will be maintained throughout the construction project in order to prevent the following:

   a. Soil compaction in the root zone area resulting from vehicular traffic, or storage of equipment or materials.

   b. Root zone disturbances due to grade changes greater than six (6) inches, cut or fill, or trenching not reviewed and authorized by the City.

   c. Wounds to exposed roots, trunks or limbs by mechanical equipment.

   d. Other activities detrimental to trees such as chemical storage, cement truck cleaning and fire.

3. Exceptions to installing fences at tree driplines may be permitted in the following cases:

   a. Where permeable paving is to be installed, erect the fence at the outer limits of the permeable paving area.

   b. Where trees are close to a proposed building, erect the fence no closer than six (6) feet to building.

G. Tree Protection – Wood Slats

1. Any roots exposed by construction activity shall be pruned flush with the soil. Backfill root areas with good quality top soil as soon as possible. If exposed root areas are not backfilled within two (2) days, cover them with organic material in a manner which reduces soil temperature, and minimizes water loss due to evaporation.

2. Prior to excavation or grade cutting within tree dripline, make a clean cut between the disturbed and undisturbed root zones with a rock saw or similar equipment, to minimize damage to remaining roots.

3. Pruning to provide clearance for structures, vehicular traffic and equipment shall take place before construction starts.

H. Excelsior Matting

1. The area to be covered shall be properly prepared, fertilized and seeded with permanent vegetation before the blanket is applied.

2. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area.

3. The blankets shall be applied in the direction of water flow, and stapled. Blankets shall be placed a minimum of three (3) rows, of four (4) foot wide (total approximate 12-foot width) within the drainage swale/ditch and stapled together in accordance with Manufacturer's instructions.

4. Side overlaps shall be four (4) inch minimum. The staples shall be made of wire, 0.091-inch in diameter or greater, "U" shaped with legs 10-inches in length and a $1^1/_2$-inch crown. The staples shall be driven vertically into the ground, spaced approximately two (2) linear feet apart, on each side, and one row in the center alternately spaced between each size.

5. Upper and lower ends of the matting shall be buried to a depth of four (4) inches in a trench.

6. Erosion stops shall be created every 25-feet by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. The bottom of the fold shall be four (4) inches below the ground surface. Staple on both sides of fold.

7. Where the matting must be cut or more than one roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of four (4) inches. Overlap lower end of upstream roll four (4) inches past edge of downstream roll and staple.

8. To ensure full contact with soil surface, roll matting with a roller weighing 100-pounds per foot of width perpendicular to flow direction after seeding, placing matting and stapling.

9. Thoroughly inspect channel after completion. Correct any areas where matting does not present a smooth surface in full contact with the soil below.

I. Temporary Mulching

1. Straw mulch shall be applied at rate of 100 lbs/1,000 ft^2 and tackified with latex acrylic copolymer at a rate of 1 gal/1,000 ft^2 diluted in a ratio of 30 parts water to one part latex acrylic copolymer mix.

G6.07 MAINTENANCE AND INSPECTIONS

A. Inspections

1. Contractor shall make a visual inspection of all sedimentation control devices once per week and promptly after every rain event exceeding ¼-inch. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas or into the vent trench, Contractor shall promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly.

B. Device Maintenance

1. Triangular Filter Dikes

   a. Realign berms as needed to prevent gaps between the sections.

   b. Accumulated silt should be removed after each rainfall event, and disposed of in a manner which shall not cause additional siltation.

2. Rock Berm

   a. Remove sediment and other debris when buildup reaches six (6) inches and dispose of the accumulated silt in an approved manner.

   b. Repair any loose wire sheathing.

   c. Reshape as needed.

   d. Replace berm when the structure ceases to function as intended due to silt accumulation among the rocks, washout, construction traffic damage, etc.

3. Silt Fences

   a. Remove accumulated sediment when buildup reaches six (6) inches.

   b. Replace damaged fabric, or patch with a two (2) foot minimum overlap.

   c. Replace or repair any sections crushed or collapsed in the course of construction activity.

   d. Make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.

4. Curb Inlet Protection

   a. Repair any damaged fabric, or patch with a two (2) foot minimum overlap.

   b. Replace any damaged sandbags.

   c. Remove accumulated sediment.

5. Stabilized Construction Entrance

a. Periodic top dressing with additional stone may be required as conditions demand to prevent tracking or flowing of sediment onto public rights-of-way.

c. Cleanout any measures used to trap sediment as needed.

d. All sediment spilled, dropped, washed or tracked on to public rights-of-way should be removed immediately by the Contractor.

e. When necessary, wheels should be cleaned to remove sediment prior to entrance onto public rights-of-way.

f. When washing is required, it should be done on an area stabilized with crushed stone that drains into an approved sediment trap or sediment basin.

g. All sediment should be prevented from entering any storm drain, ditch or water course by using approved methods.

6. Tree Protection – Chain Link Fence

a. Repair or replace any chain link fence damaged by construction activities.

7. Tree Protection – Wood Slats

a. Repair or replace any wood slats damaged by construction activities.

8. Excelsior Matting

a. Replace matting as needed to prevent erosion from occurring.

9. Temporary Mulch

a. Replace mulch as needed to prevent erosion from occurring.

G6.08 REMOVAL AND FINAL CLEANUP

A. Once the site has been fully stabilized against erosion, remove sediment control devices and all accumulated silt. Dispose of silt and waste materials in proper manner. Re-grade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated on the Plans.

G6.09 PAYMENT

A. Silt fence and rock berm will be paid per linear foot installed as listed in the Proposal and Bid Schedule.

B. Stabilized Construction Entrance will be paid per each installed as listed in the Proposal and Bid Schedule.

C. Tree protection will be paid per each installed as listed in the Proposal and Bid Schedule.

D. Erosion Control Blankets will be paid per square yard as listed in the Proposal and Bid Schedule.

E. Triangular Filter Dikes will be paid per linear foot as listed in the Proposal and Bid Schedule.

F. No separate payment will be made for all other work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION G7 – LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL

G7.01 SCOPE OF WORK

A. This specification covers the requirements to provide erosion control and place topsoil, finish grade, apply fertilizer, hydraulically apply seed and mulch and maintain all seeded areas as shown on the Plans and as specified herein, including all areas disturbed by the Contractor.

G7.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, samples of all materials to be used and all other pertinent data to illustrate conformance to the specification found within.

G7.03 TOPSOIL

A. Topsoil shall be fertile, friable, natural topsoil typical of topsoil of the locality and shall be obtained from a well drained site that is free of flooding. It shall be without admixture of subsoil or slag and free of stones, lumps, plants or their roots, sticks, clay, peat and other extraneous matter and shall not be delivered to the site or used while in a frozen or muddy condition. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than three (3) percent organic matter as determined by loss of ignition of moisture-free samples dried at 100 degrees Celsius. The topsoil shall meet the following mechanical analysis:

	Percentage Passing
1-inch screen opening	100
No. 10 mesh	95 - 100
No. 270 mesh	35 - 75
0.002 mm*	5 - 25

* Clay size fraction determined by pipette or hydrometer analysis.

B. At least 10 days prior to anticipated start of topsoiling operations, a one pint sample of topsoil material shall be delivered by the Contractor to a laboratory for testing and approval. All testing shall be at the sole expense of the Contractor. Based on tests performed by the laboratory, the topsoil shall be identified as acceptable, acceptable with certain fertilizer and limestone applications or unacceptable. If the topsoil is found acceptable the fertilizer and lime requirements will be as specified or as recommended by the laboratory. If the topsoil is found unacceptable, the Contractor shall be responsible for identifying another source of topsoil and shall incur all expenses associated with testing additional samples. All topsoil incorporated into the site work shall match the sample provided to the laboratory for testing. Topsoil stockpiled under other Sections of these Specifications may be used subject to the testing and approval outlined above. Contractor will be responsible for screening stockpiled topsoil and providing additional topsoil as required at his/her own expense.

C. Lime shall be ground limestone containing not less than 85-percent calcium and magnesium carbonates and be ground to such fineness that at least 50-percent shall pass a 100-mesh sieve and at least 90-percent shall pass a 20-mesh sieve.

D. All planting shall be done between May 1 and September 15, except as specifically authorized in writing. If planting is authorized to be done outside the dates specified, the seed shall be planted with the addition of winter fescue (Kentucky 31) at a rate of 100 lbs. per acre.

E. The seed shall be furnished and delivered premixed in the proportions specified within. A Manufacturer's Certificate of Compliance to the specified mixes shall be submitted by the Manufacturers for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates.

F. Seed shall be delivered in sealed containers bearing the dealer's guaranteed analysis.

G. Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air-dry weight content and not contain in excess of 10-percent moisture.

H. Excelsior matting blanket installed in all drainage swales and ditches shall be in accordance with Section G6 - SEDIMENTATION AND TEMPORARY EROSION CONTROL.

G7.04 APPLICATION OF TOPSOIL

A. Unless otherwise shown on the plans, topsoil shall be placed to a minimum compacted depth of six (6) inches on all parts of the site not covered with structures, pavement, or existing woodland.

B. For all areas to be seeded:

1. Fertilizer (10-20-10) shall be applied at the rate of 30-lbs. per 1,000-sq. ft. or as determined by the soil test.

2. Seed shall be applied at the rate of five (5) lbs. per 1,000-sq. ft.

3. Fiber mulch shall be applied at the rate of 40-lbs. per 1,000-sq. ft.

C. After the topsoil is placed and before it is raked to true lines and rolled, limestone shall be spread evenly over the loam surface and thoroughly incorporated by heavy raking to at least one half the depth of topsoil.

D. The application of fertilizer may be performed hydraulically in one operation with hydroseeding and fiber mulching. The Contractor is responsible for cleaning all structures and paved areas of unwanted deposits of the hydroseeded mixture.

G7.05 INSTALLATION OF TOPSOIL

A. Previously established grades, as shown on plans shall be maintained in a true and even condition.

B. Subgrade shall be prepared by tilling prior to placement of topsoil to obtain a more satisfactory bond between the two (2) layers. Tillage operations shall be across the slope. Tillage shall not take place on slopes steeper than two (2) horizontal to one vertical or where tillage equipment cannot be operated. Tillage shall be accomplished by disking or harrowing to a depth of nine (9) inches parallel to contours. Tillage shall not be performed when the subgrade is frozen, excessively wet, extremely dry or in other conditions which would not permit tillage. The subgrade shall be raked and all rubbish, sticks, roots and stones larger than two (2) inches shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with loam.

C. Topsoil shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No loam shall be spread in water or while frozen or muddy.

D. After topsoil has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All stiff clods, lumps, roots, litter and other foreign material shall be removed from the loamed area and disposed of by the Contractor. The areas shall also be free of smaller stones, in excessive quantities, as determined by the Engineer or the City. The whole surface shall then be rolled with a hand roller weighing not more than 100-lbs per foot of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until a smooth and even finished grade is created.

E. Seeding shall be done within 10 days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quantity to the specified rates. Prior to the start of work, the Contractor shall furnish the Engineer with a certified statement as to the number of pounds of materials to be used per 100-gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the Contractor's hydroseeder. Upon completion of seeding operations, the Contractor shall furnish the Engineer and the City with a certified statement on the actual quantity of solution applied.

F. In order to prevent unnecessary erosion of newly topsoiled and graded slopes and unnecessary siltation of drainageways, the Contractor shall carry out seeding and mulching as soon as he/she has satisfactorily completed a unit or portion of the project. A unit or portion of the project shall be determined by the City or Engineer. When protection of newly loamed and graded areas is necessary at a time which is outside of the normal seeding season, the Contractor shall protect those areas by what ever means necessary as approved by the Engineer and the City and shall be responsible for prevention of siltation in the areas beyond the limit of work.

G. When newly graded subgrade areas cannot be topsoiled and seeded because of season or weather conditions and will remain exposed for more than 30 days, the Contractor shall protect those areas against erosion and washouts in accordance with Section G6 - SEDIMENTATION AND TEMPORARY EROSION CONTROL, or by other measures as approved by the Engineer and the City. Prior to application of topsoil, any such materials applied for erosion

control shall be removed or thoroughly incorporated into the subgrade by disking. Fertilizer shall be applied prior to spreading of topsoil.

H. On slopes, the Contractor shall provide against washouts by a method approved by the Engineer and the City. Any washout which occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.

G7.06 HYDROMULCHING

A. Fertilizer: 18-18-5, (Nitrogen, Phosphoric Acid, Potash) show release granular at a rate of 25-lbs per 1,000-sq. ft.

B. Water: The Contractor shall provide water necessary for grass planting and maintenance until acceptance by the City.

C. Planting Seasons: Grass planting by sodding, sprigging, or hydromulching shall normally be done between May 1 and September 15.

D. Hydromulching General

1. Submit Manufacturer's product specifications and guaranteed purity analysis for fertilizer.

2. Product Delivery, Storage and Handling

a. Deliver fertilizer to site in original unopened containers bearing Manufacturer's guaranteed chemical analysis, name, trademark and conformance to State Law.

b. Store fertilizer in a dry location and protect from weather.

3. Guaranty and Replacement

a. Provide guaranty for a period of one year after final completion and acceptance of project, that the installed grass areas be at least the quality and condition as during acceptance.

b. Rehydromulch unacceptable areas during the guaranty period. Guaranty shall not include damage or loss of lawn due to acts of God, acts of vandalism or negligence on the part of the City.

E. Native Grass Hydromulching-Products

1. Grass Seed: Common Bermuda grass, hulled, minimum 82% pure live seed. All grass seed shall be free from noxious weed, grade "A" recent crop, recleaned and treated with appropriate fungicide at time of mixing. Seed shall be furnished in sealed, standard containers with dealer's guaranteed analysis.

2. Mulch: Conwed regular wood fiber mulch or approved equal.

3. Fertilizer: 18-18-5, water-soluble or an approved equal.

4. Topsoil: Supply high quality imported topsoil of loamy character to the limits shown on the Plans, high in humus and organic content from local agriculture source. Topsoil to be

free from clay, lumps, coarse sands, stones, roots and other foreign matter. There shall be no toxic amounts of acid or alkaline elements. Soil to be used for on-site mixing of backfill.

F. Native Grass Hydromulching-Execution

1. Preparation: Fine grade to final elevation removing any debris and insuring the seedbed is smooth.

2. Installation: Use a hydromulcher (sprayer) and apply the mixture at the following rate (mix in accordance with Manufacturer's recommendations).

a. Hydromulch mixture shall contain 2.5-lbs. of common Bermuda grass seed per 1,000-sq. ft. hydromulch applied.

b. Mulch – 60-lbs. per 1,000-sq. ft.

c. Fertilizer – 25-lbs (18-18-5) per 1,000-sq. ft.

3. General Maintenance

a Water the completed installation as necessary to insure germination of grass.

b. Maintain grass areas until complete germination and establishment of all areas.

c. Correct defective work as soon as apparent. Maintenance shall include, but not be limited to, weeding and fertilizing.

d. Clean up: Remove trash and debris from the site.

e. Acceptance: Substantial completion inspection to determine acceptance of grass areas will be made by the City after complete germination and coverage has been attained.

G7.07 MAINTENANCE OF DEVELOPING GRASS

A. The Contractor shall water and maintain all grassed areas until final acceptance. He shall also re-fertilize at the rate of one pound of nitrogen and one pound of phosphorous per 1,000-sq. ft. every 60 days until the grass is accepted.

B. Areas which, due to settling or improper leveling, do not have positive drainage shall be re-leveled with topsoil and replanted with grass.

C. Areas damaged by erosion, vehicle ruts and similar damage shall be re-leveled with topsoil and replanted. Finished ground surface shall be sufficiently smooth and level to facilitate mowing.

G7.08 ACCEPTANCE

A. Work under this section shall be considered acceptable when finish graded surfaces are level and well-drained, when there are no bare spots larger than three (3) square feet, when no more than 10 percent of the total area has bare spots larger than one square foot, when not more than 15 bare spots larger than six (6) inches square and the grass is at least two (2) inches high, and when other requirements listed herein are met.

B. Acceptance of work normally coincides with final acceptance of the entire project. However, seasonal factors may be cause for delay in grass planting, development, and acceptance.

C. The City will accept responsibility for normal maintenance when grass is accepted. However, the Contractor shall remain responsible for any subsequent grass damage that he causes and for warranty of materials and workmanship for a period of not less than one year from the time of acceptance.

D. The Contractor shall furnish full and complete written instruction for maintenance of the seeded areas to the City at the time of acceptance.

G7.09 PAYMENT

A. No separate payment will be made for finish grading, placement of topsoil or grass planting and fertilizing. All related costs shall be included in the proper item of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION G8 – MISCELLANEOUS WORK AND CLEANUP

G8.01 SCOPE OF WORK

A. This specification covers the requirements to do the miscellaneous work not specified in other sections but obviously necessary for the proper completion of the work as shown on the Plans.

G8.02 SUBMITTALS

A. Within 10 days after the Notice to Proceed, the Contractor shall submit to the Engineer, in triplicate, a breakdown of any lump sum included in the Proposal and Bid Form. This breakdown shall be subject to approval by the Engineer and when so approved shall become the basis for determining progress payments and for negotiation of change orders, if required. In some contracts, a lump sum item shall not be provided in the Proposal and Bid Form and shall be subsidiary to the other work items.

G8.03 GENERAL

A. When applicable, the Contractor will perform the work in accordance with other sections of this Specification. When no applicable specification exists, the Contractor shall perform the work in accordance with the best modern practice and/or as directed by the Engineer.

B. The work of this Section includes, but is not limited to, the following:

1. Crossing and Relocating Existing Utilities.
2. Restoring Driveways, Fences and Curbing.
3. Cleaning Up.
4. Incidental Work.
5. Restoring Easements and Rights-of-Way.

G8.04 CROSSING AND RELOCATING EXISTING UTILITIES

A. This item includes any extra work required in crossing culverts, water courses including streams and drainage ditches, drains, gas mains, water mains and water services and other utilities. This work shall include but is not limited to the following: bracing, hand excavation and backfill (except screened gravel) and any other work required for crossing the utility or obstruction not included for payment in other items of this specification. Notification of Utility Companies shall be the Contractor's responsibility.

B. In locations where existing utilities cannot be crossed without interfering with the construction of the work as shown on the Plans, the Contractor shall remove and relocate the utility as directed by the Engineer or Representative of the City or cooperate with the Utility Companies concerned if they relocate their own utility.

C. At pipe crossings and where designated by the Plans, the Contractor shall furnish and place crushed stone bedding so that the existing utility or pipe is firmly supported for its entire exposed length. The bedding shall extend to the mid-diameter of the pipe crossed.

G8.05 RESTORING OF DRIVEWAYS AND FENCES

A. Existing public and private driveways disturbed by the construction shall be replaced. Paved drives shall be repaved to the limits and thicknesses existing prior to construction. Gravel dirt roads and drives shall be replaced and regraded.

B. Fences in the vicinity of the work shall be protected from damage. If damaged, fences shall be replaced in condition equal to that prior to being damaged and the work shall be satisfactory to the City.

G8.06 CLEANING UP

A. The Contractor shall remove all construction material, excess excavation, buildings, equipment and other debris remaining on the job as a result of construction operations and shall restore the site of the work to a neat and orderly condition. All stored materials shall be kept in a neat manner, secured and protected from the public.

G8.07 INCIDENTAL WORK

A. Do all incidental work not otherwise specified, but obviously necessary to the proper completion of the Contract as specified and as shown on the Plans.

G8.08 RESTORING THE EASEMENTS AND RIGHTS-OF-WAY

A. Portions of the work may be within easements through private property. The Contractor shall be responsible for all damage to private property due to his/her operations. The Contractor shall protect from injury all walls, fences, cultivated shrubbery and vegetables, fruit trees, pavement, underground facilities, such as water pipes, or other utilities which may be encountered along the easement. If removal and replacement are required, it shall be done in a workmanlike manner so that replacement is equivalent to that which existed prior to construction.

B. Existing lawn and sod surfaces damaged by construction in easements shall be replaced. The Contractor may cut and replace the lawn and sod, or may restore the areas with an equivalent depth and quality of loam, seeded and fertilized as specified in Section G7 - LOAMING, HYDROSEEDING AND PERMANENT EROSION CONTROL if acceptable to the owner of the private property and the City. These areas shall be maintained and re-seeded or re-sodded at the option of the owner of the private property and the City, if necessary, until all work under this Contract has been completed and accepted. Any additional work required to restore easements to their original condition shall be performed by the Contractor.

G8.09 PAYMENT

A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATION

SECTION G9-STRUCTURAL EXCAVATION

G9.01 SCOPE OF WORK

A. This specification covers the requirements for excavation for the placing of structures, except pipe, for the disposal of such excavated material, and for the backfilling around completed structures to the level of the original ground.

G9.02 SUBMITTALS

A. None required unless specifically called for in the Plans, Standards or requested by the Engineer or the City.

G9.03 CONSTRUCTION METHODS

A. Excavation shall be done in accordance with the lines and depths indicated on the Plans or as established by the City. Unless otherwise specified on the Plans or permitted by the City no excavation shall be made outside a vertical plane three (3) feet from the footing lines and parallel thereto. When caissons are provided, no excavation will be permitted outside the outer faces of the caissons.

B. To permit the City to judge the adequacy of a proposed foundation, the Contractor, if requested, shall make soundings or take cores to determine the character of the subgrade materials. The maximum depth of soundings or cores will in general, not exceed five (5) feet below the proposed footing grade. It is the intent of this provision that soundings shall be made at the time the excavation in each foundation is approximately complete.

C. Excavations shall conform to elevations shown on the Plans, or raised or lowered by written order of the City, when such alterations are judged proper. When deemed necessary to increase or decrease the plan depth of footings, the alterations in the details of the structure shall be as directed by the City. The City shall have the right to substitute revised details resulting from consideration of changes in the design conditions.

D. When a structure is to be placed on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final excavation to grade shall not be performed until just before the footing is placed.

E. Excavated material required to be used for backfill may be deposited by the Contractor in storage piles at points convenient for its rehandling during the backfilling operations and with the approval of the City.

F. For all single and multiple box culverts, pipe culverts, pipe arch culverts, and box sewers of all types, where the soil encountered at established footing grade is a quicksand, muck, or similar unstable material, the following procedure shall be used unless other methods are called for on the Plans:

1. The depth to which unstable material is removed will be determined by the City. The depth will not exceed two (2) feet below the footing of culverts that are two (2) feet or more in height, and will not exceed the height of culverts of those less than two (2) feet high. Excavation shall be carried at least one (1) foot horizontally beyond the limits of the structure on all sides. All unstable soil removed shall be replaced with suitable stable material, in uniform layers of suitable depth for compaction as directed by the City. Each layer shall be wetted; if necessary, and compacted by rolling or tamping as required to provide a stable foundation for the structure. Soil which has sufficient stability to properly sustain the adjacent sections of the roadway embankment will be considered a suitable foundation material.

2. When in the opinion of the City, it is not feasible to construct a stable footing as outlined above, the Contractor shall construct it by the use of special materials, such as flexible

base, cement stabilized base, cement stabilized backfill or other material, as directed by the City.

G. When the material encountered at footing grade of a culvert is found to be partially rock, or incompressible material, and partially a compressible soil which is satisfactory for the foundation, the incompressible material shall be removed for a depth of six (6) inches below the footing grade and backfilled with a compressible material similar to that used for the rest of the structure.

G9.04 BACKFILLING

A. General: As soon as practicable, all portions of excavation not occupied by the permanent structure shall be backfilled. Back-fill material shall be free from large or frozen lumps, wood or other extraneous material.

1. That portion of backfill which will not support any portion of completed roadbed or embankment shall be placed in layers not more than 10-inches in depth (loose measurement) and shall be compacted to a density comparable with the adjacent, undisturbed material.

2. That portion of the backfill which will support any portion of the roadbed or embankment or is within two (2) feet of the roadbed or embankment shall be placed in uniform layers not to exceed six (6) inches in depth (loose measurement) and each layer compacted to the density specified for the appropriate material. Each layer of backfill material, if dry, shall be wetted uniformly to the moisture content required to obtain the specified density and shall be compacted to that density by means of mechanical tamps, except that the use of rolling equipment of the type generally used in compacting embankments will be permitted on portions which are accessible to such equipment. All portions of embankment too close to any portion of a structure to permit compaction by the use of the blading and rolling equipment used on adjoining sections of embankment, shall be placed and compacted in the same manner as specified above for backfill material. These provisions require the mechanical compaction, by means of either rolling equipment or mechanical tamps, of all backfill and embankment adjoining the exterior walls and wingwalls of culverts. Unless otherwise provided by the Plans or Special Conditions, hand tamping will not be accepted as an alternate for mechanical compaction. As a general rule, material used in filling or backfilling the portions described in this paragraph shall be an earth free of any appreciable amount of gravel or stone particles more than four (4) inches in greatest dimension and of a gradation that permits thorough compaction. The percentage of fines shall be sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density. When required by the Plans or by written order of the City, cement stabilized material shall be used for backfilling.

3. All portions of fill and backfill described in the preceding paragraph shall be compacted to the same density requirements specified for the adjoining sections of embankment in accordance with the governing specifications therefore.

4. Where no embankment is involved on the Project and no specifications therefor are included in the Contract, all backfill shall be compacted to a density comparable with the adjacent undisturbed material.

5. Care shall be taken to prevent any wedging action of backfill against the structure, and the slopes bounding the excavation shall be stepped or serrated to prevent such action.

6. Backfilling shall not proceed prior to inspection and approval of the inspector.

G9.05 PIPE CULVERTS

A. The following requirements shall apply to the backfilling of pipe culverts in addition to the pertinent portions of the general requirements given in the preceding and in pipe bedding Standards.

1. Backfilling shall be continued in this manner to the elevation of the top of the pipe. Special care shall be taken to secure thorough compaction of the material placed under the haunches of the pipe. In the case of pipe in trenches, that portion of the backfill above the top of the pipe which supports embankment or the roadbed or is within two (2) feet of the roadbed or embankment shall receive mechanical compacting as specified, and the portion which will not support any portion of embankment or roadbed shall be placed in layers not more than ten (10) inches in depth (loose measurement) and shall be compacted by whatever means the Contractor chooses, to a density comparable with the adjacent, undisturbed material.

G9.06 PAYMENT

A. No separate payment will be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END SECTION

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TECHNICAL SPECIFICATIONS

SECTION SD1 - HOT MIX ASPHALTIC CONCRETE PAVEMENT

SD1.01 SCOPE OF WORK

A. This specification covers the requirements for furnishing and installing hot mix asphaltic concrete as shown in the Plans and specified within. Construction shall include a base course, a level-up course, a surface course or any combination of these courses as shown on the Plans, each course being composed of a compacted mixture of aggregate and asphalt mixed hot in a mixing plant, in accordance with the details shown on the Plans and the requirements herein.

SD1.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature including mix design, aggregate source, aggregate gradation, aggregate type, and all other pertinent data to illustrate conformance to the specification found within.

SD1.03 MATERIALS

A. The mineral aggregate shall be composed of a course aggregate, a fine aggregate, and if required, a mineral filler. Coarse aggregate shall be that part of the aggregate retained on the No. 10 sieve and shall be stone, crushed slag, crushed gravel, or gravel. Fine aggregate shall be that part passing the No. 10 sieve and shall consist of sand or screenings. Mineral filler shall consist of dry stone dust, Portland cement, or fly ash. Mineral aggregate shall meet the requirements of Item 340, Texas Department of Transportation, Standard Specifications for Construction of Highways, Streets and Bridges. The plasticity index of fine aggregate portion passing the No. 40 sieve shall not be more than six (6).

SD1.04 ASPHALTIC MATERIAL

A. Asphalt for the paving mixture shall meet the requirements of Texas Department of Transportation, Item 300 of the Standard Specifications for Construction of Highways, Streets and Bridges. The grade of asphalt used shall be designated by the Engineer or the City after design tests have been made using the mineral aggregate to be used in the job.

SD1.05 TACK COAT

A. Tack coat shall be in accordance with Texas Department of Transportation, Item 300 of the Standard Specifications for Construction of Highways, Streets and Bridges. Asphaltic material shall be approved by the Engineer or the City.

SD1.06 TYPES OF ASPHALTIC CONCRETE

A. The mixture shall be designed and tested in accordance with the current Texas Department of Transportation, Standard Specifications for Construction of Highways, Streets and Bridges, Item 340, Type D, and will have a laboratory density of not less than 94.5% nor more than 97.5%, and a stability of not less than 35.

B. The asphaltic material shall form from four to eight (4–8) percent of the mixture by weight or from nine to nineteen (9-19) percent of the mixture by volume.

SD1.07 EQUIPMENT

A Spreading and Finishing Machine

1. The spreading and finishing machine shall be a type approved by the Engineer, shall be capable of producing a surface that will meet the requirements of the typical cross section and the surface test, when required, and when the mixture is dumped directly into the finishing machine, shall have adequate power to propel the delivery vehicles in a satisfactory manner. The finishing machine shall be equipped with a flexible spring and/or hydraulic-type hitch sufficient in design and capacity to maintain contact between the rear wheels of the hauling equipment and the pusher rollers of the finishing machine while the mixture is being unloaded.

2. The use of any vehicle which requires dumping directly into the finishing machine and which the finishing machine cannot push or propel in such a manner as to obtain the desired lines and grades without resorting to hand-finishing will not be allowed. Unless otherwise permitted by the Plans, vehicles of the semi-trailer type are specifically prohibited from dumping directly into the finishing machine while in contact with the finishing machine. Vehicles dumping directly or indirectly into the finishing machine shall be so designed and equipped that unloading into the finishing machine can be mechanically and/or automatically operated in such a manner that overloading the finishing machine being used cannot occur and the required lines and grades will be obtained without resorting to hand-finishing.

3. Dumping of the asphaltic mixture in a windrow and then placing the mixture in the finishing machine with loading equipment will be permitted, provided that the loading equipment is constructed and operated in such manner that substantially all of the mixture deposited on the roadbed is picked up and loaded in the finishing machine without contamination of foreign material of the mixture, and excessive temperature loss is not encountered. The loading equipment will be so designed and operated that the finishing machine being loaded will obtain the required line, grade, and surface without resorting to hand-finishing. Any operation of the loading equipment resulting in the accumulation and subsequent shedding of this accumulated material into the asphaltic mixture will not be permitted.

B. Rolling Equipment

1. Rolling equipment shall consist of pneumatic tire rollers, two-axle tandem roller weighing not less than eight (8) tons, three-wheel roller weighing not less than 10-tons, three-axle tandem roller weighing not less than 10-tons, and trench rollers having a 20-inch wheeldrive and producing 325 pounds per linear inch of roller width at a speed of 1.8 miles per hour in low gear.

C. Straight Edges and Templates

1. The Contractor shall provide an acceptable 10-foot straight edge for surface testing.

SD1.08 CONSTRUCTION METHODS

A. The prime coat, tack coat or the asphaltic mixture, when placed with a spreading and finishing machine, shall not be placed when the air temperature is below 50 degrees F and is falling, but it may be placed when the air temperature is above 40 degrees F and is rising. The air temperature shall be taken in the shade away from artificial heat. It is further provided that the prime coat, tack coat or asphaltic mixture shall be placed only when the humidity, general weather conditions and temperature and moisture condition of the base, in the opinion of the Engineer or the City, are suitable.

B. Prime Coat

1. A prime coat is required, and shall be applied at the rate determined by the Engineer but not less than 0.2-gallons per square yard of MC-1 asphalt. The asphaltic concrete shall not be applied on a previously primed flexible base until the primed base has completely cured to the satisfaction of the Engineer and the City.

C. Transporting Asphaltic Concrete

1. The asphaltic mixture, prepared as directed above, shall be hauled to the work site in tight vehicles previously cleaned of all foreign material. The dispatching of the vehicles shall be

arranged so that all material delivered may be placed, and all rolling shall be completed during daylight hours. In cool weather, or for long hauls, canvas covers and insulating of the truck bodies may be required. The inside of the truck body may be given a light coating of oil, lime slurry or other material satisfactory to the Engineer and the City, if necessary, to prevent mixture from adhering to the body.

D. Placing

1. Generally, the asphaltic mixture shall be dumped and spread on the approved prepared surface with the specified spreading and finishing machine, in such manner that when properly compacted, the finished pavement will be smooth, of uniform density, and will meet the requirements of the typical cross-sections and the surface tests. During the application of asphaltic material, care shall be taken to prevent splattering of adjacent pavement, curb and gutter, and structures. When the asphaltic mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement, or placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated when authorized by the Engineer or the City, provided a satisfactory surface can be obtained by other approved methods.

E. Compacting

1. Rolling: The pavement shall be compressed thoroughly and uniformly with the specified roller and/or other approved rollers. Rolling with the three-wheel and tandem rollers shall start longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the rear wheel. Alternate trips of the roller shall be slightly different in length. Rolling with pneumatic-tire roller shall be done as directed by the Engineer. Rolling shall be continued until no further compression can be obtained and all roller marks are eliminated. One (1) tandem roller, one (1) pneumatic-tire roller, and at least one (1) three-wheel roller, as specified above, shall be provided for each job. If the Contractor elects, he may substitute the three-axle tandem roller for the two-axle tandem roller and/or the three-wheel roller; but in no case shall less than three rollers be in use on each job. Additional rollers shall be provided if needed. The motion of the roller shall be slow enough at all times to avoid displacement of the mixture. If any displacement occurs, it shall be corrected at once by the use of rakes and of fresh mixtures where required. The roller shall not be allowed to stand on pavement which has not been fully compacted. To prevent adhesion of the surface mixture to the roller, the wheels shall be kept thoroughly moistened with water, but an excess of water will not be permitted. All rollers must be in good mechanical condition. Necessary precautions shall be taken to prevent the dropping of gasoline, oil, grease, or other foreign matter on the pavement, either when the rollers are in operation or when standing. Regardless of the method used for compaction, all rolling to achieve specified density shall cease when the Hot Mix Asphaltic Mixture drops below 175°F (80°C).

2. In-Place Density: The Hot Mix Asphaltic mixture shall be tested daily at the project site for conformance to specification requirements. Unless directed otherwise by the Engineer or designated representative, a bag sample and a core or section will be obtained for each 2000 square yards or portion of paving each day, with a minimum of three bag samples and three cores for each day's paving.

Bag samples shall be taken during lay-down operations. The primary sampling point for the bag samples shall be from the windrow if a windrow elevator is used. If a windrow elevator is not used, the sample shall be taken from the middle of the paving machine hopper. Gradation, asphalt content and stability value of the hot mix asphaltic mixture shall be reported for each of the bag samples. The stability value reported for each of the bag samples shall be the average of three (3) tests per bag.

Pavement thickness and in-place density shall be determined from the field cores or sections. The average of all hot mix asphaltic concrete pavement core or section thicknesses shall meet the minimum thickness of 2.0". No individual core or section thickness deficiency may be greater than 0.2 inches. Pavement that does not meet the

thickness specification shall be removed and replaced as outlined below. The in-place density tests are intended for compaction-control tests and will be tested according to Test Method Tex-207-F. The core or section densities shall average from 91.0% to 96.0% of the maximum theoretical density except that the minimum acceptable density of an individual sample is 89.0% or the maximum acceptable density of an individual sample is 97.0%. There will be no two consecutive core or section densities below 91.0% or above 96.0%. Asphalt pavement represented by a density less than 89.0%, more than 97.0% or two consecutive densities less than 91.0% shall be removed and replaced.

Any pavement to be removed and replaced will be removed and replaced from curb to curb or edge of asphalt to edge of asphalt at the contractor's expense. Additional density tests shall be used to delineate the limits of the in-place hot mix asphaltic pavement that does not meet the density specification and the results of the tests shall not be used in the calculation of the overall average density. Protocol to assess the area of asphalt pavement removal and replacement shall start between the failing density or two consecutive densities that are less than 91.0% and the next passing density to either side of the failing pavement. Additional cores or sections will be required to quantify the area of replacement back to an in-place density of 91.0%. Backscattering (nuclear densities) shall not be used to determine the actual density of asphaltic pavement.

Pavements with low-density results may be retested; but the pavement shall not receive any additional compactive effort.

Final acceptance of the pavements shall be the responsibility of the Engineer.

3. Hand-Tamping: The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller or in such position as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

F. Surface Tests

1. The surface of the pavement, after compaction, shall be smooth and true to the established line, grade, and cross-section, and when tested with a 10-foot straightedge placed parallel to the centerline of the roadway or tested by other equivalent and acceptable means, except as provided herein, the maximum deviation shall not exceed 1/4-inch in 10-feet, and any point in the surface not meeting this requirement shall be corrected.

SD1.09 ROADS DAMAGED BY CONSTRUCTION

A. The Contractor shall reconstruct existing asphalt paved roads which are damaged as a result of construction of this project at no additional cost to the City. Reconstruction shall consist of reconstructing the road to an "as new condition" to the existing pavement cross section. The Contractor may use existing base material, adding new base material as needed. Contractor shall compact and reshape road subgrade to existing grade. The subbase and base shall be compacted in accordance with these specifications. The Contractor shall install at least two (2) inches of hot-mix asphalt pavement in accordance with these specifications.

SD1.10 MEASUREMENT AND PAYMENT

A. Payment for furnished and installed hot mix asphaltic concrete pavement shall be paid according to the unit price per square yard in the proper item of the Proposal and Bid Schedule.

B. All work and materials to complete the hot mix asphaltic concrete shall be subsidiary to this item.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION SD2 – ROADWAY EXCAVATION

SD2.01 SCOPE OF WORK

A. This specification covers the requirements for shaping and finishing of all earthwork on the entire length of roadway, and approaches to same, in conformity with the required lines, grades and typical cross sections and in accordance with specification requirements herein outlined. Compaction shall conform to the method of "Density Control" and/or "Ordinary Compaction" as shown on the Plans and Specifications.

SD2.02 SUBMITTALS

A. None required unless specifically called for in the Plans, Standards, or requested by the City or Engineer.

SD2.03 CONSTRUCTION METHODS

A. All roadway excavation and corresponding embankment construction shall be performed as specified herein and in Section S3- EMBANKMENT, and the completed roadway shall conform to the established alignment, grades and cross sections.

B. All suitable excavated materials shall be utilized, insofar as practicable, in constructing the required roadway sections. Unsuitable roadway excavation and roadway excavation in excess of that needed for the construction of the roadway shall be disposed of outside the limits of the right-of-way. Unsuitable material encountered below subgrade elevation in roadway cuts, shall be removed and replaced, as directed by the Representative of the City with material from the roadway excavation or with other suitable material.

C. During construction, the roadbed and ditches shall be maintained in such condition as to insure proper drainage at all times and ditches and channels shall be so constructed and maintained as to avoid damage to the roadway section. Soils with plasticity index (PI) of 20 or more shall be stabilized with an amount of lime adequate to reduce the PI to less than 20. Type A Grade 1 base material may be used with a minimum ratio of 1 to 1, in lieu of lime. If using lime treatment refer to Item 260 in the Texas Department of Transportation's "Standard Specifications for Construction of Highways, Streets and Bridges".

NOTE: **ALL UNDERGROUND UTILITIES SHALL BE INSTALLED PRIOR TO ANY LIME TREATMENT OR FLEXIBLE BASE PLACEMENT.**

NOTE: Blue-tops will be set on the center and crown of the streets or roads at every 50-foot station. These grade stakes will be to finished grade and visible for inspection before flexible base is applied.

SD2.04 PAYMENT

A. No separate payment will be made for work performed in accordance with this specification. Select back fill shall be paid for according to the unit price per cubic yard according to the appropriate item, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION SD4 – FLEXIBLE BASE
(Crushed Stone)

SD4.01 SCOPE OF WORK

A. This specification covers the requirements for the use of "Flexible Base (Crushed Stone)" for this project.

SD4.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature including binding material, additives, aggregate source, aggregate type, aggregate gradation and all other pertinent data to illustrate conformance to the specification found within.

SD4.03 GENERAL

A. "Flexible Base (Crushed Stone)"shall consist of a foundation course for surface course or for other base courses; shall be composed of crusher-run broken stone; and shall be constructed as herein specified in one or more courses in conformity with the typical sections shown on Plans and to the lines and grades as established by the Plans.

SD4.04 MATERIAL

A. The material shall be crushed and shall consist of durable particles of stone mixed with approved binding material. The material source shall be approved by the Representative of the City, and conform to the requirements as follows:

B. When properly slaked and tested by standard Texas Department of Transportation laboratory methods, the flexible base material shall meet the following requirements:

C. Physical requirements

a. General. All types shall meet the physical requirements for the specified grade(s) as set forth in Table 1.

Additives, such as, but not limited to, lime, cement or fly ash, shall not be used to alter the soil constants or strengths shown in Table 1, unless otherwise shown on the Plans.

Unless otherwise shown on the Plans, the base material shall have a minimum Bar Linear Shrinkage of two (2) percent as determined by Test Method Tex-107-E, Part II.

b. The flexible base shall be:

1. Type A. Type A material shall be crushed stone produced from oversized quarried aggregate, sized by crushing and produced from a naturally occurring single source. Crushed gravel or uncrushed gravel shall not be acceptable for Type A material. No blending of sources and/or additive materials will be allowed in Type A material.

TABLE 1
PHYSICAL REQUIREMENTS

Grade 1	
Triaxial Class 1: Min. compressive strength, psi: 45 at 0 psi lateral pressure and 175 at 15 psi lateral pressure	
Master Grading	
1-3/4"	0
7/8"	10-35
3/8"	30-50
No. 4	45-65
No. 40	70-85

Grade 1
Max LL 35
Max PI 10
Wet Ball Mill
Max 40
Max increase in passing
No. 40 20

1. Gradation requirements are percent retained on square sieves.

2. When a magnesium soundness value is shown on the Plans the material will be tested in accordance with Test Method Tex-411-A.

Sieve Analysis	Tex-110-E
Moisture-Density Determination	Tex-113-E
Roadway Density	Tex-115-E
Wet Ball Mill	Tex-116-E
Triaxial Tests (Part I or II as selected by the Engineer)	Tex-117-E
Particle Count	Tex-460-A, Part I

Samples for testing the base material for triaxial class, soil constants, gradation and wet ball mill will be taken prior to the compaction operations.

SD4.05 TOLERANCES

A. The limits establishing reasonably close conformity with the specified gradation and plasticity index are defined by the following:

B. The City may accept the material, providing not more than two (2) out of 10 consecutive gradation tests performed are outside the specified limit on any individual or combination of sieves by no more than five (5) percent and where no two (2) consecutive tests are outside the specified limit.

C. The City may accept the material providing not more than 2 out of 10 consecutive plasticity index samples tested are outside the specified limit by no more than two (2) points and where no two (2) consecutive tests are outside the specified limit.

SD4.06 CONSTRUCTION METHODS

A. Preparation of Subgrade

1. The roadbed shall be excavated and shaped in conformity with the typical sections, lines and grades as shown on the Plans. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material. All holes, ruts and depressions shall be filled with approved material, and if required, the subgrade shall be thoroughly wetted with water and reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the base material. The surface of the

subgrade shall be finished to line and grade as established and in conformity with the typical section shown on the Plans, and any deviation in excess of ½-inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of work.

B. First Course

1. Immediately before placing the base material, the subgrade shall be checked as to conformity with grade and section.

2. The material shall be delivered in approved vehicles of a uniform capacity and it shall be the charge of the Contractor that the required amount of specified material shall be delivered in each 100-foot station. Material deposited upon the subgrade shall be spread and shaped the same day unless otherwise directed by the City in writing. In the event inclement weather or other unforeseen circumstances render impractical the spreading of the material during the first 24-hour period, the material shall be scarified and spread as directed by the City. The material shall be sprinkled, if directed, and shall then be bladed, dragged and shaped to conform to typical sections as shown on the Plans. The base layer shall be constructed in lifts not exceeding six (6) inches compacted thickness with each course being of equal thickness. All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well graded material, as directed by the City.

3. The course shall be compacted by the method of compaction hereinafter specified as the "Density Control" method of compaction.

   a. The course shall be sprinkled as required and compacted to the extent necessary to provide not less than the percent density as hereinafter specified under "Density". In addition to the requirements specified for density, the full depth of flexible base shown on the Plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of flexible base is completed, density tests shall be taken every 750 square yards of roadbed surface or every 250 linear feet, whichever is the least. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown on the Plans and to the established lines and grades. In that area on which pavement is to be placed, any deviation in excess of ¼-inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling. Should the base course, due to any reason or cause, lose the required stability, density and finish before the surfacing is complete, it shall be recompacted and refinished at the sole expense of the Contractor. The base material shall be placed at the optimum moisture contents to ± 3%.

C. Succeeding Courses

1. Construction methods shall be the same as prescribed for the first course.

D. Density

1. When the "Density Control" method of compaction is used, each course of flexible base shall be compacted to the percent density indicated below. The testing will be as outlined in TEX 113E. It is the intent of this specification to provide in that part of the base included in the flexbase section as shown on the Plans immediately below the finished surface of the roadway, not less that 100 percent of the density as determined by the compaction ratio method. Field

density determination shall be made in accordance with approved methods.

SD4.07 NOTES

A. Invoices showing total amount of flexible base delivered to each street or road shall be furnished to the City before asphalt is applied.

B. Bluetops will be set on the center, crown and back of curb of the streets or roads every 50-foot station or sufficient to maintain line and grade. These grade stakes will be to finished grade and visible for inspection before asphalt is applied.

SD4.08 PAYMENT

A. Payment for furnished and installed flexible base shall be paid according to the unit price per square yard in the proper item of the Proposal and Bid Schedule.

B. All work and materials to complete the installation of flexible base shall be subsidiary to this item.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION SD5 - STRIPING

SD5.01 SCOPE OF WORK

A. This specification covers the requirements for furnishing and installing pavement markings as shown on the Plans and specified within.

SD5.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including material type, test data, and all other pertinent data to illustrate conformance to the specification found within.

SD5.03 MATERIALS

A. All pavement markings shall be thermoplastic type materials that require heating to elevated temperatures for application. They shall conform to Texas Department of Transportation Materials Specification D-9-8220. Each container of thermoplastic material shall be clearly marked to indicate the color, weight, type of material, Manufacturer's name and the lot/batch number.

SD5.04 STREET SIGNS

A. All signage sheeting shall be high intensity or better. All signage posts shall be 2.375" OD x .095" thin wall steel tubing. All signs shall have breakaway foundations. All signage shall meet the current edition of TMUTCD.

SD5.05 EQUIPMENT

A. All equipment used to place pavement markings shall be maintained in a satisfactory condition. The equipment shall be able to place markings at a rate that will produce a uniform product meeting all the requirements set within item 666 of the standard specifications for Construction of Highways, Streets and Bridges. It shall be capable of placing linear markings up to eight (8) inches in width in a single pass and able to place a center line and no passing barrier line configuration of one (1) broken line with two (2) solid lines at the same time to the alignment and spacing shown on the Plans. Equipment shall be capable of placing lines with clean edges of a uniform cross section within a tolerance of $^{1}/_{8}$ of an inch per four (4) inches width of marking. It shall have an automatic cut-off device with manual operating capabilities to provide clean, reasonably square marking ends to the satisfaction of the Engineer or the City and provide a method of applying broken line in an approximate stripe-to-gap ratio of 10 to 30. The length of the stripe shall not be less than 10-feet or more than 10.5-feet. The total length of any stripe-gap cycle shall not be less than 39.5-feet or more than 40.5-feet. It shall provide a continuous mixing and agitation of the pavement marking material. The use of pans, aprons or similar appliances will not be permitted for longitudinal striping applications. Beads shall be applied by an automatic bead dispenser that is attached to the pavement marking equipment in such a manner that the beads are dispensed uniformly and almost instantly as the marking is placed on the pavement surface. The bead dispenser shall have an automatic cut-off control, synchronized with the cut-off of the pavement marking equipment. A hand held thermometer shall be kept on the project during the placement of pavement markings capable of measuring the temperature of the pavement marking material.

SD5.06 CONSTRUCTION METHODS

A. Pavement marking shall be applied with an approximate stripe-to-gap ratio of 10 to 30 when the application is broken line striping. The length of the broken stripe shall not be less than 10-feet nor more than 10.50-feet. The total length of any stripe-gap cycle shall not be less than 39.50-feet nor more than 40.50-feet.

B. With prior approval from the City of Georgetown, pavement markings may be placed on roadways open to traffic. When markings are to be placed under traffic, a minimum of interference to the operation of the traffic flow shall be maintained. Traffic control shall be maintained as shown on the approved

Traffic Control Plan. All markings placed under open-traffic conditions shall be protected from traffic damage and disfigurement.

C. The deviation rate in pavement marking alignment shall not exceed one (1) inch per 200-feet of roadway and the maximum deviation shall not exceed two (2) inches nor shall any abrupt deviations be acceptable.

D. Markings shall have a uniform cross section. The density and quality of the markings shall be uniform throughout their thickness. The applied markings shall have no more than five (5) percent, by area, of holes or voids and shall be free of blisters.

E. Markings shall be reflectorized both internally and externally. Glass beads shall be applied to the materials at a uniform rate sufficient to achieve uniform and distinctive retroflective characteristics when observed in accordance with Test Method Tex-828-B.

F. Pavement markings that are not in alignment or sequence, as shown on the Plans or Standards, shall be removed and replaced at the sole expense of the Contractor.

SD5.07 SURFACE PREPARATION

A. New Portland cement concrete surfaces shall be cleaned to remove curing membrane, dirt, grease, loose and/or flaking existing construction markings and other forms of contamination.

B. Older Portland cement concrete surfaces and asphalt surfaces that exhibit loose and/or flaking existing markings shall be cleaned to remove all loose and flaking markings.

C. All pavement on which pavement markings are to be placed shall be completely dry.

SD5.08 APPLICATION

A. Unless otherwise shown on the Plans, Portland cement concrete surfaces and asphaltic surfaces that are three (3) years old or older shall be sealed by the use of paint type striping. The paint type markings shall be placed a minimum of two (2) and a maximum of 30 calendar days in advance of placing the thermoplastic type pavement markings. If the paint type markings become dirty for any reason prior to placing the thermoplastic type markings, they shall be cleaned by washing, brushing, compressed air or other means approved. The pavement and paint type marking shall both be thoroughly dry before any thermoplastic type markings are placed. The color of the paint type markings shall be the same as the thermoplastic type markings.

B. Pavement markings shall not be applied when the temperature and moisture limitations are beyond the Manufacturer's recommendation. The minimum thickness for thermoplastic markings shall be 0.060-inches (60-mil) for edgeline markings and 0.090-inches (90-mil) for stop bars, legends, symbols, gore and centerline/no passing barrier line markings, when measured in accordance with Test Method Tex-854-B. The maximum thickness of all thermoplastic type markings shall be 0.180-inches (180 mil).

C. All markings which do not meet the specifications found within or are not satisfactory to the striping plan, installation of the markings, or do not meet the requirements of the project, shall be removed and replaced at the sole expense of the Contractor. In the event that damage is done to the pavement surface in the replacement operation, the damage shall be corrected to the satisfaction of the City at the sole expense of the Contractor.

SD5.09 MEASUREMENT AND PAYMENT

A. Payment for furnished and installed pavement markings shall be paid according to the unit price per linear foot in the proper item of the Proposal and Bid Schedule.

B. All work and materials to complete the pavement markings shall be subsidiary to this item.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION WW1 – CONCRETE MANHOLES

WW1.01 SCOPE OF WORK

A. This specification covers the requirements to install precast concrete manholes, frames and covers, and appurtenances as shown on the Plans and as specified herein.

WW1.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, shop drawings, product data, materials of construction, and details of installation shall be submitted in accordance with Section CIP10- SUBMITTALS. Submittals shall include the following: base sections, riser sections, eccentric conical top sections, flat slab tops, grade rings with notarized certificate indicating compliance with ASTM C478, pipe connection to manhole, manhole frame and cover with notarized certificate indicating compliance with ASTM A48, Class 30, method of repair for minor damage to precast concrete sections, manhole lining system.

B. Design Data

1. Precast concrete structures:

a. Six (6) copies of sectional plan(s) and elevations showing dimensions and reinforcing steel placement.

b. Six (6) copies of concrete design mix.

C. Test Reports

1. Precast concrete structures:

a. Six (6) copies of concrete test cylinder reports from an approved testing laboratory certifying conformance with specifications.

WW1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A48 - Specification for Gray Iron Castings.

2. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

3. ASTM C33 - Specification for Concrete Aggregates.

4. ASTM C150 - Standard Specification for Portland Cement.

5. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.

6. ASTM D4101 - Specification for Propylene Plastic Injection and Extrusion Materials.

B. American Concrete Institute (ACI)

1. ACI 318 - Building Code Requirements for Reinforced Concrete.

2. ACI 350R - Concrete Sanitary Engineering Structures.

C. American Association of State Highway and Transportation Officials (AASHTO)

1. Standard Specifications for Highway, Streets and Bridges.

D. Occupational Safety and Health Administration (OSHA)

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

WW1.04 QUALITY ASSURANCE

A. All material shall be new and unused.

B. Materials' quality, manufacturing process and finished sections are subject to inspection and approval by Engineer or other City representative. Inspection may be made at place of Manufacture, at work site following delivery, or both.

C. Materials will be examined for compliance with ASTM specifications, these Specifications and approved Manufacturer's drawings. Additional inspection criteria shall include: appearance, dimensions(s), blisters, cracks and soundness.

D. Materials shall be rejected for failure to meet any Specification requirement. Rejection may occur at place of manufacture, at work site, or following installation. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no cost to City.

E. Repair minor damage to precast concrete sections by approved method, if repair is authorized by Engineer or the City.

WW1.05 PRODUCTS

A. Reference to a Manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials/equipment shall be the end products of one Manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and Manufacturer's service.

C. Provide lifting lugs or holes in each precast section for proper handling.

WW1.06 PRECAST CONCRETE MANHOLE SECTIONS

A. Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478 and meet the following requirements:

1. Bottom slab thickness shall be 12-inches.

2. Top section shall be flat slab with a minimum clear opening of 32 $^{7}/_{8}$-inches diameter.

3. Base, riser and transition top sections shall have tongue and groove joints.

4. Sections shall be cured by an approved method.

5. Precast concrete sections shall be shipped after concrete has attained 3,000 psi compressive strength.

6. Design precast concrete base, riser, transition top, flat slab top and grade ring for a minimum HS-20 loading plus earth load. Calculate earth load with a unit weight of 130 pounds per cubic foot.

7. Mark date of manufacture, name and trademark of Manufacturer on the inside of each precast section.

8. Construct and install precast concrete base as shown on the Plans.

9. Provide integrally cast knock-out panels in precast concrete manhole sections at locations, and with sizes shown on Plans. Knock-out panels shall have no steel reinforcing.

B. Manhole diameter shall be as shown on the Plans, but not less than the diameter of the largest connecting pipe plus two (2) feet.

C. Pipe Sections

Pipe sections shall conform to current specifications for Precast Reinforced Manhole Sections, ASTM Designation C478, with the following additions:

1. Pipe shall be machine made by a process which will provide for uniform placement of zero slump concrete in the form and compaction by mechanical devices which will assure a dense concrete in the finished product.

2. Aggregates for the concrete shall consist of limestone aggregates in the proportion of at least 75% by weight of the total aggregates.

3. Minimum wall thickness for the manhole risers shall be as listed under Wall "B" in the "Class Tables" of ASTM C76 for Class III pipe.

D. Joints

1. Joints shall conform to the joint specifications in ASTM C478, C76, and ASTM C443. All manhole sections, including the bottom section, shall be furnished with "O-ring" type rubber gasket joints. The joints shall be furnished and installed with the bell down to resist groundwater infiltration. All joints shall be sealed with mortar or an approved non-shrink grout on the inside and the outside of the manhole. Grade rings shall be mortared to each other and on the inside and outside to provide a waterproof seal.

E. Manhole Steps

1. Unless specifically approved by the City, manhole steps shall not be provided.

WW1.07 MANHOLE FRAME AND COVER

A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30.

B. Manhole covers shall have a diamond pattern, pickholes and the word SEWER as appropriate cast in three (3) inch letters. Manhole frame and covers shall be Neenah Foundry, Western Iron Works, Vulcan Foundry, or equal. Model numbers refer to Western Iron works products:

1. Manhole Frame and cover - WRM-36.

WW1.08 JOINTING PRECAST MANHOLE SECTIONS

A. Seal tongue and groove joints of precast manhole sections with rubber "O"-ring gasket. O-ring gasket shall conform to ASTM C443.

B. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

WW1.09 PIPE CONNECTIONS TO MANHOLE

A. Connect pipe to manhole in the following ways:

1. Flexible sleeve - Integrally cast sleeve in precast manhole section or install sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PSX Press-Seal Gasket or equal.

2. Compression gasket - Integrally cast compression gasket in precast manhole section. Insert pipe into compression gasket. Compression gasket shall be A-Lok, or equal.

WW1.10 INSTALLATION

A. Manhole Installation

1. Manholes shall be constructed to the dimensions shown on the Plans and as specified herein. Protect all work against flooding and flotation.

2. Place manhole base on a bed of screened gravel eight (8) inches in depth as shown on the Plans. Set manhole base so that a maximum grade adjustment of eight (8) inches is required to bring the manhole frame and cover to final grade.

Use precast concrete grade rings to adjust manhole frame and cover to final grade.

3. Set precast concrete barrel sections plumb with a $^{1}/_{4}$-inch maximum out of plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber "O" ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finished flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with non-shrink grout to the satisfaction of the Engineer and the City.

4. Allow joints to set for 14 hours before backfilling unless a shorter period is specifically approved by the Engineer or the City.

5. Plug holes in the concrete barrel sections required for handling with a non-shrinking grout or non-shrinking grout in combination with concrete plugs. Finish flush on the inside.

6. Core holes in precast sections to accommodate pipes prior to setting manhole sections in place to prevent jarring which may loosen the mortar joints.

7. Backfill carefully and evenly around manhole sections.

B. Manhole Pipe Connections

1. Construct manhole pipe connections, including pipe stubs, as specified above. Close or seal pipe stubs for future connections with a gasketed watertight plug.

C. Setting Manhole Frame and Cover

1. Set manhole covers and frames in a full mortar bed. Utilize precast concrete grade rings, for a maximum adjustment of twelve (12) inches, to assure frame and cover are set to the finished grade. Set manhole frame and cover to final grade prior to placement of permanent paving.

WW1.11 TESTS

A. Test each manhole in accordance with Section CIP12- TESTING OF PIPELINES AND MANHOLES. Engineer or the City's representative shall observe each test.

WW1.12 CLEANING

A. Thoroughly clean all new manholes of all silt, debris and foreign matter of any kind, prior to final inspections.

WW1.13 PAYMENT

A. Payment for furnished and installed manholes shall be paid according to the unit price per each in the proper item of the Proposal and Bid Schedule.

B. All work and materials to complete the reinforced concrete pipe including but not limited to excavation, bedding, backfill, connection to pipe, etc. shall be subsidiary to this item.

END OF SECTION

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TECHNICAL SPECIFICATIONS

SECTION W2 – POLYVINYL CHLORIDE (PVC) PIPE-WATER

W2.01 SCOPE OF WORK

A. This specification covers the requirements to install polyvinyl chloride (PVC) water pipe and ductile iron fittings for the water line, including excavation, sheeting, shoring, dewatering, pipe laying, jointing, testing, backfilling and any other work that is required or necessary to complete the installation as shown on the Plans and as specified herein.

W2.02 SUBMITTALS

A. Within 30 days of the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the name of the pipe and fittings suppliers, a list of materials to be furnished, shop drawings and schedules of all PVC pipe and fittings required, prior to each shipment of pipe, submit certified test reports that the pipe for this Contract was Manufactured and tested in accordance with the ASTM Standards specified herein.

W2.03 QUALITY ASSURANCE

A. All PVC pipe and fittings shall be from a single Manufacturer. The supplier shall be responsible for the provisions of all test requirements specified in ASTM D3034 or ASTM F789 and/or ASTM F758 as applicable. In addition, all PVC pipe to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the City. The Contractor shall require the Manufacturer's cooperation in these inspections. The cost of plant inspection of all pipe approved for this Contract, plus the cost of inspection of disapproved pipe, will be borne by the Contractor.

B. Inspections of the pipe may also be made by the Engineer or other representatives of the City after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

W2.04 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

1

A. Polyvinyl chloride pipe for water lines, unless otherwise specifically shown on the Plans, or approved in writing, shall be AWWA C900 or C909 Class 150 psi with a dimension ratio of 25 (DR-25), for water lines and shall be extruded, be of rubber gasket type, and be furnished in 20-foot nominal laying lengths. All such pipe shall bear a mark denoting approval by the Underwriters' Laboratories of Chicago, Illinois, so that it will be acceptable to the Texas State Fire Insurance Commission for use in fire protection lines without penalty. All joints shall be of the type which provides a recession in the bell for the employment of a single rubber gasket to be placed before the insertion of the succeeding spigot. Each size of polyvinyl chloride pipe shall have the same outside diameter as the corresponding size of cast iron pipe.

B. Fittings shall be ductile iron, mechanical joint or flanged type and shall be Class 250 in accordance with AWWA Specifications C110-77, C-111-80, and C115-75. Flanges shall be faced and drilled in accordance with ASA Standard B16.1, Class 125 unless otherwise shown on the Plans or in the Special Conditions. All fittings shall be tar coated on the outside surface and shall have an interior cement lining with seal coat per AWWA Specifications C104-80 unless otherwise shown or specified.

C. The Contractor shall obtain installation instructions, including support spacing and solvent welding, from the supplying Manufacturer, shall comply with the instructions, and shall meet the requirements of ASTM D-2855, Standard Recommended Practice for making Solvent Cemented Joints with PVC Pipe and Fittings. The PVC solvent cement shall comply with ASTM D-2564 and shall be furnished by the pipe and fitting Manufacturer for the class and type of pipe supplied to the project.

W2.05 HANDLING AND CUTTING PIPE

A. Pipe and fittings are slightly brittle. Care shall be taken in shipping, handling and laying to avoid damaging the pipe and fittings. Extra care will be necessary during cold weather construction.

B. Any pipe or fitting showing a crack or which has received a blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

C. All pipe ends shall be square after cutting.

D. While stored, pipe shall be adequately supported from below at not more than three (3) foot intervals to prevent deformation. Pipe shall not be stacked higher than six (6) feet. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of direct sunlight. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature buildup when exposed to direct sunlight will not be permitted.

W2.06 JOINTING POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. PVC pipe and fittings shall be jointed in accordance with the recommendations of the latest ASTM Standards and detailed instructions of the Manufacturer.

W2.07 INSTALLING POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Unless otherwise specified on the Plans, polyvinyl chloride pipe shall be installed to clear all utility lines and shall have three (3) feet minimum cover. For water lines to be constructed under a future roadway, the cover may be increased to allow for future paving grades. The depth of cover, where shown on the Plans, is that distance from the top of the pipe to the approximate proposed grade line.

B. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than $^{1}/_{16}$-inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the Manufacturer shall be explicitly followed.

C. Any pipe or fittings discovered to be defective after laying shall be removed and replaced with a sound piece.

D. The Engineer or the City may examine each bell and spigot end to determine whether any preformed joint has been damaged prior to installation. Any pipe having defective joint surfaces shall be rejected, marked as such, and immediately removed from the job site.

E. All pipe shall be sound and clean before laying. When laying is not in progress, including lunch time, the open ends of the pipe shall be closed by watertight plugs or other approved means. Good alignment shall be preserved in laying.

F. Pipe and fittings shall be installed in accordance with the instructions of the Manufacturer, ASTM D2321 and as specified herein. As soon as the excavation is complete to normal grade of the bottom of the trench, embedment material shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. The pipe shall be laid accurately to the lines and grades indicated on the Plans. The specified embedment shall be accurately shaped and trimmed to receive the pipe barrel and each pipe section, when in place, shall have a uniform bearing on the subgrade for the full length of the pipe barrel. Pipe shall not be laid unless the subgrade is free of water and in a satisfactory condition. Embedment material shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to force the embedment material under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. Embedment material shall then be placed to 12-inches above the top of the pipe. Next, the varying depths of select material backfill above the embedment material backfill shall be placed according to the Plan Details and carefully compacted. Generally, the compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient select material backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in

compacting the varying depths of select material backfill shall be approved by the pipe Manufacturer's representative prior to use. Adjustments of the pipe to line and grade shall be made by scraping away or filling in with granular material, and not by wedging or blocking up the bell.

G. Perforated PVC Pipe and fittings shall be installed in accordance with the instructions of the Manufacturer, ASTM F758 and as specified herein. As soon as the excavation for the trench is complete to normal grade of the bottom of the trench, geotextile fabric shall be laid and then the pea gravel bedding shall be carefully placed (so not to damage the geotextile fabric) and graded to provide uniform and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. Before the perforated pipe is laid on the trench, the perforated pipe shall be wrapped around and closed according to the Manufacturer's closure recommendations with the geotextile fabric. The pipe shall be laid accurately to the lines and grades indicated on the Plans. Blocking under the perforated PVC pipe will not be permitted. Pea gravel shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to gently place the pea gravel under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. Making sure not to damage the geotextile fabric, pea gravel shall then be carefully placed above the top of the perforated pipe varying from two to three (2-3) feet depending on the Plans. Once the remaining pea gravel has been placed, overlap or close the geotextile fabric according to the Manufacturer's recommendations or six (6) inches minimum overlap. Then one (1) foot of topsoil shall be placed over the pea gravel to the ground level with proper grass sodding on top.

H. Joints shall not be "pulled" or "cramped". Each joint of pipe shall be completed in compliance with Manufacturer's recommendations.

I. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.

J. Precautions shall be taken to prevent flotation of the pipe in the trench.

K. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and backfill or embedment material. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, embedment material shall be placed to fill any voids created and the embedment material and backfill shall be recompacted to provide uniform side support for the pipe.

W2.08 CONCRETE AND BLOCKING

A. 2,500 psi concrete shall be placed for blocking at each change in direction in the pipeline, as shown in the Standard Details and in such manner as will substantially brace the pipe against undisturbed trench walls. In no event shall this quantity of concrete blocking be less than those shown in the Plans. Concrete blocking, made from Type I cement, shall have been in place four (4) days prior to testing the pipeline as hereinafter specified. Tests may be made in two (2) days after completion of blocking if Type III cement is used.

B. At all points where wet connections are made to existing lines, the existing lines shall be adequately blocked and the tapping connection fittings shall be supported by blocking up to the spring line with 2,500 psi concrete.

C. Concrete blocking will not be measured or paid for as a separate item but the cost thereof shall be included in the various items listed in the Proposal and Bid Schedule.

W2.09 TESTING AND ALLOWABLE LEAKAGE

A. All PVC pipe and fittings shall be leak tested and sterilized according to Section CIP12.05- TEST PROCEDURES FOR PRESSURE PIPELINES.

W2.10 PAYMENT

A. The pipeline, complete in place, including cleanup, will be measured for payment in linear feet along the centerline of the pipe actually installed. Measurement shall be through all fittings, specials, valves, etc., and no deduction in length shall be made for such appurtenances. Installation of the pipeline will be paid for at the unit contract price per linear foot as provided in the Proposal and Bid Schedule.

B. Payment of the unit contract price for the items of work performed shall be the total compensation for furnishing all labor, materials, tools, equipment and incidentals and performing all work that is necessary for the installation, testing, and sterilization of the pipe, fittings, connections, blocking, embedment or placing in encasement pipe and all other appurtenances in accordance with the Plans and the provisions of the Specifications.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION WW3 – CONNECTIONS TO AND WORK ON THE EXISTING WASTEWATER SYSTEM

WW3.01 SCOPE OF WORK

A. This specification covers the requirements to maintain flow in existing sewers, handle existing wastewater flow, construct and maintain all temporary connections and diversions and construct the permanent connections to the new system as shown on the Plans and as directed by the Engineer.

WW3.02 SUBMITTALS

A. None required unless specifically called for in the Plans, details, or requested by the Engineer.

WW3.03 GENERAL

A. The Contractor shall supply all materials, equipment and labor required for plugging existing wastewater lines, all work on existing manholes (including all work and materials required to reshape existing manhole inverts with concrete and connecting new wastewater lines to existing manholes) and all additional work required.

B. Should damage of any kind occur to the existing wastewater line, the Contractor shall at his/her own expense, as part of the work under this Section, make repairs to the satisfaction of the Engineer.

C. The Contractor shall notify the Engineer immediately of any discrepancies in elevations of existing wastewater lines and manholes between those shown on the Plans and those established during construction in order that the Engineer can make the necessary modifications.

D. All new wastewater pipe for connection shall conform to the pipe specifications in Section WW2-POLYVINYL CHLORIDE (PVC) PIPE - WASTEWATER.

WW3.04 HANDLING WASTEWATER FLOWS

A. The Contractor shall provide all labor, equipment and materials necessary to maintain existing flows, including temporary diversions and all pumping of sewage that may be required to prevent backing up of wastewater lines and shall immediately remove all offensive matter at his/her own expense.

B. The Contractor shall not be permitted to overflow, bypass, pump or by any other means convey sewage to any stream, or other water course.

C. All procedures for maintaining flows must meet the approval of the Engineer and the Contractor shall be required to submit to the Engineer, for approval, a detailed written plan of all methods of flow maintenance 10 days in advance of flow interruption.

WW3.05 PAYMENT

A. No separate payment shall be made for work performed in accordance with this section of the specifications, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION W1 – DUCTILE IRON PIPE AND FITTINGS

W1.01 SCOPE OF WORK

A. This specification covers the requirements to furnish and install ductile iron pipe and ductile iron pipe fittings including bracing, pipe laying, jointing, testing, blocking, and any other work that is required or necessary to complete the installation as shown on the Plans and as specified herein.

W1.02 SUBMITTALS

A. Within 30 days of the Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature including the name of the pipe and fitting suppliers and a list of materials to be furnished, completely detailed working drawings and schedules of all ductile-iron pipe and fittings required, prior to each shipment of pipe, submit certified test reports that the pipe for this Contract was manufactured and tested in accordance with the ASTM and ANSI/AWWA Standards specified herein.

W1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs 60,000 PSI Tensile Strength.

B. American Water Works Association (AWWA)

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pressure Pipe and Fittings.

2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.

3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-inch Through 48-in for Water and Other Liquids.

4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. AWWA C115 - Standard for Flanged Ductile-Iron Pipe with Threaded Flanges.

6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.

7. AWWA C153 - Ductile-Iron Compact Fittings, 3-inch Through 16-inch for Water and Other Liquids.

8. AWWA C600 - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.

9. AWWA C651 - Disinfection Water Mains

C. American National Standards Institute (ANSI)

1. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

W1.04 QUALITY ASSURANCE

3

A. All pipe shall be from one single source and all fittings shall be from one single source. All ductile-iron pipe to be installed under this Contract may be inspected at the foundry for compliance with these Specifications by an independent testing laboratory provided by the City. The Contractor shall require the Manufacturer's cooperation in these inspections. The cost of foundry inspection of all pipe approved for this Contract, plus the cost of inspection of disapproved pipe will be borne by the Contractor.

B. Inspection of the pipe will be made by the Engineer or other representatives of the City after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the job.

W1.05 MATERIALS

A. Ductile iron pipe shall conform to AWWA C151, be manufactured from metal having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi, and a minimum elongation of 10 percent (60–42–10), and be provided in the following minimum pressure classes:

1. 12-inch and smaller, Class 350.
2. 14-inch through 20-inch, Class 250.
3. 24-inch, Class 200.
4. 30-inch and larger, Class 150.

B. Ductile iron fittings shall conform to AWWA C110 or C153.

C. All pipe and fittings shall have a bituminous outside coating in accordance with AWWA C151 and C110, respectively. All pipe and fittings shall be cement-mortar lined and seal coated in accordance with AWWA C104. Cement mortar lining shall be double thickness.

D. Ductile iron pipe with push-on or mechanical joints shall be centrifugally cast pipe in accordance with AWWA C150 and C151.

3

E. Restrained joints shall be restrained push-on joints, TR Flex by U.S. Pipe and Foundry; Flex-Ring, or equal. Joints shall be suitable for 250 psi working pressure and be fabricated of heavy section ductile iron casting. Bolts and nuts shall be low carbon steel conforming to ASTM A307, Grade B.

F. Sleeve type couplings shall be of steel and shall be Style 38 by Dresser Manufacturing Division, Smith-Blair or equal. Couplings shall be furnished with black steel bolts and nuts and with pipe stop removed. Gaskets shall be of a material suitable for exposure to liquid within the pipe.

W1.06 POLYETHYLENE ENCASEMENT

A. All buried ductile iron pipe and metallic fittings shall be encased with 8 mil, Type I, Grade E-1, polyethylene film conforming to AWWA C105. Class usage shall be:

1. Class A - Natural Color where exposure to weather (including sunlight) is less than 48 hours total before burial.
2. Class C - Black where exposure to weather (including sunlight) may be more than 48 hours.

B. Exposure to weather shall be kept to a minimum, and in no case shall it exceed 10 days. The Class of polyethylene used shall be approved by the Engineer.

C. Polyethylene encasement shall not be paid for separately, but the cost there of shall be included in he appropriate item of the Proposal and Bid Schedule.

W1.07 LAYING DUCTILE IRON PIPE AND FITTINGS

A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe, lining or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe linings or coatings shall be repaired as directed by the Engineer. Handling and laying of pipe and fittings shall be in accordance with the Manufacturer's instruction and as specified herein.

B. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when laid, shall conform to the lines and grades required. Pipe shall not be laid unless the subgrade is free of water and in a satisfactory condition. Ductile iron pipe and fittings shall be installed in accordance with the requirements of AWWA C600 except as otherwise provided herein. All piping on this project regardless of size or class shall be placed in the embedment as shown on the detail sheets in the Plans. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor, at his own expense.

C. All pipe shall be sound and clean before laying. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by watertight plugs or other approved means. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the Manufacturer. Fittings, in addition to those shown on the Plans, shall be provided, if required, for crossing utilities which may be encountered upon opening the trench. Solid sleeves shall be used only where approved by the Engineer and the City.

D. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be joined with a bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged.

E. Joints shall be protected by eight (8) mil. Polyethylene film prior to placing concrete. Concrete shall be placed against undisturbed material, and shall not cover joints, bolts or nuts, or interfere with the removal of any joint.

W1.08 PUSH-ON JOINTS

A. Push-on joints shall be made in accordance with AWWA C111 and the Manufacturer’s instructions. Pipe shall be laid with bell ends in the direction of trenching. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe to be laid shall then be aligned and inserted in the bell of the pipe to which it is to be joined and pushed home with a jack or by other means. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is correctly located.

W1.09 MECHANICAL JOINTS

A. Mechanical joints shall be made in accordance with Appendix “A” of AWWA C111 and the Manufacturer's instructions. Thoroughly clean and lubricate the joint surfaces and rubber gasket with soapy water before assembly. Bolts shall be tightened to the specified torque. Under no conditions shall extension wrenches or pipe over the handle of ordinary ratchet wrench be used to secure greater leverage.

W1.10 RESTRAINED JOINTS

A. Restrained joints shall be installed where shown on the Plans. The joint assemblies shall be made in accordance with the Manufacturer's recommendations.

W1.11 SLEEVE TYPE COUPLINGS

A. Couplings shall be installed where shown on the Plans. Couplings shall not be assembled until adjoining push-on joints have been assembled. After installation, apply a heavy bitumastic coating to bolts and nuts.

W1.12 POLYETHYLENE ENCASEMENT

A. The polyethylene encasement shall be installed in accordance with either method specified in AWWA C105.

W1.13 CONCRETE AND BLOCKING

A. 2,500 psi concrete shall be placed for blocking at each change in direction in the pipeline, in such manner as will substantially brace the pipe against undisturbed trench walls. Concrete blocking, made from Type I cement, shall have been in place four (4) days prior to testing the pipeline as hereinafter specified. Test may be made in two (2) days after completion of blocking if Type III cement is used.

B. At all points where wet connections are made to existing lines, the existing lines shall be adequately blocked and the tapping connection fittings shall be supported by blocking up to the spring line with 2,500 psi concrete.

C. Concrete blocking will not be measured or paid for as a separate item but the cost thereof shall be included in the proper items listed in the Proposal and Bid Schedule.

W1.14 CLEANING

A. At the conclusion of the work thoroughly clean all of the new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If obstructions remain after this cleaning, the obstructions shall be removed.

W1.15 CONNECTIONS AND APPURTENANCES

A. The Contractor shall make the alterations and the necessary connections to existing water mains as shown on the Plans. Such connection shall be made at such time and in a manner approved by the City; in each case, when the work is started, it shall be prosecuted expeditiously and continuously until completed.

B. Fittings, bends, plugs and valves and shall be of standard manufacture and mechanical joint type to fit AWWA pipe specifications in Classes A, B, C and D, unless otherwise shown on the Plans.

C. Payment for fittings and gate valves shall be restrained and shall be made separately under the appropriate bid items listed in the Proposal and Bid Schedule.

W1.16 LEAKAGE TESTING AND STERILIZATION

A. All Ductile Iron Pipe shall be leak tested and sterilized according to Section CIP12 – TESTING OF PIPELINES.

W1.17 PAYMENT

A. The pipeline, complete in place, including cleanup, will be measured for payment in linear feet along the centerline of the pipe actually installed. Measurement shall be through all fittings, specials, valves, etc., and no deduction in length shall be made for such appurtenances. Installation of the pipeline will be paid for at the unit contract price per linear foot as provided in the Proposal and Bid Schedule.

B. Payment of the unit contract price for the items of work performed shall be the total compensation for furnishing all labor, materials, tools, equipment and incidentals and performing all work that is necessary for the installation, testing, and sterilization of the pipe, fittings, connections, blocking, embedment or placing in encasement pipe and all other appurtenances in accordance with the Plans and the provisions of the Specifications.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION W2 – POLYVINYL CHLORIDE (PVC) PIPE-WATER

W2.01 SCOPE OF WORK

A. This specification covers the requirements to install polyvinyl chloride (PVC) water pipe and ductile iron fittings for the water line, including excavation, sheeting, shoring, dewatering, pipe laying, jointing, testing, backfilling and any other work that is required or necessary to complete the installation as shown on the Plans and as specified herein.

W2.02 SUBMITTALS

A. Within 30 days of the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including the name of the pipe and fittings suppliers, a list of materials to be furnished, shop drawings and schedules of all PVC pipe and fittings required, prior to each shipment of pipe, submit certified test reports that the pipe for this Contract was Manufactured and tested in accordance with the ASTM Standards specified herein.

W2.03 QUALITY ASSURANCE

A. All PVC pipe and fittings shall be from a single Manufacturer. The supplier shall be responsible for the provisions of all test requirements specified in ASTM D3034 or ASTM F789 and/or ASTM F758 as applicable. In addition, all PVC pipe to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the City. The Contractor shall require the Manufacturer's cooperation in these inspections. The cost of plant inspection of all pipe approved for this Contract, plus the cost of inspection of disapproved pipe, will be borne by the Contractor.

B. Inspections of the pipe may also be made by the Engineer or other representatives of the City after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

W2.04 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

1

A. Polyvinyl chloride pipe for water lines, unless otherwise specifically shown on the Plans, or approved in writing, shall be AWWA C900 or C909 Class 150 psi with a dimension ratio of 25 (DR-25), for water lines and shall be extruded, be of rubber gasket type, and be furnished in 20-foot nominal laying lengths. All such pipe shall bear a mark denoting approval by the Underwriters' Laboratories of Chicago, Illinois, so that it will be acceptable to the Texas State Fire Insurance Commission for use in fire protection lines without penalty. All joints shall be of the type which provides a recession in the bell for the employment of a single rubber gasket to be placed before the insertion of the succeeding spigot. Each size of polyvinyl chloride pipe shall have the same outside diameter as the corresponding size of cast iron pipe.

B. Fittings shall be ductile iron, mechanical joint or flanged type and shall be Class 250 in accordance with AWWA Specifications C110-77, C-111-80, and C115-75. Flanges shall be faced and drilled in accordance with ASA Standard B16.1, Class 125 unless otherwise shown on the Plans or in the Special Conditions. All fittings shall be tar coated on the outside surface and shall have an interior cement lining with seal coat per AWWA Specifications C104-80 unless otherwise shown or specified.

C. The Contractor shall obtain installation instructions, including support spacing and solvent welding, from the supplying Manufacturer, shall comply with the instructions, and shall meet the requirements of ASTM D-2855, Standard Recommended Practice for making Solvent Cemented Joints with PVC Pipe and Fittings. The PVC solvent cement shall comply with ASTM D-2564 and shall be furnished by the pipe and fitting Manufacturer for the class and type of pipe supplied to the project.

W2.05 HANDLING AND CUTTING PIPE

A. Pipe and fittings are slightly brittle. Care shall be taken in shipping, handling and laying to avoid damaging the pipe and fittings. Extra care will be necessary during cold weather construction.

B. Any pipe or fitting showing a crack or which has received a blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

C. All pipe ends shall be square after cutting.

D. While stored, pipe shall be adequately supported from below at not more than three (3) foot intervals to prevent deformation. Pipe shall not be stacked higher than six (6) feet. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of direct sunlight. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature buildup when exposed to direct sunlight will not be permitted.

W2.06 JOINTING POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. PVC pipe and fittings shall be jointed in accordance with the recommendations of the latest ASTM Standards and detailed instructions of the Manufacturer.

W2.07 INSTALLING POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Unless otherwise specified on the Plans, polyvinyl chloride pipe shall be installed to clear all utility lines and shall have three (3) feet minimum cover. For water lines to be constructed under a future roadway, the cover may be increased to allow for future paving grades. The depth of cover, where shown on the Plans, is that distance from the top of the pipe to the approximate proposed grade line.

B. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than $^{1}/_{16}$-inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the Manufacturer shall be explicitly followed.

C. Any pipe or fittings discovered to be defective after laying shall be removed and replaced with a sound piece.

D. The Engineer or the City may examine each bell and spigot end to determine whether any preformed joint has been damaged prior to installation. Any pipe having defective joint surfaces shall be rejected, marked as such, and immediately removed from the job site.

E. All pipe shall be sound and clean before laying. When laying is not in progress, including lunch time, the open ends of the pipe shall be closed by watertight plugs or other approved means. Good alignment shall be preserved in laying.

F. Pipe and fittings shall be installed in accordance with the instructions of the Manufacturer, ASTM D2321 and as specified herein. As soon as the excavation is complete to normal grade of the bottom of the trench, embedment material shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. The pipe shall be laid accurately to the lines and grades indicated on the Plans. The specified embedment shall be accurately shaped and trimmed to receive the pipe barrel and each pipe section, when in place, shall have a uniform bearing on the subgrade for the full length of the pipe barrel. Pipe shall not be laid unless the subgrade is free of water and in a satisfactory condition. Embedment material shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to force the embedment material under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. Embedment material shall then be placed to 12-inches above the top of the pipe. Next, the varying depths of select material backfill above the embedment material backfill shall be placed according to the Plan Details and carefully compacted. Generally, the compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient select material backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in

compacting the varying depths of select material backfill shall be approved by the pipe Manufacturer's representative prior to use. Adjustments of the pipe to line and grade shall be made by scraping away or filling in with granular material, and not by wedging or blocking up the bell.

G. Perforated PVC Pipe and fittings shall be installed in accordance with the instructions of the Manufacturer, ASTM F758 and as specified herein. As soon as the excavation for the trench is complete to normal grade of the bottom of the trench, geotextile fabric shall be laid and then the pea gravel bedding shall be carefully placed (so not to damage the geotextile fabric) and graded to provide uniform and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. Before the perforated pipe is laid on the trench, the perforated pipe shall be wrapped around and closed according to the Manufacturer's closure recommendations with the geotextile fabric. The pipe shall be laid accurately to the lines and grades indicated on the Plans. Blocking under the perforated PVC pipe will not be permitted. Pea gravel shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to gently place the pea gravel under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. Making sure not to damage the geotextile fabric, pea gravel shall then be carefully placed above the top of the perforated pipe varying from two to three (2-3) feet depending on the Plans. Once the remaining pea gravel has been placed, overlap or close the geotextile fabric according to the Manufacturer's recommendations or six (6) inches minimum overlap. Then one (1) foot of topsoil shall be placed over the pea gravel to the ground level with proper grass sodding on top.

H. Joints shall not be "pulled" or "cramped". Each joint of pipe shall be completed in compliance with Manufacturer's recommendations.

I. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.

J. Precautions shall be taken to prevent flotation of the pipe in the trench.

K. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and backfill or embedment material. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, embedment material shall be placed to fill any voids created and the embedment material and backfill shall be recompacted to provide uniform side support for the pipe.

W2.08 CONCRETE AND BLOCKING

A. 2,500 psi concrete shall be placed for blocking at each change in direction in the pipeline, as shown in the Standard Details and in such manner as will substantially brace the pipe against undisturbed trench walls. In no event shall this quantity of concrete blocking be less than those shown in the Plans. Concrete blocking, made from Type I cement, shall have been in place four (4) days prior to testing the pipeline as hereinafter specified. Tests may be made in two (2) days after completion of blocking if Type III cement is used.

B. At all points where wet connections are made to existing lines, the existing lines shall be adequately blocked and the tapping connection fittings shall be supported by blocking up to the spring line with 2,500 psi concrete.

C. Concrete blocking will not be measured or paid for as a separate item but the cost thereof shall be included in the various items listed in the Proposal and Bid Schedule.

W2.09 TESTING AND ALLOWABLE LEAKAGE

A. All PVC pipe and fittings shall be leak tested and sterilized according to Section CIP12.05- TEST PROCEDURES FOR PRESSURE PIPELINES.

W2.10 PAYMENT

A. The pipeline, complete in place, including cleanup, will be measured for payment in linear feet along the centerline of the pipe actually installed. Measurement shall be through all fittings, specials, valves, etc., and no deduction in length shall be made for such appurtenances. Installation of the pipeline will be paid for at the unit contract price per linear foot as provided in the Proposal and Bid Schedule.

B. Payment of the unit contract price for the items of work performed shall be the total compensation for furnishing all labor, materials, tools, equipment and incidentals and performing all work that is necessary for the installation, testing, and sterilization of the pipe, fittings, connections, blocking, embedment or placing in encasement pipe and all other appurtenances in accordance with the Plans and the provisions of the Specifications.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION W3 – VALVES, HYDRANTS AND APPURTENANCES

W3.01 SCOPE OF WORK

A. This specification covers the requirements to provide all buried valves, valves in manholes and underground vaults, hydrants and appurtenances complete with actuators and all accessories as shown on the Plans and as specified herein.

W3.02 SUBMITTALS

A. Within 30 days of the Notice to Proceed, the Contractor shall submit to the Engineer or the City for approval, technical product literature including Manufacturer's literature, illustrations, specifications and engineering data which includes dimensions, size, materials of construction, weight, protection coating, and all other pertinent data to illustrate conformance to the specification found within. The Contractor shall also submit four (4) copies of all certified shop test results specified herein, complete operation and maintenance manuals including all copies of all approved shop drawings, and certificates of compliance where required by referenced standards: For each valve specified to be manufactured and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required tests, and certification of proper installation.

W3.03 REFERENCE STANDARDS

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. American Water Works Association (AWWA)

1. AWWA C515 - Gate Valves, three (3)-inch through 48-inch NPS, for Water and Sewage Systems.

2. AWWA C502 - Dry-Barrel Fire Hydrants.

3. AWWA C509 - Resilient-Seated Gate Valves, three (3) inch through 12-inch NPS, for Water and Sewage Systems.

C. American National Standards Institute (ANSI)

1. ANSI B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.

2. ANSI C111 - Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

D. American Society for Testing and Materials (ASTM)

1. ASTM A48 - Gray Iron Castings.

2. ASTM A126 - Gray Iron Castings for Valves, Flanges and Pipe Fittings

3. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4. ASTM A276 - Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes.

5. ASTM A536 - Ductile Iron Castings.

E. Steel Structures Painting Council (SSPC)

1. SSPC SP-6 - Commercial Blast Cleaning

F. Where reference is made to one (1) of the above standards, the revision in effect at the time of bid opening shall apply.

W3.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the work.

B. Protect threads and seats from corrosion and damage. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until time of use.

C. Provide covers for all openings.

1. All valves three (3) inches and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.

2. All valves smaller than three (3) inches shall be shipped and stored as above except that heavy card board covers may be furnished instead of wood.

D. Store equipment to permit easy access for inspection and identification. Any corrosion in evidence at the time of City acceptance shall be removed, or the valve shall be removed from the job.

E. Store all equipment in covered storage off the ground.

W3.05 COORDINATION

A. Review installation procedures under other Sections and coordinate with the work which is related to this Section including buried piping installation and site utilities.

B. Contractor shall coordinate the location and placement of concrete thrust blocks when required.

W3.06 GENERAL

A. All valves shall open counter-clockwise.

B. The use of a Manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

C. Valves shall be of the size shown on the Plans or as noted, and as far as possible equipment of the same type shall be identical and from one Manufacturer.

D. Valves shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard to which they are manufactured cast in raised letters on some appropriate part of the body.

E. Unless otherwise noted, valves shall have a minimum working pressure of 200 psi or be of the same working pressure as the pipe they connect to, whichever is higher, and suitable for the pressures noted where they are installed.

F. Valves shall be of the same nominal diameter as the pipe or fittings they are connected to. Except as otherwise noted, joints shall be mechanical joints, with joint restraint where the adjacent piping is required to be restrained.

G. Valves shall be constructed for buried service.

W3.07 VALVE BOXES

A. All gate valves shall be provided with extension shafts (where the operating nut is greater than five (5) feet below grade), operating nuts and valve boxes as follows:

1. Extension shafts shall be steel and the operating nut shall be two (2) inches square. Shafts shall be designed to provide a factor of safety of not less than four (4). Operating nuts shall be pinned to the shafts.

2. Valve boxes shall be a heavy-pattern cast iron, three (3) piece, telescoping type box with dome base suitable for installation on the buried valves. Inside diameter shall be at least 5¼-inches. Barrel length shall be adapted to the depth of cover, with a lap of at least six (6) inches when in the most extended position. Covers shall be cast iron with integrally-cast direction-to-open arrow and "WATER" shall be cast in the cover when used on a water line or "SEWER" when used on a wastewater force main. Aluminum or plastic are not acceptable. A means of lateral support for the valve extension shafts shall be provided in the top portion of the valve box. The valve box lid shall be furnished with a pentagon-head bolt for locking.

3. The upper section of each box shall have a bottom flange of sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve and shall be oval.

4. An approved operating key or wrench shall be provided.

5. All fasteners shall be Type 304 stainless steel.

W3.08 RESILIENT SEATED GATE VALVES

A. Valves shall be manufactured in accordance with AWWA C509.

Acceptable Gate Valves are:

1. American Flow Control – Series 2500
2. Mueller – 2360 Series
3. Clow

B. Valves shall be provided with a minimum of two (2) O-ring stem seals.

C. Bonnet and gland bolts and nuts shall be either fabricated from a low alloy-steel for corrosion resistance or electroplated with zinc or cadmium. The hot-dip process in accordance with ASTM A153 is not acceptable.

D. Wedges shall be totally encapsulated with rubber.

E. Units shall be, in addition, UL and FM approved.

F. Resilient wedge gate valves shall be furnished and installed in sizes and shall be manufactured in accordance with the latest AWWA C-509 and cast iron shall conform to the latest ASTM A-126 standards. Gate valves furnished under these specifications shall be of the solid wedge, resilient seat type with cast iron/ductile iron body and bronze stem designed for 250 pounds per square inch working pressure. All gate valves shall be tested hydrostatically to 400 pounds per square inch. Gate valves shall meet the latest AWWA standard specifications (C-509).

G. The seat shall be made of Styrene Butadiene rubber and provide a positive water tight seal. The seat shall be permanently bonded or mechanically attached to the wedge with stainless steel screws. If bonded, ASTM P-429 requirements shall be followed. Non-rising stem gate valves shall be equipped with "O" ring type packing gland consisting of at least two (2) "O" rings. The thrust collar shall work in an "O" ring seal lubricant reservoir or against bearings or washers, above and below constructed of Delrin or approved equal material. Gate valve stems, shall be fabricated from solid bronze rod having a tensile strength of not less than 60,000 pounds per square inch, and a minimum yield strength of 30,000 pounds per square inch.

H. Cast iron body shall be of iron with an even grain and shall possess a tensile strength of not less than 32,000 pounds per square inch. All bronze castings, except the stem, shall have a tensile strength of not less than 30,000 pounds per square inch. The entire internal valve body surfaces shall be coated with a factory applied two (2) component epoxy system or approved equal. The seating surface shall be machined or otherwise constructed to provide a smooth, even surface for the resilient seat. All valves shall open left (counter clockwise) and have a two (2) inch square wrench nut unless specified otherwise.

W3.09 TAPPING SLEEVES AND TAPPING VALVES

A. Tapping sleeves shall be of cast iron epoxy coated, designated for working pressure not less than 200 psi. Armored end gaskets shall be provided for the full area of the sleeve flanges. Sleeves shall be as manufactured by A.P. Smith Division of U.S. Pipe, Mueller, Clow, or equal. Nuts and bolts shall be Type 304 stainless steel.

B. Size-on-Size tapping sleeve shall be ductile iron or cast iron.

C. Tapping valves shall conform to the requirements specified above for gate valves except that one (1) end shall be flanged and one (1) mechanical. Tapping valves shall be provided with an oversized opening to permit the use of full size cutters. Tapping valves shall be Ford B81-777 or equal.

W3.10 CHECK VALVES

A. Controlled Closing Swing Check Valves (lever & weight)

1. Check valves shall be of the controlled closing swing type. The controlled closing swing check valves shall be guaranteed to operate under severe conditions as check valves. The valve shall be designed to open smoothly, provide full pipe line flow, permit minimum head loss and close at a controlled rate of speed for the final predetermined portion of its stroke. All bolts and nuts used in the assembly shall be steel, commercial.

2. The valve body shall be Cast Iron ASTM A126-B/ductile iron ASTM A536. The disc arm and chamber level shall be of heavy steel construction and keyed to the hinge shaft. The hinge shaft shall be of 18-8 stainless steel and of adequate diameter to withstand a complete hydraulic unbalance pressure of 125 psi on the valve disc. A single cushioning device mounted on the external side of the valve shall control the valve closure by way of the interchange of oil to and from an oil reservoir. The use of air or gas pressurized oil reservoir shall not be permitted. The oil plunger assembly shall be rigidly attached to the valve body by shoulder bolts or dowel pins to prevent fretting.

3. The Manufacturer, if required by the Engineer or the City, shall submit design calculations of principle component stresses to substantiate the integrity of the valve for the working pressure involved.

4. The valve when closed shall be tight seating by way of a resilient replaceable seat against a bronze seat ring in the body.

5. Valves shall be as manufactured by GA Industries or Series 6000 as manufactured by APCO. The City reserves the right to inspect all valves before shipment is made. Any failure of valves to operate satisfactorily during the first year of installation due to faulty workmanship or defective material shall be replaced and made good by the Manufacturer. Under these specifications, any valve stuffing box that leaks for any reason or because of excessive wear or deterioration of packing, shall be reason for classification as defective material.

B. Slanted / Tilted Check Valves

1. Slanted or tilted check valves shall be furnished and installed where shown on the Plans.

2. The body of the valve shall be ductile iron or cast iron with access ports to the disc. The disc shall be cast iron. The seat and disc rings shall be bronze. Pivot pins and bushings shall be bronze or stainless steel. The valve shall include a localized indicator of the position of the valve.

3. The valves shall include a top mounted oil dash pot to prevent slamming of the disc. The dash pot shall control the last 10% of closure of the disc. The speed of closure within this 10% shall be adjustable.

4. Valves shall be APCO Slanting Disc, Valmatic or Golden Anderson Tilted Disc or approved equal.

W3.11 FLANGES

A. Flanges shall be cast solid and faced accurately at right angles to the axis of the casting. Dimensions and drilling of flanges shall be in accordance with the American Standard Association for a working pressure of 125 pounds per square inch. Special drilling shall be provided where necessary.

W3.12 FIRE HYDRANTS

A. Fire hydrants shall be dry-barrel type conforming to the requirements of the latest revision of AWWA C502. Hydrants shall be designed such that the hydrant valve closes with line pressure preventing loss of water and consequent flooding in the event of traffic damage.

B. Hydrants shall have six (6)-inch mechanical joint inlet connections, two 2½-inch hose connections and one $4^1/_2$-inch pumper connection. Threads for the hose and pumper connections shall be in accordance with National Standard Thread. Hydrants shall be according to Manufacturer's standard pattern. Hydrants shall be equipped with "O" ring packing. Each nozzle cap shall be provided with a Buna-N rubber washer.

C. Hydrants shall be so arranged that the direction of outlets may be turned 90 degrees without interference with the drip mechanism or obstructing the discharge from any outlet. The body of the hydrant shall be equipped with a breakable flange, or breakable cast iron flange bolts, just above the grade line.

D. A bronze or rustproof steel nut and check nut shall be provided to hold the main hydrant valve on its stem.

E. Hydrant valve opening shall have an area at least equal to that area of a $4^1/_2$-inch minimum diameter circle and be obstructed only by the valve rod. Each hydrant shall be able to deliver 500 gallons minimum through its two 2½-inch hose nozzles when opened together with a loss of not more than two (2) psi in the hydrant.

F. Hydrants shall be designed for installation in a trench that will provide minimum cover as noted on Plans and for the flange to be $3\ ^1/_2$-inches above ground surface. Hydrant extensions shall be as manufactured by the company furnishing the hydrants and of a style appropriate for the hydrants as furnished.

G. Hydrants shall be provided with an automatic and positively operating, non-corrodible drain or drip valve so

as to drain the hydrant completely when the main valve is shut. A drain valve operating by springs or gravity is not acceptable.

H. Operating stems whose threads are located in the barrel or waterway shall be of manganese bronze, everdur, or other high-quality non-corrodible metal, and all working parts in the waterway shall be bronze to bronze.

I. Hydrants shall open by turning operating nut to left (counter-clockwise) and shall be marked with a raised arrow and the word "open" to indicate the direction to turn stem to open hydrant.

J. Hydrants shall be furnished with caps, double galvanized steel hose cap chain, galvanized steel pumper hose cap chain, a galvanized steel chain holder and any other hooks and/or appurtenances required for proper use.

K. Hydrant operating nut shall be AWWA Standard pentagonal type measuring 1½-inch point to flat.

L. Hydrants shall be hydrostatically tested as specified in AWWA C502.

M. Hydrants shall be of the following:

1. Kennedy – K81

3. American Darling – B84B

2. Clow Medallion

N. All iron work to be set below ground, after being thoroughly cleaned, shall be painted with two (2) coats of asphalt varnish specified in AWWA C502. Iron work to be left above ground shall be factory primed and painted silver using a high grade enamel paint of quality and color to correspond to the present standard of the City.

O. Fire hydrants shall be installed on the same side of the street or roadway as the water main and shall be installed plumb and true.

P. Heel and thrust blocks shall be placed in undisturbed soil as shown in the details of the Plans.

Q. Double blue reflector “HYE – LITES” brand as manufactured by pavement markers ink shall be installed at the centerline of the street or roadway perpendicular to the hydrant.

W3.13 CORPORATION STOPS

A. Corporation stops shall be brass, not less than 1-inch in diameter and shall be installed where shown, specified or required.

B. Provide corporation stops as manufactured by the following:

1. Ford Company

W3.14 COMBINATION AIR-VACUUM RELIEF VALVES

A. The air-vacuum release valves shall be installed as shown on the Plans. The valve body shall be of cast iron ASTM A126-B; the floats, float guide, and stem shall be of Type 316 stainless steel. The resilient seat shall be of Buna N. The valve shall be suitable for 150 psig working pressure. Valve shall have standard NPT inlets and outlet ports with diameters as indicated on the Plans. Valve shall be Model 200A Series by APCO Valve and Primer Corporation, Schaumburg, IL, or approved equal.

W3.15 SURFACE PREPARATION AND SHOP COATINGS

A. The interior ferrous metal surfaces, except finished or bearing surfaces, shall be blast cleaned in accordance with SSPC SP-6 and painted with two (2) coats of an approved two (2) component coal tar

epoxy coating specifically formulated for potable water use. The coating used must appear on the current edition of the United States Environmental Protection Agency's list entitled "Accepted Categories and Subcategories of Coatings, Liners and Paints for Potable Water Usage."

B. Exterior ferrous metal surfaces of all buried valves and hydrants shall be blast cleaned in accordance with SSPC SP-6 and given two (2) shop coats of a heavy coat tar enamel or an approved two (2) component coat tar epoxy paint.

W3.16 INSPECTION AND PREPARATION

A. During installation of all valves and appurtenances, the Contractor shall verify that all items are clean, free of defects in material and workmanship and function properly.

B. All valves shall be closed and kept closed until otherwise directed by the Engineer or the City.

W3.17 INSTALLATION OF BURIED VALVES AND VALVE BOXES

A. Buried valves shall be cleaned and manually operated before installation. Buried valves and valve boxes shall be set with the stem vertically aligned in the center of the valve box. Valves shall be set on a firm foundation and supported by tamping pipe bedding material under the sides of the valve. The valve box shall be supported during backfilling and maintained in vertical alignment with the top flush with finish grade. The valve box shall be set so as not to transmit traffic loads to the valve.

B. Before backfilling, all exposed portions of any bolts shall be coated with two (2) coats of bituminous paint.

W3.18 INSTALLATION OF TAPPING SLEEVES AND VALVES

A. The City of Georgetown shall be contacted and their permission granted prior to tapping a line. The required procedures and time table shall be followed exactly.

B. Installation shall be made under pressure and flow shall be maintained. The diameters of the tap shall be a minimum of $^1/_4$-inch less than the inside diameter of the branch line.

C. The entire operation shall be conducted by workers experienced in the installation of tapping sleeves and valves. The tapping machine shall be furnished by the Contractor.

D. Determine the location of the line to be tapped to confirm that the proposed location will be satisfactory and that no interference will be encountered such as joints or fittings. No tap or sleeve will be made closer than three (3) feet from a pipe joint.

E. A tapping sleeve and valve with boxes shall be set squarely centered on the line to be tapped. Adequate support shall be provided under the sleeve and valve during the tapping operation. Thrust blocks or other permanent restraint acceptable to the Engineer and the City shall be provided behind all tapping sleeves. Proper tamping of supporting pipe bedding material around and under the valve and sleeve is mandatory for buried installations.

F. After completing the tap, the valve shall be flushed to ensure that the valve seat is clean. All proper regulatory procedures (including disinfection) shall be followed exactly.

W3.19 INSTALLATION OF FIRE HYDRANTS

A. Fire hydrants shall be set at the locations as shown on the Plans and bedded on a firm foundation. Hydrants and connecting pipe shall have at least the same depth of cover as the distributing pipe. A drainage pit as detailed on the Plans shall be filled with ¾-inch washed rock gravel and compacted. The hydrants shall be set upon a slab of concrete not less than four (4)-inches thick and 15-inches square. During backfilling, additional screened gravel shall be brought up around and six (6) inches over the drain port. Each hydrant shall be set in true vertical alignment and properly braced.

B. 2,500 psi concrete thrust blocks shall be placed between the back of the hydrant inlet and undisturbed soil at the end of the trench. Minimum bearing area shall be as shown on the Plans. Eight (8) mil. Poyethlene film shall be placed around the hydrant elbow before placing concrete. CARE SHALL BE TAKEN TO ENSURE THAT CONCRETE DOES NOT PLUG THE DRAIN PORTS.

C. All connections from the main to the fire hydrants shall be anchoring mechanical joints designed to prevent movement due to thrust or pressure.

D. The hydrant shall be tied to the pipe with suitable rods or clamps, and shall be coated with Koppers 300 or approved equal at a minimum of 8 mil. thick. Bolts shall have a zinc bolt cover per AWWA. Hydrant paint shall be touched up as required after installation.

E. Fire hydrants shall be factory primed and painted silver using a high grade enamel.

F. Fire sprinkler lines shall be protected by a reduced pressure zone (RPZ). All fire lines shall be ductile iron pipe. All private fire lines shall be separated by double detecta check.

W3.20 FIELD TESTS AND ADJUSTMENTS

A. Conduct a functional field test of each valve, including actuators and valve control equipment, in presence of Engineer or the Representative of the City to demonstrate that each part and all components together function correctly. All testing equipment required shall be provided by the Contractor at his/her sole expense.

W3.21 PAYMENT

A. Gate valves, tapping sleeves and tapping valves, fire hydrants, and air and vacuum relief valves complete in place as shown on the Plans and as specified, will be paid for at the unit contract price per each as provided in the Proposal and Bid Schedule.

B. The unit price per each installation shall be the total compensation for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the work including excavation, base blocking, disposal of surplus materials and backfill in conformance with the Plans and these specifications. The six (6) inch connection pipe, six (6) inch gate valve, test station, concrete collar, thrust block, drain pit, concrete pad, rods, bolts, paint, protective coatings, and fittings for fire hydrants shall not be paid for separately.

C. Fire hydrants shall be furnished with the proper length of barrel to comply with these specifications. Barrel extensions will not be measured and paid for separately.

D. No separate payment shall be made for work performed in accordance with this specification, other than that listed in Parts A-C of this subsection, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION W4 – ENCASEMENT PIPE

W4.01 SCOPE OF WORK

A. This specification covers the requirements for furnishing and installing encasement pipe complete in place including any required spacers and end plugs as shown on the plans and specified herein.

W4.02 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Engineer for approval, technical product literature including type and Manufacturer of pipe, spacers, and end plugs, and all other pertinent data to illustrate conformance to the specification found within.

W4.03 GENERAL

A. Where pipe is required to be installed under highways, streets, or other facilities, construction shall be made in such a manner that will not interfere with the operation of the street, highway, or other facility, and shall not weaken or damage any embankment or structure.

B. All carrier pipe shall be laid to the required line and grade within the specified limits through the encasement pipe. Carrier pipe shall be handled and placed in the encasement pipe by use of proper skids, wedges, guide fails or other approved means. Care shall be taken that once the pipe is in place to line and grade, it shall not be disturbed or become displaced. All carrier pipe shall have restrained joints.

W4.04 MATERIALS

A. Encasement pipe shall be smooth steel 35,000 psi yield strength with thickness according to the following table:

Carrier Size	Minimum Encasement Steel Casing Size	Minimum Casing Thickness
(Inner Diameter)	(Inner Diameter)	(Inches)
4"	14"	0.2500
6"	16"	0.2500
8"	18"	0.2500
10"	20"	0.3125
12"	24"	0.3175
14"	24"	0.375
16"	30"	0.4375
18"	30"	0.4375
20"	36"	0.500
24"	42"	0.500
27"	42"	0.500
30"	48"	0.500
33"	48"	0.500
36"	54"	0.500
39"	60"	0.500
42"	60"	0.500

B. Casing spacers shall be bolt-on style with a shell made in two (2) sections of Heavy T-304 stainless steel. Connecting flanges shall be ribbed for extra strength Casing spacers shall have runners made of ultra high molecular weight polymer, with a minimum height of two (2) inches. Wedges shall not be used between the top of the carrier pipe and the inside of the easement pipe. Casings spacers shall have a minimum of one (1) inch clear distance between the runners on top of the casing spacers and the inside of the encasement pipe. Prior to inserting the carrier pipe, all water shall be pumped out of the encasement pipe to at least a point where no more than two (2) inches of water remains. Spacers shall be required within at least three (3) feet from both openings of the encasement pipe and spaced no greater than six (6) feet through out the encasement pipe. Casing spacers will not be paid for directly but shall be considered subsidiary to the bid item of encasement pipe. . Casing spacers shall be made by Cascade Waterworks MFG Company or approve equal.

C. End Plugs shall be provided as required and as specified by the pipe manufacturer.

W4.05 PAYMENT

A. Separate payment will be made for Steel Encasement Pipe per linear foot as called for on the Plans and set forth in the Proposal and Bid Schedule.

B. All costs incurred for furnishing and installing encasement pipe shall include all labor, materials, tools, equipment and incidentals necessary to perform all work or whatever nature required to complete the specific operation.

END OF SECTION

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Specification and Drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 “Execution” for coordination of Owner-installed products.

1.3 DEFINITIONS

A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

A. Project Identification: Dove Springs WWTP Rehabilitation Project:

1. Project Location: Georgetown, TX.

B. Owner: City of Georgetown, Georgetown Municipal Complex, Purchasing Department, at 510 W. 9th Street, Georgetown, Texas 78626.

C. Engineer: Alexandra Doody, CDM Smith, Inc., 8310-1 North Capital of Texas HWY, Suite 250, Austin, Texas 78731.

D. Engineer's Consultants: Engineer has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Geotechnical Engineer: Terracon Consultants, Inc.:

a. Project Engineer: Larson Snyder

1) Email: Larson.Synder@terracon.com
2) Phone: 512-891-2675

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.5 WORK COVERED BY CONTRACT DOCUMENTS- NOT USED

1.6 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

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SECTION 011716 - EXISTING UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes responsibilities for utility properties and service.

1. Subsurface investigations performed by: Terracon Consulting indicating:

a. Subsurface conditions at various locations at the site.
b. Presented in Boring Logs.

2. Existing ground profiles shown on the Plans: plotted from field surveys and existing Drawings.

1.3 CONTRACTOR ACKNOWLEDGEMENTS:

A. Contractor is satisfied as to nature and location of the Work; general and local conditions, particularly those bearing upon availability of transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, river/stream stages, or similar physical conditions at the site; conformation and conditions of the ground; character of equipment and facilities needed preliminary to and during the prosecution of the Work; and all other matters which can in any way affect the Work or the cost thereof under this Contract.

B. Contractor is further satisfied as to character, quality, and quantity of surface and subsurface materials to be encountered from inspecting the site, as well as from information presented herein as a part of these Contract Documents. Any failure to acquaint themself with available information will not relieve Contractor from responsibility for properly estimating the difficulty or cost of successfully performing the Work. Neither Owner nor Engineer assumes responsibility for any conclusion or interpretation made by Contractor on the basis of the information made available by Owner or Engineer.

1.4 RESPONSIBILITY FOR UTILITY PROPERTIES AND SERVICE

A. Known utilities and structures adjacent to or encountered in the Work are shown on Drawings. Locations shown are taken from existing records and the best information available from existing plans; however, it is expected that there may be some discrepancies and omissions in the locations and quantities of utilities and structures shown. Those shown are for the

convenience of Contractor only, and no responsibility is assumed by either Owner or Engineer for their accuracy or completeness.

B. Neither Owner nor his officers or agents shall be responsible to Contractor for damages as a result of Contractor's failure to protect utilities encountered in the Work.

C. Provide unobstructed access to fire hydrants, underground conduit, manholes, and water or gas valve boxes at all times.

D. Where Contractor's operations could cause damage which might result in considerable expense, loss, and inconvenience when operations are adjacent to or near railway, telegraph, telephone, television, power, oil, gas, water, sewer, irrigation, or other systems, do not commence operations until making all arrangements necessary for protection of these utilities and services.

E. Notify utility offices that are affected by construction operation at least five days in advance of commencing construction operations. Do not expose any utility without first obtaining permission from the affected agency. Once permission has been granted, locate and, if necessary, expose and provide temporary support for existing underground utilities in advance of operations.

F. Be solely and directly responsible to owners and operators of such utility properties for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of any injuries or damage that may result from construction operations under this Contract.

G. In the event of interruption to domestic water, sewer, storm drain, or other utility services as a result of accidental breakage due to construction operations, promptly notify proper authority and cooperate with said authority in restoration of service as promptly as possible and bear all costs of repair. In no event shall interruption of any water or utility service be allowed unless prior approval is granted by utility owner.

H. Replace other existing utilities or structures removed or damaged during construction, unless otherwise provided for in these Contract Documents.

I. Where existing utility lines or structures are so located as to physically conflict with permanent structures to be constructed under this Contract, the conflicting utility line or structure shall be permanently relocated. Such relocations shall be considered as required by this Contract.

J. Give immediate notice to Engineer, Owner and owner of the utility (where applicable) when a physical conflict is determined to exist. Any delays resulting from required relocations of utilities are the responsibility of Contractor.

K. Where existing utility lines or structures are so located as to interfere with Contractor's prosecution of the Work, but do not physically conflict with completed manholes or other permanent structures to be constructed under this Contract, any modification, alteration, or relocation of interfering utility, either permanent or temporary, shall be accomplished at expense of Contractor.

L. Give immediate notice to Engineer and Owner of the utility when an interference is determined to exist and obtain approval to relocate such utility or to discontinue service from Engineer and utility owner. Utility owner shall have the right to do all work required to discontinue, relocate,

and replace interfering utilities and charge Contractor for related costs. When approved by Engineer and utility owner, work required to discontinue, relocate, and replace interfering utilities may be done by, or arranged for, by Contractor. All such discontinuance, relocation, and replacement shall be accomplished in accordance with all requirements of utility owner.

M. When notified by Contractor that an interference or conflict has been determined to exist, Engineer will determine whether such interference shall be considered as required by construction or as incidental to construction.

1.5 INTERFERING STRUCTURES

A. Take necessary precautions to prevent damage to existing structures whether on surface, aboveground, or underground. An attempt has been made to show major structures on Drawings. While information has been compiled from best available sources, its completeness and accuracy cannot be guaranteed, and it is presented as a guide to avoid known possible difficulties.

B. Protect existing structures from damage, whether or not they lie within the right of way or the limits of the easements obtained by Owner. Where existing structures must be removed to properly conduct the Work, or are damaged during the Work, they shall be restored by Contractor's to at least their original condition and to satisfaction of Engineer.

C. Contractor may, with approval of Engineer and without additional compensation, remove and replace in a condition as good as or better than original, any small interfering structures such as fences and signposts that interfere with Contractor's operations.

1.6 FIELD RELOCATION

A. During the progress of the Work, minor relocations of the work may be necessary. Such relocations shall be made only by direction of Owner or Engineer. If existing structures are encountered that will prevent construction as shown, notify Owner or Engineer before continuing with the Work in order that Engineer may make such field revisions as necessary to avoid conflict with the existing structures. If Contractor fails to notify Owner or Engineer when an existing structure is encountered and proceeds with the Work despite this interference, Contractor shall be responsible for any damage that may occur.

1.7 LAND MONUMENTS

A. Preserve or replace any existing Federal, State, County, City, and private land monuments encountered. All monument replacement by Contractor shall be performed by a land surveyor licensed in the State of Texas.

1.8 PAYMENT

A. The Work specified in this Section shall be considered incidental and payment will be included as part of the appropriate lump sum or unit prices specified in the Section 00300, Proposal Form.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOTUSED)

END OF SECTION 011716

SECTION 012200 - MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the measurement and payment of the various elements of the Work; with provisions applicable to lump sum prices, unit prices, and Owner-Directed Improvements, if applicable.

B. The Total Amount Proposed in the Proposal Form shall cover all Work required by the Contract Documents. The lump sum and unit prices proposed shall include all costs in connection with the proper and successful completion of the Work, including but not limited to: furnishing all materials, equipment, supplies, and appurtenances; providing all construction equipment and tools; and performing all necessary labor and supervision to fully complete the Work. All Work not specifically set forth as to the pay item or items in the Proposal shall be considered subsidiary obligations of Contractor and all costs in connection therewith shall be included in the prices or included in Proposal Item No. 2.

C. Related Requirements:

1. Section 00300 – Proposal Form

2. Section 00700 – General Conditions

3. Section 013300 – Submittal Procedures

4. Section 014000 “Quality Requirements” for field testing by an independent testing agency.

1.3 DEFINITIONS

A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROPOSAL FORM

A. The Proposal Form is a part of these Contract Documents and lists each item of work for which payment will be made. No payment will be made for items other than those listed in the Proposal Form. Lump Sum measurement will be for the entire item, unit of work, structure, or combination thereof, as specified and as indicated in the Proposal Form.

B. Required items of work and incidentals necessary for the satisfactory completion of the Project which are not specifically listed in the Proposal Form, and which are not specified in this Section to be measured or to be included in one of the items listed in the Proposal Form shall be considered as incidental to the work required under this contract, and all costs thereof, including Contractor's overhead costs and profit, shall be considered as included in the prices Proposal for the variou' Proposal Items. The Contractor shall prepare his Proposal accordingly.

C. Work includes furnishing all plant, labor, equipment, tools and materials, and performing all operations required to complete the work satisfactorily, in place, as specified and as indicated on the Drawings.

D. Measurement

1. Measurement shall be based on the estimated percent complete of each item of the Schedule of Values, as determined by the Engineer.

E. Payment

1. Payment will be made at the lump sum price proportional to the completion percentages approved by the Engineer.

1.5 UNIT PRICE ITEMS

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

1.6 LUMP SUM ITEMS

A. Lump Sum measurement will be for the entire item, unit of work, structure, or combination thereof, as specified and as indicated in the Proposal Form. Measurement and payment for all Proposal items indicated as Lump Sums shall include the cost of all labor, materials and equip-

ment necessary to furnish, install, clean, test, and place each Proposal item into operation; including permitting, general conditions, overhead and profit.

B. Progress payments will be based on schedule of values prepared by the Contractor and approved by the Engineer and Owner before acceptance of the first Application for Payment.

C. In order for the Contractor to request progress payments against Lump Sum items, Contractor shall provide a disaggregation or breakdown in sufficient measurable detail that is acceptable to Engineer.

D. Measurement

1. Measurement shall be based on the estimated percent complete of each item of the Schedule of Values, as determined by the Engineer.

E. Payment

1. Payment will be made at the lump sum price proportional to the completion percentages approved by the Engineer.

1.7 OWNER-DIRECTED IMPROVEMENT

A. Owner-Directed Improvements, if any, specified in the Contract Documents and indicated in the Proposal Form are considered provisional amounts to be used only if directed. Owner-Directed Improvements are exclusive of work indicated in the Contract Documents for which payment is included under other items in the Proposal Form. No work may be performed under an Owner-Directed Improvement without prior written approval of the Owner.

B. Any unused balance of the Owner-Directed Improvements shall revert to the Owner upon completion of the project. Prior to final payment, the original amount provided for Owner-Directed Improvements shall be adjusted to actual costs by deductive Change Order, adjusting the contract price, accordingly.

C. The Contractor shall make no claim, nor receive any compensation, for anticipated profits, loss of profit, damages, or any extra payment due to any unexpended portion of the Owner-Directed Improvements.

D. The Contractor is to include time for Owner-Directed Improvement work in the construction schedule. No adjustment of Contract Time shall be allowed for any work performed under Owner-Directed Improvement items.

E. Owner-Directed Improvement items shall be included in the Schedule of Values.

F. Unless otherwise indicated in the specific measurement and payment provisions under Owner-Directed Improvement items, the measurable and allowable costs for work performed under an Owner-Directed Improvement item shall be limited to the actual, demonstrable, and direct costs associated with that Owner-Directed Improvement item. Shipping and sales taxes are allowable costs.

1. No mark-up for overhead or profit shall be included for payment under an Owner-Directed Improvement account item. Overhead and profit shall be included in the contract base Proposal or allocated across other Proposal items.

2. Work authorized by the Owner under an Owner-Directed Improvement may be performed as a lump sum (negotiated before the fact), unit prices (when applicable), or time and material. For work performed under time and material, Contractor shall submit detailed verification (break-down) of all costs, subject to the approval of the Engineer or Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1: Solids and Trash Removal, Loading, Transport, and Disposal from the Aeration Basins.

1. Description: Removal of approximately one-foot deep of grit, rags, and debris from the aeration basins.
2. Unit of Measurement: Wet Tons
3. Review Specification Section 460200 “Tank and Structure Cleaning” for requirements.

END OF SECTION 012200

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form that is part of web-based Project management software and acceptable to Engineer.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.

c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of Engineers and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 7 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Engineer's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Engineer does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. The Contractor shall note that the Engineer's design is based upon the first listed manufacturer for items of equipment, though not necessarily the manufacturer's "standard" product.

B. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

C. If the Contractor chooses other manufacturer's equipment they shall be responsible for the total cost, including engineering design, of modifications, alterations, adjustment, and coordination necessary to make the proposed equipment compatible with the treatment process and with the specified equipment, structures, spaces and other features of the original design.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Engineer will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Engineer.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include

compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Substitution request is fully documented and properly submitted.
e. Requested substitution will not adversely affect Contractor's construction schedule.
f. Requested substitution has received necessary approvals of authorities having jurisdiction.
g. Requested substitution is compatible with other portions of the Work.
h. Requested substitution has been coordinated with other portions of the Work.
i. Requested substitution provides specified warranty.
j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012500

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
2. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
3. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

A. RFI: Request for Information. Request from Owner, Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office,and in prominent location in each administration facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and direction of Project coordinator to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner’s Project number.
4. Name of Engineer.
5. Engineer’s Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Engineer's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer of additional information.
3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 00941 “Change Order Form and Instructions”.

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 5 days of receipt of the RFI response.

D. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. . Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Engineer.
4. RFI description.
5. Date the RFI was submitted.
6. Date Engineer's response was received.
7. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
8. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

E. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Engineer's Digital Data Files: Digital data files of Engineer's CAD drawings will be provided by Engineer for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.

    a. Subcontractors, and other parties granted access by Contractor to Engineer's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Engineer.

B. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion. General Contractor shall be responsible for the full cost for the project team including costs for Owner, Engineer, Contractor, subcontractors and suppliers.

1. Web-based Project management software includes, at a minimum, the following features:

    a. Compilation of Project data, including Contractor, subcontractors, Engineer, Engineer's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    c. Document workflow planning, allowing customization of workflow between project entities.
    d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    e. Track status of each Project communication in real time, and log time and date when responses are provided.
    f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    g. Processing and tracking of payment applications.
    h. Processing and tracking of contract modifications.
    i. Creating and distributing meeting minutes.
    j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
    k. Management of construction progress photographs.
    l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to seven Project management software user licenses for use of Owner, Engineer, and Engineer's consultants. Provide 4 hours of software training at Engineer's office for web-based Project software users.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Engineer. Provide data in locked format to prevent further changes.
4. Provide one of the following Project management software packages under their current published licensing agreements:

    a. Autodesk; Constructware.
    b. Corecon Technologies, Inc.
    c. Meridian Systems; Prolog.
    d. Newforma, Inc.
    e. Procore Technologies, Inc.
    f. Viewpoint, Inc.

C. PDF Document Preparation: Where PDFs are required to be submitted to Engineer, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.

B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Contractor, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Responsibilities and personnel assignments.
b. Tentative construction schedule.
c. Phasing.
d. Critical work sequencing and long lead items.
e. Designation of key personnel and their duties.
f. Lines of communications.
g. Use of web-based Project software.
h. Procedures for processing field decisions and Change Orders.
i. Procedures for RFIs.
j. Procedures for testing and inspecting.
k. Procedures for processing Applications for Payment.
l. Distribution of the Contract Documents.
m. Submittal procedures.
n. Sustainable design requirements.
o. Preparation of Record Documents.
p. Use of the premises and existing building.
q. Work restrictions.
r. Working hours.
s. Owner's occupancy requirements.
t. Responsibility for temporary facilities and controls.
u. Procedures for moisture and mold control.
v. Procedures for disruptions and shutdowns.
w. Construction waste management and recycling.
x. Parking availability.
y. Office, work, and storage areas.
z. Equipment deliveries and priorities.
aa. First aid.
bb. Security.

cc. Progress cleaning.
dd. List of major subcontractors and suppliers.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Engineer of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Engineer, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

    a. Preparation of Record Documents.
    b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    c. Procedures for completing and archiving web-based Project software site data files.
    d. Submittal of written warranties.
    e. Requirements for completing sustainable design documentation.
    f. Requirements for preparing operations and maintenance data.
    g. Requirements for delivery of material samples, attic stock, and spare parts.
    h. Requirements for demonstration and training.
    i. Preparation of Contractor's punch list.
    j. Procedures for processing Applications for Payment at Substantial Completion and for final payment including final change order.
    k. Submittal procedures.
    l. Coordination of separate contracts.
    m. Owner's partial occupancy requirements including certificate of occupancy and closeout of permits.
    n. Installation of Owner's furniture, fixtures, and equipment.
    o. Responsibility for removing temporary facilities and controls.
    p. Final cleaning.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at regular intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction

behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Status of sustainable design documentation.
6) Deliveries.
7) Off-site fabrication.
8) Access.
9) Site use.
10) Temporary facilities and controls.
11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) Status of RFIs.
16) Status of Proposal Requests.
17) Pending changes.
18) Status of Change Orders.
19) Pending claims and disputes.
20) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Contractor will conduct Project coordination meetings at monthly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Contractor, and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of

schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site use.
9) Temporary facilities and controls.
10) Work hours.
11) Hazards and risks.
12) Progress cleaning.
13) Quality and work standards.
14) Status of RFIs.
15) Proposal Requests.
16) Change Orders.
17) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Aerial and preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Final Completion construction photographs.
5. Preconstruction video recordings.
6. Periodic construction video recordings.
7. Construction webcam.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
3. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
4. Section 311000 "Site Clearing" for related information.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos on CD-ROM or thumb-drive or by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in file metadata tag or in web-based Project management software site:

a. Name of Project.
b. Name and contact information for photographer.

c. Name of Engineer.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

C. Video Recordings: Submit video recordings within seven days of recording.

1. Submit video recordings on CD-ROM or thumb drive or by uploading to web-based Project management software site. Include copy of key plan indicating each video's location and direction.
2. Identification: With each submittal, provide the following information in file metadata tag or on web-based Project management software site:

a. Name of Project.
b. Name and address of photographer.
c. Name of Engineer.
d. Name of Contractor.
e. Date video recording was recorded.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.4 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

B. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, web-based software, and related services for construction projects, with a record of providing satisfactory services similar to those required for Project.

1.5 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.

C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

D. Metadata: Record accurate date and time from camera.

E. File Names: Name media files with date Project area and sequential numbering suffix.

F. Usage Rights

1. Obtain and transfer copyright usage rights from photographer and videographer to Owner for unlimited reproduction of photographic and videographic documentation.

1.6 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before commencement of the Work take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.

1. Flag excavation areas and construction limits before taking construction photographs.
2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:

1. Underground utilities.
2. Underslab services.
3. Piping.
4. Electrical conduit.
5. Waterproofing and weather-resistant barriers.
6. Fine and Coarse Bubble Diffusers.
7. Submersible Pumps.

E. Periodic Construction Photographs: Take 50 photographs monthly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

F. Aerial Photographs:

1. Provide aerial photography of the entire project site. Do not extend limits past the project boundary in order to provide the greatest level of detail of the entire work area.
2. Provide three different views at the following periods of the Project.

a. Prior to commencement of the Work.
b. Each month of construction.

c. At project completion.

G. Final Completion Construction Photographs: Take 100 photographs after date of Substantial Completion for submission as Project Record Documents. Engineer will inform photographer of desired vantage points.

H. Additional Photographs: Engineer may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:

a. Special events planned at Project site.
b. Immediate follow-up when on-site events result in construction damage or losses.
c. Photographs shall be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
d. Substantial Completion of a major phase or component of the Work.
e. Extra record photographs at time of final acceptance.
f. Owner's request for special publicity photographs.

1.7 CONSTRUCTION VIDEO RECORDINGS

A. Video Recording Photographer: Engage a qualified videographer with not less than three years' experience to record construction video recordings.

B. Narration: Describe scenes on video recording by audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.

1. Confirm date and time at beginning and end of recording.
2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.

C. Preconstruction Video Recording: Before starting excavation, demolition, or construction, record video recording of Project site and surrounding properties from different vantage points, as directed by Engineer.

1. Flag construction limits before recording construction video recordings.
2. Show existing conditions adjacent to Project site before starting the Work.
3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of excavation, demolition, or construction.
4. Show protection efforts by Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013233

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
2. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
3. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
4. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
5. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
6. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
7. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Mass Submittals: Six or more submittals or items in one day or 15 or more submittals or items in one week.

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Engineer's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.5 SUBMITTAL FORMATS

A. Numbering System: Utilize the following example submittal identification numbering system to identify submittals and as file names for PDF submissions:

1. First Identifier - Alphabet Character: D, S, M, or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.
2. Second Identifier - Next 6 or 8 Digits: Applicable Specification Section Number. Do not mix submittals from different specification sections into a single submittal.
3. Third Identifier - Next Three Digits: Sequential number of each separate item or drawing submitted under each Specification Section, in chronological order submitted, starting at 001.
4. Fourth Identifier - Last Alphabet Character: A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc.
5. EXAMPLE: D-033000.13-008-B.

a. D = Shop Drawing.
b. 033000.13 = Section; use only 6 digits for sections that do not include 8 digits.
c. 008 = the eighth different submittal under this Section.
d. B = the second submission (first resubmission) of that particular shop drawing.

B. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Engineer.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

C. Options: Identify options requiring selection by Engineer.

D. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

E. Paper Submittals: For Operation and Maintenance Manuals only.

1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.

F. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

G. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.

    a. Engineer will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 30 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 30 working days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.

4. Repetitive Reviews: Shop drawings, O&M manuals, and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.7 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Engineer's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.

c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

   a. Project name and submittal number.
   b. Generic description of Sample.
   c. Product name and name of manufacturer.
   d. Sample source.
   e. Number and title of applicable Specification Section.
   f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

   a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.

7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit two sets of Samples. Engineer will retain one Sample sets; remainder will be returned.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Contractor’s Certification: Each shop drawing, working drawing, product data, and sample shall have affixed to it the following Certification Statement:

a. "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements. "

3. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
4. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

5. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
6. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
7. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.8 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 PROPOSED PRODUCT LIST

A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.10 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Contractor Responsible for:

1. Determination and verification of materials including manufacturer’s catalog numbers.
2. Determination and verification of field measurements and field construction criteria.
3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
4. Determination of accuracy and completeness of dimensions and quantities.
5. Confirmation and coordination of dimensions and field conditions at Site.
6. Construction means, techniques, sequences, and procedures.
7. Safety precautions.
8. Coordination and performance of Work of all trades.
9. Other requirements enumerated in Contract Documents.

C. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.11 ENGINEER'S REVIEW

A. Do not make mass submittals to Engineer. If mass submittals are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review mass submittals based on priority determined by Engineer after consultation with Owner and Contractor.

B. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required, and return.

1. PDF Submittals: Engineer and Construction Manager will indicate, via comments on the submittal response form, the appropriate action.
2. Submittals by Web-Based Project Management Software: Engineer will indicate, on Project management software website, the appropriate action.

C. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

F. Engineer will return without review submittals received from sources other than Contractor.

G. Submittals not required by the Contract Documents will be returned by Engineer without action.

H. Shop drawings will be returned to Contractor with one of the following codes.

1. "APPROVED" - This code is assigned when there are no notations or comments on the submittal. When returned under this code Contractor may release the equipment and/or material for manufacture.
2. "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by Contractor. Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
3. ÁPPROVED AS NOTED/CONFIRM" - This code is assigned when a confirmation of the notations and comments IS required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted.
4. "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. The resubmittal is to address all comments, omissions and non-conforming items that were noted. An additional box is checked to indicate whether the resubmission is for the complete package, or for parts of the package. If no box is checked, a complete resubmittal shall be provided. Review code may designate if a partial or full submittal is required. If full submittal is required, a

complete resubmittal package addressing all comments shall be provided. If a partial submittal is designated, resubmittal shall only include information pertaining to those items noted in review comments requiring clarification and any portions of submittal impacted as a result of the response. Resubmittal is to be received by Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.

5. "REJECTED" - This code is assigned when the submittal does not meet the intent of the Contract Documents. Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the Contract Documents.
6. "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Approval)" - This code is assigned to acknowledge receipt of a submittal that is not subject to Engineer's approval. This code is generally used with submittals involving Contractor’s means and methods of construction work plans, and health and safety plans.

1.12 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.

B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:

1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
6. Receiver shall not hold Engineer responsible for such viruses or their consequences, and shall hold Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated, and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance

with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" shall have the same meaning as the term "testing agency."

H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer.

1.4 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Engineer regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Engineer for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel and Delegated-Designer.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award, and not less than five days prior to preconstruction conference. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

C. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents.

D. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

E. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include Work Engineer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Design Professional Qualifications: A professional engineer / registered architect who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Design / engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged in the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329**,** and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect, demonstrate, repair and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor’s Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payments.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Engineer.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's and authorities’ having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

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SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).

28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformite Europeenne; http://ec.europa.eu/growth/single-market/ce-marking/
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csagroup.com.
65. CSA - CSA International; www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).

73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org .
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridaroof.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
98. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. ICBO - International Conference of Building Officials; (See ICC).
101. ICC - International Code Council; www.iccsafe.org.
102. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
103. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
104. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
105. IEC - International Electrotechnical Commission; www.iec.ch.
106. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
107. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
108. IESNA - Illuminating Engineering Society of North America; (See IES).
109. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
110. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
111. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
112. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
113. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
114. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
115. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).

116. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
117. ISO - International Organization for Standardization; www.iso.org.
118. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
119. ITU - International Telecommunication Union; www.itu.int/home.
120. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
121. LMA - Laminating Materials Association; (See CPA).
122. LPI - Lightning Protection Institute; www.lightning.org.
123. MBMA - Metal Building Manufacturers Association; www.mbma.com.
124. MCA - Metal Construction Association; www.metalconstruction.org.
125. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
126. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
127. MHIA - Material Handling Industry of America; www.mhia.org.
128. MIA - Marble Institute of America; www.marble-institute.com.
129. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
130. MPI - Master Painters Institute; www.paintinfo.com.
131. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
132. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
133. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
134. NADCA - National Air Duct Cleaners Association; www.nadca.com.
135. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
136. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
137. NBI - New Buildings Institute; www.newbuildings.org.
138. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
139. NCMA - National Concrete Masonry Association; www.ncma.org.
140. NEBB - National Environmental Balancing Bureau; www.nebb.org.
141. NECA - National Electrical Contractors Association; www.necanet.org.
142. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
143. NEMA - National Electrical Manufacturers Association; www.nema.org.
144. NETA - InterNational Electrical Testing Association; www.netaworld.org.
145. NFHS - National Federation of State High School Associations; www.nfhs.org.
146. NFPA - National Fire Protection Association; www.nfpa.org.
147. NFPA - NFPA International; (See NFPA).
148. NFRC - National Fenestration Rating Council; www.nfrc.org.
149. NHLA - National Hardwood Lumber Association; www.nhla.com.
150. NLGA - National Lumber Grades Authority; www.nlga.org.
151. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
152. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
153. NRCA - National Roofing Contractors Association; www.nrca.net.
154. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
155. NSF - NSF International; www.nsf.org.
156. NSPE - National Society of Professional Engineers; www.nspe.org.
157. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
158. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
159. NWFA - National Wood Flooring Association; www.nwfa.org.
160. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
161. PDI - Plumbing & Drainage Institute; www.pdionline.org.

162. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
163. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
164. RFCI - Resilient Floor Covering Institute; www.rfci.com.
165. RIS - Redwood Inspection Service; www.redwoodinspection.com.
166. SAE - SAE International; www.sae.org.
167. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
168. SDI - Steel Deck Institute; www.sdi.org.
169. SDI - Steel Door Institute; www.steeldoor.org.
170. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
171. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
172. SIA - Security Industry Association; www.siaonline.org.
173. SJI - Steel Joist Institute; www.steeljoist.org.
174. SMA - Screen Manufacturers Association; www.smainfo.org.
175. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
176. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
177. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
178. SPIB - Southern Pine Inspection Bureau; www.spib.org.
179. SPRI - Single Ply Roofing Industry; www.spri.org.
180. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
181. SSINA - Specialty Steel Industry of North America; www.ssina.com.
182. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
183. STI - Steel Tank Institute; www.steeltank.com.
184. SWI - Steel Window Institute; www.steelwindows.com.
185. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
186. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
187. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
188. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
189. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
190. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
191. TMS - The Masonry Society; www.masonrysociety.org.
192. TPI - Truss Plate Institute; www.tpinst.org.
193. TPI - Turfgrass Producers International; www.turfgrasssod.org.
194. TRI - Tile Roofing Institute; www.tileroofing.org.
195. UL - Underwriters Laboratories Inc.; http://www.ul.com.
196. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
197. USAV - USA Volleyball; www.usavolleyball.org.
198. USGBC - U.S. Green Building Council; www.usgbc.org.
199. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
200. WA - Wallcoverings Association; www.wallcoverings.org
201. WASTEC - Waste Equipment Technology Association; www.wastec.org.
202. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
203. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
204. WDMA - Window & Door Manufacturers Association; www.wdma.com.
205. WI - Woodwork Institute; www.wicnet.org.
206. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.

207. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).

4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.

6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section CIP3 “Summary of Work” for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Engineer, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

E. Water and Sewer Service from Existing System: Water from Owner's existing water system is not available for use. Provide connections and extensions of services as required for construction operations.

F. Electric Power Service from Existing System: Electric power from Owner's existing system is not available for use. Contractor to provide connections and extensions of services and metering as required for construction operations.

G. Contractor shall refer to Section 00700 “General Conditions” regarding permanent utilities connections.

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Refer to Specification CIP 15 “Project Identification Signage.”

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

G. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:

1. Methods used to meet the goals and requirements of the Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.

5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.
6. Indicate locations of sensitive equipment areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.5 QUALITY ASSURANCE

A. Temporary facilities shall comply with all applicable state and local ordinances, codes, and regulations.

B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

D. Accessible Temporary Egress: Comply with applicable provisions in 2012 Texas Accessibility Standards (TAS).

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Temporary Chain-Link Fencing: Minimum 2 inch thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8 inch OD line posts and 2-7/8 inch OD corner and pull posts, with 1-5/8 inch OD top rails.

B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Engineer from manufacturer's standard colors.

C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

D. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 inches by 60 inches.

E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

A. Field Offices: Field engineer's office is not required.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where shown on Drawings or where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work. Engineer's trailer shall be set up and ready for occupancy within 30 days of the Notice to Proceed.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use within 30 days of the Notice to Proceed and prior to Commencement of Work at the site. Do not remove until approved by Engineer or are replaced by authorized use of completed permanent facilities.

3.3 CONTRACTOR'S FIELD OFFICE

A. Provide a temporary field office(s) for Contractor's use for the duration of the project. An authorized representative of Contractor shall be present at all times while the Work is in progress. Instructions received at Contractors field office from Engineer shall be considered delivered to Contractor.

B. Locate field office(s) in accordance with approved shop drawings and as directed by Owner.

C. Establish and occupy field office within 30 days of the Notice to Proceed, unless otherwise approved by Engineer or Owner.

3.4 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.

    a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
    b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

G. Temporary Light and Power: Provide by Contractor, including 220 Volt service for welding, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.

H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.
2. Connect temporary service to Owner's existing power source, as directed by Owner. Provide any necessary metering equipment and appurtenances to make the connection.

I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

J. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Engineer and Owner.

3.5 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Utilize designated area within existing building for temporary field offices.
3. Maintain support facilities until Engineer schedules Final Completion inspection. Remove just before Final Completion.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas accordance with Section 312000 "Earthwork."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 321216 "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Provide temporary parking areas for construction personnel.

F. Storage and Staging: Use designated areas of Project site for storage and staging needs.

G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

H. Project Signs: Provide Project signs as indicated in Section CIP 15 “Project Identification Signage”.

I. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

J. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

K. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

L. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

M. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

N. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.6 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section CIP3 “Summary of Work.”

C. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Section 311000 "Site Clearing” and CIP 9 “environmental Protection Procedures.”

D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

F. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."

G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

H. Site Enclosure Fence: Before construction operations begin or Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As indicated on Drawings.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner and Engineer’s Field Representative.

I. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

K. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide, install and maintain signage directing occupants to temporary egress.

L. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.

1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
2. Paint and maintain appearance of walkway for duration of the Work.

M. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

N. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard, with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
2. Construct dustproof partitions with two layers of 6 mil polyethylene sheet on each side. Cover floor with two layers of 10 mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

    a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.

3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Insulate partitions to control noise transmission to occupied areas.
5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
6. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.

O. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

P. Weather protection shall comply with M.G.L. Chapter 149 Section 44G.

3.7 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Engineer.
    c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.8 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
2. Clear snow and ice from all drives, walks and stairs to maintain safe vehicle and pedestrian access to the site and facilities as directed by the Engineer.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Final Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Final Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. Just prior to Final Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 015353 – TEMPORARY PACKAGED WASTEWATER TREATMENT PLANT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Section Includes:

1. Requirements of the installing Contractor to coordinate schedule for delivery and installation of the vessels and equipment for one (1) temporary wastewater treatment package plant, temporary blowers, interconnecting piping, and electrical distribution equipment as shown on the Drawings and as specified herein.
2. The following are to be procured directly by the Owner. Owner is soliciting the provision of this equipment from a Package Plant Supplier on a Lease basis:

    a. Temporary wastewater treatment package plant.
    b. Temporary blowers.
    c. Delegated Design (by Package Plant Supplier):

        1) Vessels and equipment designed for treating 1 million gallons per day (MGD) (Average Daily Flow) and 2 MGD (Peak Hourly Flow) of domestic sewage to meet the specified performance requirements and to comply with applicable federal, state, and local regulatory requirements.

B. Related Requirements of this Contract:

1. Attachment 015353-A provides the delineation of scope of work by the Package Plant Supplier versus work to be performed by Contractor.
2. Section 400559.2 for motor-operated slide gate to be installed at the Headworks for diversion of wastewater to the Package Plant as shown on the Drawings.
3. Sludge transfer pumps (one installed and one shelf-spare) for conveyance from the Package Plant Sludge Basin to Aerated Sludge Holding Tank 2, as specified on Drawings.

1.4 ACTION SUBMITTALS

A. None – Submittals are responsibility of Package Plant Supplier.

1.5 DELEGATED DESIGN SUBMITTALS

A. None – Submittals are responsibility of Package Plant Supplier.

1.6 INFORMATIONAL SUBMITTALS

A. None – Submittals are responsibility of Package Plant Supplier.

1.7 WARRANTY AND MAINTENANCE

A. None – Warranty and service agreements are responsibility of Package Plant Supplier.

1.8 QUALITY ASSURANCE

A. All workmanship and materials shall be of the highest quality.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Inspect all equipment on site for damage.

B. Store equipment according to Supplier's instructions.

C. Protect parts so no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and units and equipment are ready for operation.

D. Ship equipment, material, and spare parts complete except where noted by the Supplier for on-site assembly.

1.10 FIELD CONDITIONS

A. Verify field conditions prior to fabrication and delivery.

PART 2 - PRODUCTS

2.1 PACKAGE PLANT SUPPLIERS

A. Suppliers: Subject to compliance with requirements, provide products by the following:

1. Temporary Package Plant:

a. AUC Group, LLC (1800 Augusta, Suite 108, Houston, Texas 77057)
b. Or Engineer-Approved Equal.

2.2 PACKAGE PLANT PERFORMANCE REQUIREMENTS

A. The Supplier is responsible for designing and providing a packaged system capable of meeting the specified treatment requirements. The system provided must comply with all requirements of the Texas Commission on Environmental Quality, including 30 TAC 217.

1. Alternative treatment configurations to that specified herein and list of deviations from this specification shall be submitted for approval.

B. Design and Performance Requirements:

1. Influent Characteristics and Effluent Standards:

a. Average Rated Flow: 1.0 MGD (694 GPM)
b. Peak Flow: 2.0 MGD (1,360 GPM)

2. Influent Wastewater Strength:

a. BOD_5 : 250 mg/L
b. TSS: 250 mg/L
c. NH_3: 50 mg/L

3. Effluent Treatment Requirements:

a. Thirty-day Average:
1) BOD_5: 7 mg/L
2) TSS: 15 mg/L
3) NH_3: 2 mg/L

b. Daily Maximum:
1) BOD_5: 17 mg/L
2) TSS: 40 mg/L
3) NH_3: 7 mg/L

4. Hydraulic Constraints:

a. Maximum Water Surface Elevation in First Treatment Basin: 752.00 ft
b. Proposed Inlet Pipe Centerline Elevation: 741.25 ft
c. Minimum Water Surface Elevation in Clarifier Effluent Trough: 749.00 ft
d. Top of Clarifier Gravel Foundation 737.00 ft

2.3 TEMPORARY PACKAGE PLANT MATERIALS

A. Foundation:

1. Maximum Footprint Available: 301-feet by 81 feet
2. Foundation Type: Compacted Crushed Stone per the Drawings

B. Tank Construction

1. The Supplier shall be responsible for all tank construction and materials.

2. Fabricated of one-fourth inch structural grade steel plate, (ASTM A-36), joined by arc welding with fillets of adequate section for the joint involved.
3. All walls shall be continuous and watertight and shall be supported by structural reinforcing members where required.
4. All welds on the structural members shall be continuous within the top two feet of the basins. All other welds on the structural members shall be skip welded.
5. Reinforcing members on 4'-0" maximum spacing and reinforcing shall be provided on end walls and partition walls.
6. Box tubing shall not be used as structural members.
7. Structural integrity of the steel walls shall be the responsibility of the Supplier.
8. Each hydraulically separated basin shall include a drain port.

C. Tank Coating and Corrosion Control

1. Supplier shall be responsible for all material surface preparation and coating.
2. Corrosion Resistant Construction:

   a. Materials will be exposed to corrosive sewer gas. Materials shall be fiberglass reinforced plastic, polyvinyl chloride, high density polyethylene, Type 304 or 316 stainless steel, aluminum, hot dipped galvanized steel, or epoxy coated carbon steel.
   b. Hardware: Type 316 stainless steel, ASTM A193.

3. Coating:

   a. Vessel to be painted shall be properly prepared to obtain a smooth, clean, and dry surface.
   b. Remove rust, dust, and mill scale as well as other extraneous matter by sandblasting to SSPC-6 (commercial sandblast) on outside of vessel surfaces and to SSPC-10 (near-white blast) on inside of vessel surfaces.
   c. Within the time allowed by the paint manufacturers recommendations, the inside of the tanks shall be coated with two coats of self-priming Hi-Build Epoxy at 6 to 8 mils total dry film thickness each. The outside shall receive two coats of self-priming Hi-Build Epoxy at 6 to 8 mils total dry film thickness each.

D. Aeration Basins

1. Furnish and erect aeration basins and transfer piping between basins.
2. Required Freeboard: 18-inches
3. Inlet Flange: Sch. 40 welded galvanized steel
4. Transfer Piping Flanges: Sch. 40 welded galvanized steel
5. Shaped on each side to prevent sludge accumulation, to enhance rotation of the tank contents, and to prevent scum and froth accumulation.
6. Place air diffusers longitudinally along one side of the vessel.
7. The proportion of the chamber width to depth, in the direction of rotation, shall not exceed 1.5 to 1. The velocity of rotation shall be sufficient to scour the bottom and prevent sludge filleting.

E. Clarifier

1. Furnish and field-erect one (1) circular mechanical clarifier complete and ready for operation, as detailed herein.
2. Tank Construction:

    a. The clarifier vessel shall be fabricated or erected with one-fourth inch structural grade steel plate (ASTM A-36) joined by arc welding with fillets of adequate section for the joint involved.
    b. All walls shall be continuous and watertight and shall be supported by structural-reinforcing members where required.

3. Support Bridge:

    a. Walkway shall be 3-ft in width and cover the full diameter of the clarifier.
    b. Design to support the drive unit, torque tube, sludge rake, and skimmer arm.
    c. Designed to withstand all dead loads plus a live load of 50 pounds per square foot with a maximum deflection of 1/360 over the entire span.
    d. Material:

        1) Hot dip galvanized
        2) 1” x 3/16” galvanized bar grating, support beams and structure
        3) 2.5 inches angled or 1-inch square tubing handrails.

    e. Handrail posts shall not be over 7 feet apart
    f. Top rail shall be 42 inches above the walkway.
    g. Provide 4-inch tall kick plates.

4. Inlet Connection:

    a. Schedule 40 galvanized steel clarifier influent piping:
        1) Discharge into a stilling well.
        2) Installed from a point near the bottom of the inlet stilling well in the center of the clarifier.
        3) Minimize deposition of solids and slow down the flow to improve settlements of solids.
        4) Painted like the main vessel or hot dip galvanized.

5. Outlet Connection:

    a. 14” Flange downstream of weirs in effluent trough provided for connection point.

6. Inlet Stilling Well:

    a. Size: To meet industry standards for design flows specified.
    b. Provide to reduce influent velocity and prevent short circuitry.
    c. Non-rotating and supported by structural cross members attached to the clarifier side walls.
    d. Fabricated of 3/16" steel plate and painted like the main vessel or hot dip galvanized.

7. Sludge Scraper Assembly (Rake Arm):

a. Sludge Scraper:

1) Two (2) scraping arms.
2) Fabricated of steel angles and a torque tube.
3) Hot dip galvanized or painted like the main vessel.

b. Scraper Arms

1) Fabricated from steel angle and have a neoprene squeegee blade attached to each angle to allow for sufficient movement of sludge into the center sludge collector pit.

c. Sump:

1) Installed during foundation placement.
2) Supplier to coordinate with Contractor to coordinate buried sump and process lines.

8. Surface Skimmer Arms:

a. Provide Two (2) arms to move the surface scum to the scum troughs, each rotating 180° opposite from the center torque tube and to the scum baffle to provide a full surface skimming of both the clarifier and stilling well
b. Fabricated from structural steel sections and equipped with 1/4" flexible neoprene squeegee.
c. Hot dip galvanized or painted like the main vessel.

9. Scum Trough:

a. The clarifier shall be equipped with manually rotated pipe scum trough extending through the center wells to the scum baffles.
b. Easily accessible from the walkways.
c. Drain into a drop box at the scum baffle.
d. Hot dip galvanized or painted like the main vessel.
e. Provide scum airlift assembly attached to the drop box.

10. Effluent Troughs and Weir Assembly:

a. Steel weir trough with weir plates around the entire outer diameter of the inner ring.
b. Steel weir troughs with weir plates fabricated from 3/16-inch stainless steel plate allowing up to and including 2 inches of adjustment shall be installed.

1) Weirs: 4-inches wide x 2-inch deep "V" notches on 6-inch centers.
2) Attach to the outer wall of the trough.

c. The troughs shall be made of 1/4" steel plate. The inner vertical wall of each trough shall act as a scum baffle with an adequate height above the surface to prevent overflow. The troughs shall be no less than 24" wide.
d. Painted like the main vessel or hot dip galvanized.

11. Drive Unit:

a. Vertical motorized triple reduction speed reducer equal to a Eurodrive Model RF 147 driven by 1/2 HP, 230/460 Volt, 3 Phase motor.
b. Sized for maximum gear box rating without overloading the gear box.
c. Drive and torque unit: designed for a torque rating of not less than 2,560 ft. pounds. The combination of motor to gear reducer to drive the scraper arm shall provide a peripheral speed not to exceed 8 feet per minute at the tip of the sludge collector.
d. Provide a total of twelve (12) spare shear pins.
e. Provide 2 torque switches

1) Warning: 1
2) Shutdown: 1

12. Control Panel:

a. Provided by Package Plant Supplier, shipped loose for installation by Contractor.
b. NEMA 4X, 316 stainless steel with an external disconnect switch
c. Starter: NEMA rated, minimum size 1.
d. Control Panel:

1) Single Power source: 480 V, 20A, 3 Phase
2) Selector switch: On/OFF control
3) External overload reset button
4) Running, stopped, and power indication lights
5) Overtorque warning lights.
6) Overload torque shutdown light.
7) Remote monitoring signal available to SCADA:

a) Run status (N.O. Dry Contact)
b) Overtorque Warning (N.O. Dry Contact)
c) Overtorque Alarm (N.O. Dry Contact)
d) Power On (N.O. Dry Contact)

e. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

F. Aerated Sludge Holding Basin

1. Provide one aerated sludge holding tank with mixing mechanism sized for working volume required.
2. Contractor to purchase and install pump to convey sludge from this basin to existing sludge tanks. Make and model as specified on the Drawings.
3. Equip with Non-Clog Coarse Bubble Diffusers, provided by Supplier.

G. Coarse Bubble Diffuser System

1. Supplier to furnish labor, equipment, and materials for:
   a. Non-clog, coarse bubble, single-drop type diffusers for the aeration basins and aerated sludge holding tank.

b. Air supply piping to air drops and diffuser assemblies from the Supplier-provided process air piping.
c. Bracing, fittings, supports, and anchorage parts to be required by Supplier.

2. Air Distribution Manifold:

a. Installed along one side of the aeration basin or sludge holding tank with diffuser drop assemblies connected thereto.
b. Continuous to provide for uniform pressure drop.
c. Sized for 150 percent of the required airflow at design pressures.
d. Hot dip galvanized and not be a part of the tank structure.

3. Air Drop Assemblies:

a. A single air drop assembly shall be furnished for each diffuser.
b. Furnished with a tee and plug for clean-out purposes and a ball valve and coupling for air regulating purposes.
c. Mounted near the tank wall and bottom.
d. Provide minimum standard oxygen transfer efficiency (SOTE) of 0.7% per foot of submergence.
e. Provide Corrosion Resistant materials.
f. Gaskets and seals: rated for a minimum of 300 deg F continuous service.

4. Diffusers:

a. Easily removable for inspection and servicing.

H. Airlift Pumps

1. Supplier to provide and install three (3) airlift pumps:

a. RAS Airlift:

1) Transfer settled sludge from the clarifier to the aeration basin.
2) Size: As required to provide RAS equal to 150 percent of average design flow

b. WAS Airlift:

1) Transfer settled sludge from the clarifier to the aerated sludge holding tank.
2) Size: As recommended by Supplier.
3) Equipped with isolation solenoid-operated valve to allow for automation of sludge wasting period from Owner's SCADA system.
4) Provide a local control panel with HOA switches for solenoid operated isolation valve. Contractor shall install and provide wiring and electrical service to the control panel and connect solenoid valves to SCADA.

c. Scum Airlift:

1) Transfer scum from the clarifier scum drop box to the aeration basin.
2) Size: As recommended by Supplier.

2. Airlift pump systems must meet the following requirements:

    a. The airline supplying air to the pump shall be equipped with a valve to allow for varying the capacity of the pump.
    b. Firmly support and equip with a clean-out plug to allow for easy cleaning and maintenance.
    c. Provide an expansion chamber to exhaust excess air.
    d. The Supplier shall provide and install discharge piping.

I. Air Bridges, Service Walkways, Stairway, and Handrails

1. Supplier to provide and furnish all air bridges, service walkways, stairways and handrails.
2. Air Bridge:

    a. Includes: walkway grating, handrails, kickplates, air distribution system, and diffuser drops.

3. Service Walkways:

    a. Material: Galvanized steel
    b. 3-ft wide, minimum 1-inch by 3/16-inch galvanized bar grating, support structure, and handrails.
    c. Safe Uniform Load Carrying Capacity of 50 pounds per square foot with maximum deflection of 1/360.
    d. Sit atop the vessels.

4. Handrails:

    a. The Supplier shall provide handrails around the service walkway.
    b. 2-1/2-inch galvanized fabricated angle, or 1-1/2- inch galvanized pipe, with posts spaced no more than 7 feet apart and top rails 42 inches from the walkway.
    c. Kick plates shall be 4 inches.

5. Stairways:

    a. Provide stairs as required for access at locations needed to meet code requirements.
    b. 45-degree stairways.
    c. 3-ft wide with an upper and intermediate handrail
    d. Step: 8 3/4” rise, 11” width fabricated of bar grating with checkered plate nosings
    e. Concrete landing pads provided by supplier.

J. Site Lighting

1. Contractor is responsible for design, procurement and installation of temporary site lighting including electrical work around the limits of temporary package treatment plant, as shown on Drawings.

2.4 MULTISTAGE-CENTRIFUGAL BLOWERS

A. Supplier is responsible for calculating blower performance requirements and coordinating lease of blowers that will ensure the wastewater treatment package plant system meets the performance requirements of this Section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment and conditions with Supplier and Contractor present for compliance with construction requirements, installation tolerances, and other conditions affecting performance of the Work.

3.2 INSTALLATION

A. Supplier to erect package plant vessels on crushed gravel foundation pad installed by Contractor.

B. Apply coatings as specified and re-apply field coating of items damaged during installation.

C. No field welding of hot-dipped galvanized equipment will be permitted.

D. Coordinate work with Supplier to connect piping and electrical systems for the package plant to the existing Dove Springs WWTP facilities.

3.3 FIELD QUALITY CONTROL

A. Welding:

1. If Leaking is observed: tank to be emptied and allowed to dry for repair welds to be completed.
2. Remove defective welds by chipping, arc, or carbon gouging.

B. Acceptance Testing for Package Plant Processes:

1. General: For all testing described below, the following will apply to the Supplier:

    a. Submit a written procedure for approval that describes the acceptance testing procedures. Supplier shall coordinate and receive approval prior to testing activities.
    b. Acceptance testing will include leak testing with water (potable or non-potable) followed by startup and performance testing with mixed liquor.
    c. Contractor is responsible for filling and emptying the package plants with water or mixed liquor as required for testing activities.
    d. Contractor shall be responsible for conveying water between the existing facility and the proposed package plant.
    e. Owner will provide a source of water and electricity.
    f. Supplier shall pay for all costs of testing other than the cost of water and electricity.
2. Leak Testing:

a. Upon completion of installation of equipment, the Supplier shall test structures that will contain water on a full time or intermittent basis for leaks.
b. Test the structure for leakage using the following procedure:

    1) Determine the evaporation allowance for loss of water.

        a) Use a standard circular pan procedure established by the U.S. Weather Bureau to measure evaporation rate.
        b) Calculate evaporation allowance by multiplying the evaporation rate in gallons per 24 hours per square foot of surface area by the open surface area of the water in the structure.

    2) Fill the structure to the approved freeboard with non-potable water at a rate not to exceed 2 feet per hour.
    3) Mark the water level at the structure wall. Measure the fall in water level over a 24-hour period to the nearest 1/8 inch at least twice a day for a minimum duration of 3 days to determine the quantity of water lost. Provide a stilling well for measurement if required to allow accurate measurement.
    4) Calculate the amount of water lost during the test and compare the amount of water lost to the evaporative loss allowance. The water loss may only be accounted for by evaporative losses.
    5) If the amount of water lost exceeds the evaporation allowance, drain the structure, repair the leaks, re-fill, and re-test the structure.
    6) Repeat tests until the structure passes the test.

3. Performance Testing of Process:

    a. After field adjustments are completed, test treatment unit under design conditions, or as near design conditions as permitted by the influent loads at the time of testing, for 14 consecutive days to demonstrate package plant compliance with design criteria, and permit discharge limitations.
    b. The Supplier shall initiate the performance testing period within 7-days of filling the process with mixed liquor or when the plant has reached steady-state conditions and effluent requirements have been met.
    c. Minimum sample collection requirements during performance testing

        1) Collect and analyze samples of influent and effluent for CBOD5, TSS, and ammonia-N concentrations at 8:00 AM and 4:00 PM on at least 10 days of the performance testing period.
        2) Collect and analyze samples for mixed liquor suspended solids concentrations at four locations, with at least 2 sample depths per sample location, at least 2 days of the performance testing period.
        3) Measure DO concentrations in First and Last Aeration Zones at 8:00 AM and 4:00 PM, with a minimum of 2 locations per zone, for at least 10 days of the performance testing period.

    d. Correct any deficiencies found during the performance test that do not meet the performance requirements of this Sections and at the Owner’s option, re-run the test at no additional cost.

3.4 STARTUP SERVICE

1. None – provided by Package Plant Supplier.

END OF SECTION 015353

ATTACHMENT 015353-A TEMPORARY PACKAGE PLANT SCOPE DELINEATION		
Scope of Supply	Package Plant Supplier (Separate Contract)	Contractor (This Contract)
TEMPORARY PACKAGE PLANT		
Aeration Basins – Tank Structure and Diffuser Assembly	X	
Aeration Basin 12” Inlet Flange Connection	X	
Package Plant 12” Influent Piping		X
Clarifier –Tank Structure and Internal Components (See note 1)	X	
Clarifier Effluent 14” Flange Connection	X	
Package Plant 14” Effluent Piping		X
Install “V” Notch Weir Plates and Effluent Troughs	X	
Clarifier Drive and Local Control Panel	X	
Installation and assembly of Clarifier LCP		X
Motor Starters in Clarifier LCP	X	
Sludge Holding Basin –Tank Structure and Diffuser Assembly	X	
Package Plant Sludge Transfer Piping		X
Sludge Transfer Submersible Pumps		X
Above-ground interconnecting Piping (see note 2)	X	
Buried Piping (see note 3)	X	
Installation of Buried Airlift Piping		X
Air Supply Piping within treatment units	X	
Coarse Bubble Diffuser System	X	
RAS, WAS, and Scum Airlifts	X	
Solenoid Valve (WAS)	X	
Solenoid Valve Panel	X	
Installation of Solenoid Valve Panel		X
Access Bridges, Air Bridges, Stairs, and Handrails	X	
Stair Concrete Landing Pads	X	
Furnish and Delivery of Materials and Equipment	X	
Field Assembly and Installation of Supplier Components	X	
Field Coatings and Corrosion Control	X	
Verify Elevation and Leveling of Components	X	
Perform Clear Water Test	X	
Commission and Start Up Service	X	
Training Services	X	
Anchor Bolts	X	
Package Plant O&M Manual	X	
Electrical Service from Contractor Supplied MCC to Package Plant (see note 4)		X
MCC – 3		X
Package Plant Lighting		X
Provisions for Instrumentation and Control		X
Pipe Supports within Package Plant	X	
Pipe Support Concrete Pads	X	
Excavation and Grading		X

Gravel Off-set Pad		X
Gravel Foundation Pad		X
TEMPORARY PACKAGE PLANT MULTISTAGE BLOWERS		
Multistage Blowers	X	
Blower Local Control Panels	X	
Low Pressure Air Piping from blower pad to supplier provided flange		X
Pipe Supports and Concrete Pads – Delegated Design		X
Blower Discharge Check Valves and Butterfly Valves		X
Blower Inlet Butterfly Valve and Silencer	X	
Blower Discharge Pressure Gauge		X
Concrete Blower Pad		X
Electrical Service		X

1. Internal Clarifier components include: support bridge, inlet pipe, stilling well, sludge scraper, gear drive, effluent trough, scum trough, v-notch weirs, surface skimmer, effluent pipe flange connection, drive unit, and a control panel.
2. Includes aeration basin transfer lines, clarifier influent piping, scum piping, airlift discharge piping.
3. Includes RAS piping to aeration tank and WAS piping to sludge holding tank
4. Includes all conduit and wiring to the temporary package plant and from the temporary package plant.

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary site fencing.

1.3 DEFINITIONS

A. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape or the average of the smallest and largest diameters at a height 54 inches above the ground line for trees with caliper of 8 inches or greater as measured at a height of 12 inches above the ground.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
b. Arborist's responsibilities.
c. Quality-control program.
d. Coordination of Work and equipment movement with the locations of protection zones.

e. Trenching by hand or with air spade within protection zones.
f. Field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
2. Detail fabrication and assembly of protection-zone fencing and signage.
3. Indicate extent of trenching by hand or with air spade within protection zones.

C. Samples: For each type of the following:

1. Organic Mulch: 1-pint volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For arborist and tree service firm.

B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

E. Quality-control program.

1.7 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.8 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Stockpiled soil mixed with planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

1. Mixture: Well-blended mix of two parts stockpiled soil to one part planting soil.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood, or Ground or shredded bark, or Wood and bark chips.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

C. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements: Previously used materials may be used when approved by Engineer.

1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch- diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- OD line posts, and 2-7/8-inch- OD corner and pull posts; with 1-5/8-inch- OD top rails; with 0.177-inch- diameter top tension wire and 0.177-inch- diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.

   a. Height: 72 inches.

2. Gates: Single- or Double- swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 24 inches or 36 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag each tree trunk at 54 inches above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.

1. Apply 2-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches of tree trunks.

3.3 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected areas except by entrance

gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

B. Maintain protection zones free of weeds and trash.

C. Maintain protection-zone fencing and signage in good condition as acceptable to Engineer and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earthwork" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as approved by local arborist. Consult local arborist and gain approval for all trees requiring root pruning prior to beginning any pruning work.

B. Root Pruning at Edge of Protection Zone: Prune tree roots 12 inches outside of the protection zone by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use

narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by arborist.

1. Prune to remove only broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
3. Pruning Standards: Prune trees according to ANSI A300 (Part 1).

B. Unless otherwise directed by arborist and acceptable to Engineer, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.

3.7 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Engineer.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Engineer.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 015639

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section CIP 3 “Summary of Work” for Contractor requirements related to Owner-furnished products.
2. Section 012500 "Substitution Procedures" for requests for substitutions.
3. Section 014200 "References" for applicable industry standards for products specified.
4. Section 017700 “Closeout Procedures” for submitting warranties.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycle contract materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 “Comparable Products” Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 “Substitution Procedures” for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Resolution of Compatibility Disputes between Multiple Contractors:

a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

    a. Name of product and manufacturer.
    b. Model and serial number.
    c. Capacity.
    d. Speed.
    e. Ratings.

3. See individual identification Sections in Divisions 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection for wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.

5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

    a. Submit additional documentation required by Engineer in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Engineer, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following.”

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following.”

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following.”

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product that complies with requirements.

    a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following.”
    b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer that complies with requirements.

   a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

   a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Engineer's sample," provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type,

function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.

3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of Engineers and owners, if requested.
5. Samples, if requested.

B. Engineer's Action on Comparable Products Submittal: If necessary, Engineer will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
2. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Engineer of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

D. Submittal Requirements, Single-Step Process: When acceptable to Engineer, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Engineer of Contractor' request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner’s portion of the Work.
6. Coordination of Owner-installed products.
7. Progress cleaning.
8. Starting and adjusting.
9. Protection of installed construction.

B. Related Requirements:

1. Section CIP 3 “Summary of Work” for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Engineer of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

    a. Contractor's superintendent.
    b. Trade supervisor responsible for cutting operations.
    c. Trade supervisor(s) responsible for patching of each type of substrate.
    d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.6 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Professional Engineer Qualifications: Refer to Section 014000 “Quality Requirements.”

C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements, whose structural function is not known, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Plumbing piping systems.
    f. Mechanical systems piping and ducts.
    g. Control systems.
    h. Communication systems.
    i. Fire-detection and -alarm systems.
    j. Conveying systems.
    k. Electrical wiring systems.
    l. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Exterior curtain-wall construction.
    d. Sprayed fire-resistive material.
    e. Equipment supports.
    f. Piping, ductwork, vessels, and equipment.
    g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraphs, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer in accordance to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Engineer promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.

7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Engineer. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items onsite and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with

integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Engineer. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Engineer. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F.

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Repair Work previously completed and subsequently damaged during construction period Repair to like-new condition.

C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section CIP14 “Project Closeout” for City requirement. This specification supplements these requirements.
2. Section CIP 16 “Warranty.”
3. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
4. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
5. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
6. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for Engineer’s use prior to Engineer’s inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's “punch list”), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Engineer's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Engineer.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. MS Excel Electronic File. Engineer will return annotated file.

1.10 SUBMITTAL OF PROJECT WARRANTIES

A. Submit warranty, bond, service, and maintenance contract documentation associated with the work performed.

B. Warranty period: Refer to CIP 16 “Warranty”, Division 40, and Division 46 for specific Equipment Warranties.

C. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

D. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

E. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

F. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Engineer, by uploading to web-based project software site, or by email to Engineer.

G. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

H. Provide additional copies of each warranty to include in operation and maintenance manuals.

1.11 PROJECT RECORD DOCUMENTS

A. Maintain record documents as specified under Section CIP 14 “Project Closeout” and CIP14.02 Record Documents inclusive of those documents specified therein and also including:

1. Field Test Records.
2. Correspondence.

B. Make available all documents to Owner's Inspector when requested.

C. Keep record drawings current.

D. Do not permanently conceal any work until required information has been recorded.

E. Label each drawing "CONSTRUCTION AS-BUILT" in neat, large, printed letters. Legibly mark drawings to record actual construction as required under CIP 14.02, Item E and also including:

1. Manufacturer, trade name, catalog number and supplier of all products and equipment actually installed.
2. Changes made by change order or field order.

F. Indicate all changes legibly in a contrasting color.

G. Delete Architect/Engineer seal from all record drawings.

H. Submit record drawings in compliance with CIP14.02, F. and accompany submittal with a transmittal letter, containing:

1. Date.
2. Project title and number.
3. Contractor's name and address.
4. Contents of submittal.
5. Certification that record drawings as submitted are complete and accurate.
6. Signature of Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning as required under CIP 14.04 Final Cleaning.

B. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

C. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 “Execution” before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. For Draft O&M Manuals, submit on digital media acceptable to Engineer or by uploading to web-based project software site. Enable reviewer comments on draft submittals.
2. After approval of Final O&M Manuals, submit two paper copies and final electronic copy.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Engineer will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Engineer will return copy with comments.

1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Engineer.
7. Name and contact information for Commissioning Authority.
8. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 ASSET MANAGEMENT FORM

A. Asset Management Form: Prepare a list of installed equipment. The list will include the equipment’s location, date of installation, description, position, category, manufacturer, serial number, and model. Refer to example at the end of this Section.

1.8 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.9 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.

2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.10 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

1.11 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent,

and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.12 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 Submittal Schedule

A. Operation and maintenance manuals shall be delivered directly to the office of the Engineer, as follows:

1. Provide preliminary copies of each manual to the office of the Engineer, no later than 30 days following approval of the respective shop drawings.
2. Provide final copies of each completed manual prior to testing.
3. Provide a letter that grants the Engineer and Owner to the limited right to use and reproduce each manual (in it its entirety or any portion thereof) from the respective equipment manufacturer(s). Such limited right shall allow the Engineer and Owner to use each manual or and portion thereof for:

    a. The potential assembly of a comprehensive facility operation and maintenance manual for the sole benefit of the Owner; and,
    b. supplemental training of the Owner's personnel and operators, over and above the required vendor's training, regarding operation of the facility as a system.

4. For each submitted manual, complete and submit to the Engineer the O&M Manual Review Checklist, appended to this Section.

B. The Engineer will review Operation and Maintenance manuals submittals for operating equipment for conformance with the requirements of the applicable specification Section. The review will generally be based on the O&M Manual Review Checklist appended to this Section.

C. If during test and start-up of equipment, any changes were made to the equipment, provide two hard copies of as-built drawings or any other amendments for insertion, by the contractor, in the previously transmitted final manuals. In addition, provide one revised electronic version including the as-built drawings and any other amendments. The manuals shall be completed, including updates, if any, within 30 days of start-up and testing of the facility.

D. As applicable, complete and submit the Equipment Manufacturer’s Certificate of Installation Testing and Instruction, appended to this Section, within 30 days after final inspection and plant start-up testing.

3.2 VENDOR TRAINING/INSTRUCTIONS (TO OWNER's PERSONNEL)

A. Before final initiation of operation, Contractor's vendors shall train/instruct Owner's designated personnel in the operation, adjustment, and maintenance of products, equipment and systems at times convenient to the Owner.

B. Unless specified otherwise under the respective equipment specification section, vendor training/instruction shall consist of eight hours of training for each type of equipment. Such training/instruction shall be scheduled and held at times to accommodate the work schedules of

Owner's personnel, including splitting the required training/instruction time into separate sessions and/or presented at reasonable times other than the Contractor's "normal working hours" or the Owner's normal day shift.

C. Use operation and maintenance manuals as basis for instruction. Train/instruct the Owner's personnel, in detail, based on the contents of manual explaining all aspects of operation and maintenance of the equipment. If the respective equipment is inter-related to the operation of other equipment, all interlock, constraints, and permissives shall be explained.

D. At least two weeks prior to the schedule for vendor training, a detailed lesson plan, representative of the material to be covered during instruction, shall be submitted to the Engineer for approval. Lesson plans shall consist of in-depth outlines of the training material, including a table of contents, resume of the instructor, materials to be covered, start-up procedures, maintenance requirements, safety considerations, and shut-down procedures.

E. Prepare and insert additional data in each Operation and Maintenance Manual when the need for such data becomes apparent during training/instruction.

F. Vendor's training/instruction will be considered acceptable based on the completed Owner's Acknowledgement of Manufacturer's Instruction as indicated on the Equipment Manufacturer's Certification of Installation, Testing, and Instruction appended to this Section.

EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION TESTING AND INSTRUCTION

Owner: _____

Project: _____

Contract No.: _____

CDM No.: _____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I, _____, Authorized representative of
(PRINT NAME)

_____
(PRINT MANUFACTURER'S NAME)

hereby CERTIFY that _____
(PRINT EQUIPMENT NAME AND MODEL WITH SERIAL NO.)

installed for the subject project [has] [have] been installed in a satisfactory manner, [has] [have] been satisfactorily tested, [is] [are] ready for operation, and that Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the unit[s] on Date: _____ Time: _____.

CERTIFIED BY: _____ DATE: _____
(SIGNATURE OF MANUFACTURER'S REPRESENTATIVE)

OWNER'S ACKNOWLEDGMENT OF MANUFACTURER'S INSTRUCTION

[I] [We] the undersigned, authorized representatives of the _____ and/or Plant Operating Personnel have received classroom and hands on instruction on the operation, lubrication, and maintenance of the subject equipment and [am] [are] prepared to assume normal operational responsibility for the equipment:

_____ DATE: _____

_____ DATE: _____

_____ DATE: _____

O&M Manual Review Checklist

Submittal No.: _____

Project No.: _____

Manufacturer: _____

Equipment Submitted: _____

Specification Section: _____

Date of Submittal:

	General Data	
1.	Are the area representative's name, address, e-mail address and telephone number included?	
2.	Is the nameplate data for each component included?	
3.	Are all associated components related to the specific equipment included?	
4.	Is non-pertinent data crossed out or deleted?	
5.	Are drawings neatly folded and/or inserted into packets?	
6.	Are all pages properly aligned and scanned legibly?	
7.	Is the .PDF document bookmarked according to the table of contents?	
Operations and Maintenance Data		
8.	Is an overview description of the equipment and/or process included?	
9.	Does the description include the practical theory of operation?	
10.	Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?	
11.	Are alarm and shutdown conditions specific to the equipment provided on this project clearly identified? Does it describe possible causes and recommended remedies?	
12.	Are step procedures for starting, stopping, and troubleshooting specific to the equipment provided included?	
13.	Is a list of operational parameters to monitor and record specific to the equipment provided included?	
14.	Is a proposed operating log sheet specific to the equipment provided included?	
15.	Is a spare parts inventory list included for each component?	
16.	Is a lubrication schedule for each component specific to the equipment provided included - or does it clearly state “No Lubrication Required"?	
17.	Is a maintenance schedule for each component specific to the equipment provided included?	
18..	Is a copy of the warranty information included?	

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Asset Management Form- Example

Asset # - To be assigned by the City of Georgetown	Location - Address	Internal Site Location	Commission Date - Date Accepted	Description	Position	Category	Manufacturer	Serial Number	Model	Revision	Organizati	Department	Items that are considered assests and should be reflected in the form are listed below. City of Georgetown may require additonal items to be captured as needed.
	1010 Crockett Gardens	HSPS - Pump Pad	5/31/2025	High Service Pump	Pump #1	Centrifugal	Flowserve	2012NNH00121-1	VPC-15FBL-2		GUS	U-WOPS	Pumps
	1011 Crockett Gardens	HSPS - Pump Pad	5/31/2026	Cla-valve	Pump #1	Valve	Cla Val	60-08-366F	16" 60-08BY		GUS	U-WOPS	Motors
	1012 Crockett Gardens	HSPS - Pump Pad	5/31/2027	Solenoid	Pump #1	Solenoid	ACSOX	22027005	16" 60-08BY		GUS	U-WOPS	Motor Starters

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
3) Submit Record Digital Data Files and one set(s) of plots.
4) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit Record Digital Data Files and three set(s) of Record Digital Data File plots.

3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Work Change Directive.
k. Changes made following Engineer's written orders.
l. Details not on the original Contract Drawings.

m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
2. Format: DWG
3. Format: Annotated PDF electronic file with comment function enabled.
4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
5. Refer instances of uncertainty to Engineer for resolution.
6. Engineer will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

a. See Section 013100 "Project Management and Coordination" for requirements related to use of Engineer's digital data files.
b. Engineer will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Engineer.
e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

B. Format: Submit Record Specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours. As a prerequisite for monthly progress payments, exhibit the updated record documents for review by Owner and Engineer for accuracy and completeness.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017839

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For facilitator and videographer.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Engineer.

d. Name of Contractor.
e. Date of video recording.

2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
4. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Engineer.

1.7 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.

c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Engineer will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral and a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode.

1. Submit video recordings on thumb drive and/or by uploading to web-based Project software site.
2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.

4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:

    a. Name of Contractor/Installer.
    b. Business address.
    c. Business phone number.
    d. Point of contact.
    e. Email address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

1. Film training session(s) in segments not to exceed 15 minutes.

    a. Produce segments to present a single significant piece of equipment per segment.
    b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
    c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017900

SECTION 018819 - TIGHTNESS TESTING PERFORMANCE REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Tightness testing of cast-in-place reinforced concrete liquid retaining structures.

B. Related Requirements:

1. Section 031500 "Concrete Joints and Accessories" for joints in concrete structures.
2. Section 033000 " Cast-In-Place Concrete" for concrete related construction.
3. Section 400551 “Common Requirements for Process Valves” for valves and valve actuators.

1.3 INFORMATIONAL SUBMITTALS

A. Submit in accordance with Section 013300 “Submittal Procedures”:

1. Action Plan: Submit a detailed plan and schedule for each structure, which shows method of filling, testing and disposal of water.
2. Repair Procedures: Submit for acceptance the proposed repair methods, materials, and modifications needed, if structure does not meet tightness testing.

3. Test Reports: Submit a completed Tightness Test Report, Figure A, appended at the end of this Section of each test for each structure.

1.4 FIELD CONDITIONS

A. Coordinate timing and procedures for obtaining water for testing, structure testing, and water disposal with the Owner a minimum of 30 days in advance of actual testing.

B. Water Source:

1. Provide water for testing independent from Owner’s water source.
2. Use water for testing from Owner’s plant water system. Obtain water at a time, flow rate, and location approved by Owner.
3. Provide labor, materials, equipment, incidentals, and power required to convey water to the structure.

C. Water Disposal:

1. Dispose of test water in an approved manner. Do not dispose by discharging onto the ground surface of public or private land.
2. Coordinate disposal of test water by reintroduction into the Plant process at a time, flow rate, and location with Owner.
3. Provide labor, materials, equipment, incidentals, and power required to convey water from the structure.

D. Environmental Conditions: Do not schedule test measurements for a period when the weather forecast indicates a substantial change in weather patterns that would affect testing. Do not schedule test measurements when weather forecast indicates water surface would be frozen before test is completed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Perform tightness testing of cast-in-place reinforced concrete liquid retaining structures conforming to ACI 350.1 and as specified herein.

B. Perform tightness tests prior to waterproofing and dampproofing and prior to placing backfill around structures in order to permit observation and detection of leakage points.

C. Individually test each cell of multi-cell tanks.

D. Multi-cell tanks may be tested as a single unit where indicated.

3.2 PREPARATION

A. Remove soil, mud, debris and all other contaminants from structures prior to initiating tightness tests. Flush floor and sumps with water to provide a clean surface that is ready for testing.

B. Prior to testing, temporarily seal or bulkhead inlet and outlet pipes not required to be operational for testing procedures.

C. Confirm that valves, slide gates, and watertight access/ hatch doors are completely closed. Repair and reset seals that do not completely close or leak. Test valves, slide gates, and watertight access doors for leakage in accordance with requirements of respective Sections as part of the preparation for final tightness testing under this Section.

3.3 EXAMINATION

A. Examine structures to be tested for potential leakage paths including cracks, voids, honeycombs, and unsealed joints. Repair such paths to prevent leakage prior to testing.

B. Proceed with testing only after unsatisfactory conditions have been corrected.

3.4 TESTING PROCEDURES

A. Testing Conditions:

1. Do not begin filling of reinforced concrete structure until concrete elements of the structure have attained specified design strength, but not less than 14 days after placement of all concrete elements.
2. Fill reinforced concrete structure not exceeding a rate of 4 feet per 1 hour.
3. To minimize water absorption by concrete during testing, fill reinforced concrete structure to maximum operating water surface level and maintain water at that level for at least 3 days, prior to beginning tightness tests. Observe the exterior surfaces of the structure in both the early mornings and late afternoons during 3 days prior to tightness testing. Note any water observed on the structure exterior surfaces.
4. Test only a single structure at a time. Concurrent testing of contiguous or adjacent structures will not be allowed.

B. Testing Procedures:

1. Test Duration / Test Period: At least the time required to lower the water surface 3/8 inch (9.5 mm), assuming a loss of water at the maximum allowable rate, but not longer than 5 days
2. Measure water surface elevations at 24-hour intervals. The vertical distance to the water surface shall be measured to within 1/16 inch from a fixed point on the structure above the water surface. Measure water surface elevations at the same four locations, 90 degrees apart. Record water temperature 18 inches below water surface when taking the first and last sets of measurements.

    a. Use methods to determine amount of precipitation or evaporation as approved by the Engineer.

3. Compute percentage of water volume loss based on measured change in water surface elevation, area of the horizontal water surface, initial water volume, and correction for precipitation or evaporation where applicable.
4. Restart test when test measurements become unreliable due to unusual precipitation or other external factors.

C. Reports: Prepare and submit as referenced in this Section.

3.5 ACCEPTANCE

A. Following conditions are considered as not meeting the criteria for acceptance, regardless of actual loss of water volume from the structure:

1. Groundwater seeping or flowing into the structure through floors, walls, or wall-floor joints.
2. Structures which exhibit seeping or flowing water from joints, cracks, voids, honeycombs, or from beneath the foundation.

3. Increased flow from underdrain system during tightness testing.
4. Damp spots on concrete surfaces.
5. Moisture can be deposited on a dry hand held against the exterior surface of the structure.

B. Tightness of concrete tanks and structures will be considered acceptable when the conditions of conditions included in paragraph above are not present and when loss of water volume does not exceed 0.05 percent of the starting volume per day.

3.6 REPAIRS AND RETESTING

A. Structures failing the tightness test and not exhibiting visible leakage may be retested after an additional stabilization period of 7 days. Structures failing this second test shall be repaired prior to further testing.

B. Retest repaired structures until the structure meets all requirements.

3.7 SCHEDULE

A. Test following structures for tightness:

1. Tank types include:

   a. Sodium Bisulfite Facility – new containment area detailed on SG-SF-1.
2. Wet well types include:
   a. Influent Channel upstream of wet well detailed on SG-SA sheets.
   b.

END OF SECTION 018819

FIGURE A

3.8 TIGHTNESS TEST REPORT

3.9 PROJECT _____SUBMITTED BY _____

3.10 STRUCTURE * _____TEST DATES _____

3.11 Allowable loss of water volume _____ percent in 24 hours

3.12 Measured loss of water volume _____ percent in 24 hours

3.13 TEST READINGS

3.14 Water Temperature at Start _____ [_____] degrees F

3.16 Water Temperature at End _____ [_____] degrees F

3.17 Operating Water Surface Level _____

			Water Surface Elevation				
Entry	Date**	Time	Location 1	Location 2	Location 3	Location 4	Initials**
0							
1							
2							
3							
4							
5							
Change in level (difference between entry 5 and entry 0)							
Average change in level (sum of change in level / 4)							
Correction for precipitation/evaporation							
Corrected change in level = CL =							
Measured percent water loss in 24 hrs. = $\frac{(CL) \times (\text{surface area}) \times (100)}{(\text{initial water volume}) (\text{number of test days})}$							

3.18 Notes and Field Observations **

_____

3.19 _____

3.20 _____

3.21 _____

3.22 _____

3.23 * Attach a sketch showing a plan of structure and measurement locations.

3.24 ** Place date and initials at the beginning of each entry.

END OF TIGHTNESS TEST REPORT FORM

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. General requirements for coordinating and scheduling commissioning activities.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of commissioning process test equipment, instrumentation, and tools.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

1. Section CIP3 “Summary of Work” for sequence of work and commissioning responsibilities.
2. Section 013300 "Submittal Procedures" for submittal procedure requirements for commissioning process.
3. Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
4. Section 017823 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal requirements.

1.3 DEFINITIONS

A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

B. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities. The scope of the commissioning process is defined in CIP3 “Summary of Work”.

C. Construction-Phase Commissioning-Process Completion: The stage of completion and acceptance of commissioning process when resolution of deficient conditions and issues

discovered during commissioning process and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date construction-phase commissioning-process completion is achieved. See Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.

1. Commissioning process is complete when the Work specified of this Section and related Sections has been completed and accepted, including, but not limited to, the following:

    a. Completion of tests and acceptance of test results.
    b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
    c. Comply with requirements in Section 017900 "Demonstration and Training."
    d. Completion and acceptance of submittals and reports.

D. Owner's Project Requirements: A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. For this project the Owner’s Requirements are specified in CIP3 “Summary of Work”.

E. Owner's Witness: Owner's Project Manager, or Engineer-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.

F. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

G. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning process.
2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning process.
3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning process.
4. Appointed team members shall have the authority to act on behalf of the entity they represent.

B. Members Appointed by Owner:
1. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning process.
2. Engineer, plus employees and consultants that Engineer may deem appropriate for a particular portion of the commissioning process.

1.5 INFORMATIONAL SUBMITTALS

A. Comply with requirements in Section 013300 "Submittal Procedures" for submittal procedure general requirements for commissioning process.

B. Commissioning Plan Information:

1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors performing the various commissioning requirements.
2. Schedule of commissioning activities, integrated with the Construction Schedule.
3. Contractor personnel and subcontractors participating in each test.
4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. List test instrumentation, equipment, and monitoring devices. Include the following information:

1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
2. Brief description of intended use.
3. Calibration record showing the following:

    a. Calibration agency, including name and contact information.
    b. Last date of calibration.
    c. Range of values for which calibration is valid.
    d. Certification of accuracy.
    e. Certification for calibration equipment traceable to NIST.
    f. Due date of the next calibration.

F. Test Reports:

1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
3. Commissioning Issue Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit printout of log of alarms that occurred since the last log was printed.

G. Construction Checklists:

1. Material checks.

2. Installation checks.
3. Startup procedures, where required.

1.6 CLOSEOUT SUBMITTALS

A. Commissioning Report:

1. At Construction-Phase Commissioning Completion, include the following:

a. Pre-startup reports.
b. Approved test procedures.
c. Test data forms, completed and signed.
d. Progress reports.
e. Commissioning issue report log.
f. Commissioning issue reports showing resolution of issues.
g. Correspondence or other documents related to resolution of issues.
h. Other reports required by commissioning process.
i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction-Phase Commissioning Completion.
j. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction-Phase Commissioning Process Completion.

C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Commissioning Coordinator Qualifications:

1. Documented experience commissioning systems of similar complexity to those contained in these documents on at least three projects of similar scope and complexity.

B. Calibration Agency Qualifications: Certified by The American Association for Laboratory Accreditation that the calibration agency complies with minimum requirements of ISO/IEC 17025.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Test equipment and instrumentation required to perform the commissioning process shall remain the property of Contractor unless otherwise indicated.

B. Test equipment and instrumentation required to perform commissioning process shall comply with the following criteria:

1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
2. Calibrated and certified.

    a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags shall be permanently affixed.
    b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.

3. Maintain test equipment and instrumentation.
4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.

1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

2.3 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

1. Bind report in three-ring binders.
2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
3. Record report on compact disk.
4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

1. Include a table of contents and an index to each test.
2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include the following:

    a. Test specification.

b. Pre-startup reports.
c. Approved test procedures.
d. Test data forms, completed and signed.
e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 PREPARATION

A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.2 CONSTRUCTION CHECKLISTS

A. Construction checklists cannot modify or conflict with the Contract Documents.

B. Create construction checklists based on actual systems and equipment to be included in Project.

C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment if applicable.

1. Service connection requirements, including configuration, size, location, and other pertinent characteristics.
2. Included optional features.
3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness, and lack of damage.
4. Installation Checks:

a. Location according to Drawings and approved Shop Drawings.
b. Configuration.
c. Compliance with manufacturers' written installation instructions.
d. Attachment to structure.
e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
f. Utility connections are of the correct characteristics, as applicable.
g. Correct labeling and identification.
h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.

D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, at minimum.

E. Performance Tests:

1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.

F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, deferred construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify deferred construction checklists by number and title.
2. Provide a target schedule for completion of deferred construction checklists.
3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.

G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, delayed construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify delayed construction checklist by construction checklist number and title.
2. Provide a target schedule for completion of delayed construction checklists.
3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

3.3 GENERAL EXECUTION REQUIREMENTS

A. Schedule and coordinate commissioning process with the Construction Schedule.

B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.

C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.

D. Report test data and commissioning issue resolutions.

E. Schedule personnel to participate in and perform Commissioning-Process Work.

F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:

1. Operating the equipment and systems they install during tests.
2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

3.4 COMMISSIONING COORDINATOR RESPONSIBILITIES

A. Management and Coordination: Manage, schedule, and coordinate commissioning process, including, but not limited to, the following:

1. Coordinate with subcontractors on their commissioning responsibilities and activities.
2. Obtain, assemble, and submit commissioning documentation.
3. Conduct periodic on-site commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."
4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the Construction Schedule. Update Construction Schedule at specified intervals.
5. Review and comment on preliminary test procedures and data forms.
6. Report inconsistencies and issues in system operations.
7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
8. Direct and coordinate test demonstrations.
9. Coordinate witnessing of test demonstrations by Owner's witness.
10. Coordinate and manage training. Be present during training sessions to direct video recording, present training, and direct the training presentations of others. Comply with requirements in Section 017900 "Demonstration and Training."
11. Prepare and submit specified commissioning reports.
12. Track commissioning issues until resolution and retesting is successfully completed.
13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.
14. Assemble and submit commissioning report.

3.5 COMMISSIONING TESTING

A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.

B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will

coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.

C. Construction Checklists:

1. Complete construction checklists as Work is completed.
2. Distribute construction checklists to installing contractors before they start work.
3. Installers:

    a. Verify installation using approved construction checklists as Work proceeds.
    b. Complete and sign construction checklists work performed during the preceding period.

4. Provide Engineer access to construction checklists.

D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.

F. Test Procedures and Test Data Forms:

1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
3. Completed test data forms are the official records of the test results.
4. Provide preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
5. Engineer will review preliminary test procedures and test data forms, and provide comments within 14 days of receipt.

6. After Engineer has reviewed and commented on the preliminary test procedures and test data forms, Contractor will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

G. Performance of Tests:

1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.

2. Perform and complete each step of the approved test procedures in the order listed.
3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

H. Performance of Test Demonstration:

1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.
2. Notify Owner's witness at least three days in advance of each test demonstration.
3. Perform and complete each step of the approved test procedures in the order listed.
4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.

    a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness, and shall note the absence of Owner's witness at the scheduled time and place.

7. False load test requirements are specified in related sections.

    a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Engineer's written approval.

I. Deferred Tests:

1. Deferred Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction-Phase Commissioning

Completion. Identify proposed deferred tests in the request for Certificate of Construction-Phase Commissioning Process Completion as follows:

a. Identify deferred tests by number and title.
b. Provide a target schedule for completion of deferred tests.

2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Engineer at least three working days (minimum) in advance of tests.
3. Where deferred tests are specified, coordinate participation of necessary personnel and of Engineer and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Engineer's approval of the proposed schedule.

J. Delayed Tests:

1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:

a. Identify delayed tests by test number and title.
b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.

2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Engineer at least three working days (minimum) in advance of tests.
3. Where delayed tests are approved, coordinate participation of necessary personnel and of Engineer, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Engineer's approval of the proposed schedule.

K. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.
2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:

a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
b. Submit commissioning compliance issue report form within 24 hours of the test.
c. Determine the cause of the failure.
d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.

5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.

    a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.
    b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
    c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
    d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.

6. Diagnose and correct failed test demonstrations as follows:

    a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
    b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
    c. Record the results of each step of the diagnostic procedure.
    d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
    e. Determine and record corrective measures.
    f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.

7. Retest:

    a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
    b. For each repeated test demonstration, submit a new test data form, marked "Retest."

8. Do not correct commissioning compliance issues during test demonstrations.

    a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

3.6 SEQUENCING

A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:

1. Construction Checklists:

a. Material checks.
b. Installation checks.
c. Startup, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
d. Performance Tests:

1) Static tests, as appropriate.
2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
3) Equipment and assembly performance tests.
4) System performance tests.
5) Intersystem performance tests.

2. Commissioning tests.

B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.

C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Engineer if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.

D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.7 SCHEDULING

A. Commence commissioning process as early in the construction period as possible.

B. Commissioning Schedule: Integrate commissioning activities into Construction Schedule.

1. Include detailed commissioning activities in monthly updated Construction Schedule and short-interval schedule submittals.
2. Schedule the start date and duration for the following commissioning activities:

a. Submittals.
b. Preliminary operation and maintenance manual submittals.

c. Installation checks.
d. Startup, where required.
e. Performance tests.
f. Performance test demonstrations.
g. Commissioning tests.
h. Commissioning test demonstrations.

3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
4. Determine milestones and prerequisites for commissioning process. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short-interval schedule submittals.

C. Two-Week Look-Ahead Commissioning Schedule:

1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning process.
2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

D. Owner's Witness Coordination:

1. Coordinate Owner's witness participation via Engineer.
2. Notify Engineer of commissioning schedule changes at least two work days in advance for activities requiring the participation of Owner's witness.

3.8 COMMISSIONING REPORTS

A. Test Reports:

1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:

a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.
c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.

e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.

2. Test data reports include the following:

   a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
   b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
   c. Signatures of individuals performing and witnessing tests.
   d. Data trend logs accumulated overnight from the previous day of testing.

3. Commissioning Compliance Issue Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:

   a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
   b. Action distribution list.
   c. Report date.
   d. Test number and description.
   e. Equipment identification and location.
   f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
   g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
   h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
   i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
   j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
   k. Schedule for retesting.

4. Weekly progress reports include information for tests conducted since the preceding report and the following:

   a. Completed data forms.
   b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
   c. Activities scheduled but not conducted per schedule.
   d. Commissioning compliance issue report log.
   e. Schedule changes for remaining Commissioning-Process Work, if any.

5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.

    a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
    b. Attach to the data form printed trend log data collected during the test or test demonstration.
    c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.

6. System Alarm Logs: Record and print out log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."

    a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.

3.9 CERTIFICATE OF CONSTRUCTION-PHASE COMMISSIONING PROCESS COMPLETION

A. When Contractor considers that construction-phase commissioning process, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Engineer a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning process.

B. On receipt of Contractor's list, Engineer will make an inspection to determine whether the construction-phase commissioning process or designated portion thereof is complete. If Engineer’s inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction-Phase Commissioning Process Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction-Phase Commissioning Process Completion, complete or correct such items on notification by Engineer. In such case, Contractor shall then submit a request for another inspection by Engineer to determine construction-phase commissioning process completion.

C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning process. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Engineer's services and expenses made necessary thereby, shall be at Contractor's expense.

D. When construction-phase commissioning process or designated portion is complete, Engineer will prepare a Certificate of Construction-Phase Commissioning Process Completion that shall establish the date of completion of construction-phase commissioning process. Certificate of Construction-Phase Commissioning Process Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION 019113

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SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
3. Section 017300 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove Hazardous Materials: Isolate and remove hazardous materials from existing construction and properly dispose as required by existing regulations.

C. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and discuss with Owner for reuse or storage.

D. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

E. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

F. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

E. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 4 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

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SECTION 025731 - KARST VOID MITIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Notification requirements.
2. Mitigation measures for significant voids and water flow features discovered in bedrock during excavation activities.

B. Related Requirements:
1. Pipe excavation, trenching, embedment, encasement and backfilling are included in Section G4.
2. Granular fill materials are included in Section G5.
3. Sedimentation and erosion control are included in Section G6.
4. Submittals are in included in Section CIP10.
5. Trench Safety Requirements are included in Section CIP11.
6. Concrete for structures is included in Section C2.
7. Flowable backfill is included in Section C9.

1.3 DEFINITIONS

A. Void Type Grade 1: Opening in rock measuring more than 1 cubic foot (e.g., 1 foot by 1 foot by 1 foot), but less than 18 cubic feet (e.g., 2 feet by 3 feet by 3 feet).

B. Void Type Grade 2: Opening in rock measuring 18 cubic feet or more but less than 160 cubic feet (e.g., 4 feet by 4 feet by 10 feet or 2 feet by 2 feet by 20 feet).

C. Void Type Grade 3: Opening in rock measuring 160 cubic feet or more . A specifically designed mitigation measure will typically be required for this size void.

D. Local Regulatory Authority: The Texas Commission on Environmental Quality.

E. Geologist: A licensed Professional Geologist, registered in the State of Texas, hired by either the Engineer or Contractor.

F. Qualified Geophysical Testing Firm: A firm with a Professional Geologist licensed in the State of Texas with a minimum of 5 years of experience performing geophysical testing, including ground penetrating radar (GPR) and other applicable test methods to identify potential

subsurface voids. When required, this firm will be hired by the Contractor and is to provide independent site evaluation.

1.4 UNIT PRICES

A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.

1. 24 inches outside of concrete forms other than at footings.
2. 12 inches outside of concrete forms at footings.
3. 6 inches outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
5. 24 inches beneath bottom of concrete slabs-on-grade.
6. 12 inches beneath pipe in trenches, and greater of 24 inches wider than pipe or 42 inches wide.

B. Void Mitigation:

1. Description: Includes replacement with approved materials, including all labor, materials, equipment and all appurtenances.
2. Unit of Measurement: By cubic yard.

C. Excavation:

1. Description: Includes authorized additional excavation.
2. Unit of Measurement: By cubic yard.

D. Hard Rock:

1. Description: Includes hard rock.
2. Unit of Measurement: By cubic yard.

E. Concrete:

1. Description: Includes concrete for plugging.
2. Unit of Measurement: By cubic yard.

F. Grout:

1. Description: Includes grout for plugging.
2. Unit of Measurement: By cubic yard.

G. Geotextile Fabric:

1. Description: Includes geotextile fabric.
2. Unit of Measurement: By square yard.

H. Permanent Turf Reinforcement Mat (PTRM):

1. Description: Includes permanent turf reinforcement mat.
2. Unit of Measurement: By square yard.

I. Rock-Filled Polypropylene Bags:

1. Description: Includes bags and sand/rock fill.
2. Unit of Measurement: By cubic yard.

1.5 INSTALLATION CONFERENCE

A. In-field Conference: Conduct in-field conference at void location with Owner's Representative, Engineer and Engineer's Geologist, prior to proceeding with mitigation.

1.6 ACTION SUBMITTALS

A. Material Data and Certification: For each type of material to be used. Submit prior to start of construction to avoid delay in the event a void is encountered.

1. Flowable backfill.
2. Concrete.
3. Hard Rock.
4. Filter fabric.
5. Permanent turf reinforcement mat.
6. Polypropylene bags filled with pea gravel.
7. Other materials as specified herein and shown on the Drawings.

B. Shop Drawings: Provided by the qualified licensed consulting Geologist registered in the State of Texas.

1. Include plans, sections, and requirements for furnishing and installing mitigation measures significant voids and water flow features discovered in bedrock during excavation activities of a project.
2. Provide field sketches and photographs documenting any void mitigation measures installed during construction.
3. Pipe wall crushing and deflection calculations, as appropriate for flowable fill backfill associated with Class III Void Mitigation Measures.

1.7 CLOSEOUT SUBMITTALS

A. Project Closeout: For project closeout submittal, refer to Section CIP 14 Project Closeout.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1021 for testing indicated.

B. Testing Agency Qualifications: Member company of ANSI/NETA or Nationally Recognized Testing Laboratory (NRTL).

1.9 SITE CONDITIONS

A. Visit site of work and examine premises to verify existing conditions relative to work.

B. Notify Engineer and Owner in writing within 24 hours of a discovered void that meets any of the following criteria:

1. Is at least one square foot in total area.
2. Blows air from within substrate.
3. Consistently receives water during any rain event.
4. Potentially transmits groundwater.

C. Discontinue construction within 50 feet of void extents until mitigation measures are reviewed and approved by Owner and Engineer.

1. Construction may only proceed after mitigation measures are reviewed and approved by the Engineer, Owner and Local Regulatory Authority, if applicable.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hard Rock:

1. Hardness: Greater than 7 on the Mohs hardness scale.
2. Size: 3 inches in smallest dimension and 5 inches in largest dimension.
3. Open-graded with details and fines removed.
4. Durable, sound material not susceptible to degradation due to presence of water.

B. Controlled Low Strength Material (Flowable Fill):

1. Meet requirements for flowable fill included in Section C9.

C. Low Slump Concrete:

1. Meet requirements for curb and gutter, hand-vibrated concrete as specified in Section C1.
   a. Maximum 3-inch slump.
   b. 3,500 psi concrete mixtures allowed or required by the Local Regulatory Authority that meet the same specification will be accepted as an alternate on a case-by-case basis.

D. Pea Gravel:

1. Meet requirements of pea gravel backfill included in Section G5.

E. Pipe:

1. All pipe used for Air and Moisture continuity shall comply with ASTM D1785 schedule 40 PVC.

2.2 GEOTEXTILES

A. Filter Fabric:

1. Meet requirements for silt fence fabric filter fabric included in Section G6.

B. Polypropylene Bags for Pea Gravel:

1. Description:
   a. Non-biodegradable, UV-resistant, woven geotextile fabric.
   b. Material: Polyester Polypropylene or Polyethylene.
   c. Edges: Selvaged or finished to prevent separation of outer material.
   d. Calendar such that yarns will retain relative positions.
   e. Tied to be fully enclosed to prevent loss of internal material.

2. Performance Criteria:
   a. Minimum Bag Size: 14 inches wide by 24 inches long and 6 inches thick when filled.
   b. Nominal Weight Capacity: 50 lb.
   c. Minimum Fabric Denier: 1250.
   d. Minimum UV Rating: 4,000 hours.

C. Permanent Turf Reinforcement Mat (PTRM):

1. Non-Degradable Turf Reinforcement Mat: Meet specification requirements of United States Department of Transportation, Federal Highway Administration (FHWA) FP-03, Section 713.18.
2. Material: Nylon or other inert plastic not coated with chemical, substance or film.
3. Mesh Opening: Maximum 0.1 inch.

2.3 ACCESSORIES

A. Use products to tie and secure geotextile fabrics as recommended by geotextile manufacturer to prevent loss of internal material or movement of geotextile during performance of the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. At least 72 hours before completing each of the structure excavations listed in Section 312000 “Earthwork” to the prescribed elevations, depths and extents shown on the Drawings or specified for the Work, notify Contractor’s independent geophysical testing firm when required to perform geophysical evaluation of the completed excavation. Submit geophysical results and interpretation of potential voids to Engineer as required prior to beginning backfilling.

B. Upon notification of a void meeting conditions for mitigation, Owner will direct Engineer to establish appropriate permanent void and water flow mitigation measures. Engineer will arrange for an inspection of the void by a qualified licensed consulting Geologist registered in the State of Texas and hired by the Engineer.

C. If Engineer, Engineer's consulting Geologist or designated representative observes unusually large voids or unforeseen circumstances, other measures may be prescribed than those in this Section.

3.2 MITIGATION MEASURES

A. Class I Void Mitigation Measures: Temporary measures for a void at bottom of an excavation/trench or along a side wall of an excavation/trench.

1. Cover void opening with filter fabric.
   a. Minimum 3-foot distance from edge of void to edge of filter fabric.

2. Then cover void opening with plywood planking.
   a. Minimum 1-foot distance from edge of void to edge of planking. Planking is to be placed to prevent backfill from entering void.

3. Finally, place rock or concrete block over planking to keep planking secured.
   a. Minimum weight of 5 pounds.

B. Class II Void Mitigation Measures: Permanent measures for a void at bottom of an excavation/trench.

1. For void openings greater than 30-inches deep, Engineer will provide direction to either hand pack 3 to 5-inch hard rock to provide stable bearing support and cover rock at opening with filter fabric or backfill entire void with low slump concrete (3,500 psi).
2. If 3 to 5-inch hard rock used, place low slump concrete (3,500 psi) to cover opening area and seal void at limits of excavation.
   a. Concrete: Minimum 18 inches thick within void opening extending minimum of 6 inches beyond edge of void.
   b. Seal void openings less than 30 inches deep entirely with concrete. Use form to ensure proper placement of a low slump concrete-seal.
   c. After void is covered, place flowable fill as bedding and backfill extending a minimum of 5 feet beyond edge of all voids in all directions.

3. For Class II voids, additional measures may be specified by Engineer, Engineer's consulting Geologist or Local Regulatory Agency representative (e.g., increase thickness of concrete and placement of rebar reinforcement in concrete, placement of a steel plate over void opening, etc.).

C. Class III Void Mitigation Measures: Permanent measures in wall of an excavation/trench.

1. Hand pack 3 to 5-inch hard rock to provide stable bearing support and cover rock at opening with filter fabric.
2. Hand pack void area with pea gravel-filled sealed polypropylene bags to provide stable bearing support to protect a void from infiltration of backfill material.
3. If a void is greater than 100 cubic feet or is located within a rock stratum that is structurally unstable, as determined by the Engineer or Engineer's consulting Geologist, use 3 to 5-inch hard rock behind gravel-filled polypropylene bags to prevent ground collapse.

4. As required by Engineer, Engineer's consulting Geologist or Local Regulatory Authority representative, connector pipes may be required to maintain air or water flow within a void bisected by excavation/trench.
5. After a void is filled, place low slump concrete (3,500 psi) to seal void opening. If needed, place a form to ensure a minimum thickness of concrete extends at least 18 inches into void.
6. In trenches, provide secondary containment of wastewater and storm sewer lines by outer carrier pipe or low slump concrete (3,500 psi) or flowable fill encasement.
    a. Design of carrier pipe must be reviewed by Engineer for all wastewater and storm sewer lines prior to approval of the mitigation plan by the Local Regulatory Authority. Provide stabilizing collars and other supports.
    b. Low Slump Concrete or Flowable Fill Encasement: Minimum 6-inch thickness on all sides of pipe extending minimum of 5 feet beyond edge of any voids.
    c. If flowable fill encasement is proposed, submit pipe deflection and wall crushing calculations.

D. Class IV Void Mitigation Measures: Will not be used for this project.

E. Class V Void Mitigation Measures: Permanent measures for a void which extends through excavation/trench and contains actively flowing water.

1. Place Low Slump Concrete or Flowable Fill material into excavation or along pipe length as directed by Engineer or designated representative.
2. Place pea-gravel backfill material wrapped in PTRM one foot beyond limits of void in all directions. Place PTRM along areas between gravel material and trench walls/earth backfill overlapping at top.
3. Place minimum 3 feet of Low Slump Concrete or Flowable Fill into excavation or along pipe length on either side of gravel backfill material extending minimum of 1 foot above gravel backfill material. Use forms to control placement of concrete or flowable backfill material.

F. For very large voids, Engineer's Geologist will conduct a cave stability analysis and define specific mitigation measures. Implement specific mitigation measures per direction of Engineer or designated representative after the mitigation plan is approved by the Local Regulatory Authority.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Engineer will engage a qualified licensed Geologist to perform the following inspections.

1. Geologic and biologic inspection for temporary void protection.
2. Second void or water flow feature inspection.
3. Once daily inspections during excavation operations and prior to backfilling excavation/trench.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

END OF SECTION 02 57 31

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SECTION 030130.71 - MODIFICATIONS TO EXISTING CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Cutting, removing, or modifying parts of existing concrete structures or appurtenances.
   2. Addressing existing steel reinforcing bars encountered.
   3. Bonding new concrete or grout to existing concrete.

B. Related Requirements:
   1. Section 031000 “Concrete Forming and Accessories” for formwork and related repair work.
   2. Section 032000 “Concrete Reinforcing” for reinforcing and related repair work.
   3. Section 033000 “Cast-In-Place Concrete” for concrete materials, and related work.
   4. Section 031500 “Concrete Joints and Accessories” for related work.
   5. Section 033500 “Concrete Finishing” for related work.
   6. Section 033900 “Concrete Curing” for related work.
   7. Section 036000 “Grouting” for grout and related accessories.
   8. Section 050519 “Post-Installed Anchors” for anchors and related accessories.
   9. Section 051200 “Structural Steel Framing” for related work.
   10. Section 055000 “Metal Fabrications” for various metals and related fabrications.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to modifications to existing concrete including, but not limited to, the following:
      a. Verify specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
      b. Materials, material application, sequencing, tolerances, and required clearances.
      c. Quality-control program.
      d. Coordination with building occupants.
   2. Attendees:
      a. Owner.
      b. Resident Engineer.
      c. Contractor.
      d. Engineer.
      e. Manufacturer Representative.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Submit manufacturer's technical literature and installation instructions that include:
      a. Current printed recommendations and product data sheets for products including performance criteria, product life, working time after mixing, surface preparation and application requirements and procedures, curing, volatile organic compound data, and safety requirements.
      b. Storage requirements including temperature, humidity, and ventilation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Documentation of the qualifications for Contractor qualifications, Manufacturer's qualifications, and Contractor's supervisor as specified in Part 1 “Quality Assurance” Article.

B. Material Certificates: For each material provided.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Have a minimum of ten years’ experience within last 10 years in manufacture and use of specified products and have an ongoing program of training, certifying, and technically supporting Contractor's personnel.

B. Contractor Qualifications: Complete a program of instruction in application of approved manufacturer's material and provide certification from manufacturer attesting to their training and status as an approved applicator.

C. Contractor's Supervisor: Have attended a training program sponsored by manufacturer supplying materials approved for this project.

D. Manufacturer’s Representative: A representative of product manufacturer who will visit the site for first three days of installation to give instructions to installation crew. Make periodic site visits to ensure products being installed are in accordance with published instructions.

E. Be solely responsible for workmanship and quality of modification work. Inspections by the manufacturer, Engineer, or others do not limit Contractor's responsibility for work quality.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials in original, new, and unopened packages and containers clearly labeled with the following information:
   1. Manufacturer's name.
   2. Name or title of material, and other product identification.
   3. Manufacturer's stock number and batch number.
   4. Date of manufacture.
   5. Instructions.
   6. Expiration date.

B. Storage: Store products in accordance with manufacturers' published recommendations and the following supplementary requirements:
   1. Store only approved materials on site and in locations as directed.
   2. Keep area clean and accessible.
   3. Comply with health and fire regulations including those of the Occupational Safety and Health Administration (OSHA).

C. Handling: Handle products carefully and in accordance with manufacturers' published recommendations and the following supplementary requirements:
   1. Prevent inclusion of foreign materials.
   2. Do not open containers or mix components until necessary preparatory work has been completed and application work will start immediately.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with this Section and applicable state and local regulations.

B. Epoxy Bonding Agent:
   1. Product: Two-component, solvent-free, asbestos-free moisture insensitive epoxy resin material used to bind plastic concrete to hardened concrete and complying with requirements of ASTM C881, Type V, Grade 2, Class C.

C. Epoxy Paste Adhesive:
   1. Product: Two-component, solvent-free, moisture insensitive epoxy resin material used as an adhesive for mating surfaces where the glue line is 1/8 inch or less and to bond fresh, plastic concrete to clean, sound hardened concrete and complying with requirements of ASTM C881, Type IV, Grade 3, Class C.

D. Repair Mortar (Polymer-Modified Portland Cement Mortar):
   1. Horizontal Surfaces:
      a. Product: Two-component polymer-modified, portland cement-based mortar used to repair horizontal surfaces with a migrating corrosion inhibitor and having a minimum compressive strength of 7,000 psi at 28 days tested in accordance with ASTM C881 or ASTM C109.
   2. Vertical and Overhead Surfaces:
      a. Product: Two-component polymer-modified, portland cement based, fast setting, non-sag mortar used to repair vertical and overhead surfaces with a migrating corrosion inhibitor and having a minimum compressive strength of 5,000 psi at 28 days tested in accordance with ASTM C881 or ASTM C109.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which modification work is to be installed, and notify Engineer in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting performance of the Work.

3.2 INSTALLATION - GENERAL

A. Do not shift, cut, remove, or otherwise altered existing structure or concrete until authorization is given by Engineer.

B. When removing materials from or making openings in existing structures, take precautions and erect necessary barriers, shoring and bracing, and other protective devices. Prevent damage to structures beyond limits necessary for new work, protect personnel, control dust, and to prevent damage to structures or contents by falling or flying debris.

C. Unless otherwise permitted, shown, or specified, cut existing concrete by line drilling.

D. Construction Tolerances: Comply with requirements specified elsewhere in Division 03, except as modified herein, and elsewhere in Contract Documents.

E. Make locations and phases of the work available for access by Engineer or other personnel designated by Engineer. Provide ventilation and safe access to the work.

F. Cut, remove, or otherwise modify parts of existing structures or appurtenances as indicated, specified, or as necessary to complete the work. Finishes, joints, reinforcements, sealants, and similar materials are specified in their respective Sections. Install work complying with requirements of this Section and as indicated.

G. Locations, details, and limits of modifications are indicated on Drawings. Comply with requirements of this Section and as indicated on Drawings.

H. Examine areas and conditions under which modification work is to be installed, and notify Engineer in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

I. Store, mix, apply, and cure materials in strict compliance with manufacturer's instructions.

J. Where concrete is to be modified near an expansion joint or control joint, preserve isolation between components on either side of the joint.

K. When drilling holes for dowels and bolts, stop drilling if reinforcing is encountered. Do not cut reinforcing without prior approval by Engineer. Relocate hole to avoid reinforcing as approved by Engineer.
   1. Identify reinforcing locations prior to drilling using reinforcing bar locators so that drill hole locations may be adjusted to avoid reinforcing interference.

L. Saw-cut edges for modification areas vertically and horizontally straight. Make intersecting cuts perpendicular to each other.

M. Stop saw cutting if reinforcing is encountered. Do not cut reinforcing without prior approval by Engineer. Identify reinforcing locations within 1 foot of saw cut locations in any direction prior to saw cutting using reinforcing bar locators.

N. Clean concrete surfaces of efflorescence, deteriorated concrete, dirt, laitance, and existing repair materials such as liners, adhesives, and epoxies. Remove foreign matter and deleterious films by sandblasting, oil-free air-blasting, scarifying, or other mechanical means to sound original concrete.

O. Consolidate modification materials, completely filling portions of the area to be filled.

P. Bring finished surfaces into alignment with adjacent existing surfaces to provide a uniform, flush, and even surface. Match repair surfaces to adjacent existing surfaces in texture including any coatings or surface treatments that had been provided for the existing structure.

Q. Repair or replace concrete indicated or specified to be left in place that is damaged because of the work by approved means without additional compensation.

3.3 CONCRETE REMOVAL

A. When removing materials from or making openings in existing structures, take precautions and erect necessary barriers, shoring and bracing, and other protective devices. Prevent damage to structures beyond limits necessary for new work, protect personnel, control dust, and to prevent damage to structures or contents by falling or flying debris.

B. Concrete designated to be removed to specific limits indicated or directed by Engineer, perform saw cutting 1 inch deep at limits of removal followed by line drilling and chipping, sandblasting, or oil-free air blasting, as appropriate in the areas where concrete is to be taken out. Remove concrete such that surrounding concrete and existing reinforcing to be left in place and existing in place equipment are not damaged.
   1. Perform full thickness saw-cutting at limits of concrete to be removed only if indicated, herein specified, or after obtaining written approval from Engineer.

C. Where existing reinforcing is exposed due to cutting or line drilling and no new material is to be placed on cut surface, apply a 1/4 inch thick surface treatment of epoxy paste to entire cut surface.

D. Where joint between new concrete or grout and existing concrete will be exposed in finished work, remove concrete edge by making a 1 inch deep saw cut on each exposed surface of existing concrete or as indicated.

3.4 CONNECTION SURFACE PREPARATION

A. Concrete areas requiring patching, repairs, or modifications, prepare connection surfaces as specified, as indicated, or as directed by Engineer.

B. Remove loose and deteriorated materials, efflorescence, existing repair materials, dirt, oil, grease, and other bond inhibiting materials from concrete surface by dry mechanical means such as sandblasting, chipping, wire brushing, or other mechanical means as approved by Engineer.
   1. Uniformly roughen concrete surface to approximately 1/4 inch amplitude with pointed chipping tools. Thoroughly clean surface of loose or weakened material by sandblasting or air-blasting.
   2. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete.

C. If reinforcing steel is exposed, mechanically clean to remove loose material, contaminants, and rust as approved by Engineer. If half of reinforcing steel diameter is exposed, chip out behind the steel. Chip distance behind the steel to a minimum of 1 inch. Do not damage reinforcing to be incorporated in new concrete or repair mortar during removal operation.

D. Clean reinforcing from existing removed or deteriorated concrete that is shown to be incorporated in new concrete or repair mortar by mechanical means to remove loose material and products of corrosion before proceeding. Cut, bend, or lap to new reinforcing as indicated and provide with 1 inch minimum clear cover.

E. Use following specific concrete surface preparation Methods where indicated, specified, or as directed by Engineer:
   1. Method A:
      a. Roughen and clean existing concrete surface at connection.
      b. Thoroughly saturate surfaces with water; prevent standing water during application.
      c. Scrub repair mortar into substrate filling concrete pores and voids.
      d. While scrub coat is still plastic, force repair material against surface. Use epoxy bonding agent if area is too large.
      e. Place new repair mortar as detailed.
   2. Method B:
      a. Roughen and clean existing concrete surface at connection.
      b. Apply epoxy bonding agent at connection surfaces.
      c. Place new concrete or grout mixture to limits indicated within time constraints recommended by manufacturer to ensure bond.
   3. Method C:
      a. Use adhesive anchoring system, as specified in Section 050519 “Post-Installed Anchors and Reinforcing Bars”, for installation of reinforcing steel dowels into existing concrete where indicated.
      b. Perform installation complying strictly with manufacturer's recommendations, including drill bit diameter, surface preparation, injection, and installation of dowels.
      c. Drill concrete to embedded deformed bars to indicated depths.
      d. Use oil-free compressed air to blast out loose particles and dust from drilled holes. Clean dowels to be free of dirt, oil, grease, ice, or other deleterious material that would reduce bond.
      e. Concrete in existing structures is considered to have a strength of 3,000 psi.
   4. Method D:
      a. Combination of Method B & Method C.

3.5 GROUTING

A. Grout: As specified in Section 036000 “Grouting.”

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed installations.
   1. Perform inspection with Contractor, material installer, and Engineer present. Give minimum of 72 hours’ notice prior to time of inspection.
   2. Repair modifications not in conformance with Contract Documents in accordance with manufacturer's instructions at no additional cost to Owner.
   3. At completion of non-conforming repairs, Contractor, material installer, and Engineer shall reinspect the repaired problem areas.
   4. Prepare inspection reports, identifying acceptable work, type and locations of unacceptable work, and actions taken to correct unacceptable work.
   5. Complete field quality control work without additional compensation.

END OF SECTION 030130.71

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SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formwork for cast-in-place concrete.
2. Shoring, bracing, and anchorage.
3. Architectural form liners.
4. Form accessories.
5. Form stripping.
6. Delegated Design.

B. Related Requirements:

1. Section 032000 “Concrete Reinforcing” for reinforcing steel and required supports for cast-in-place concrete.
2. Section 033000 “Cast-in-Place Concrete” for cast-in-place concrete.
3. Section 033500 “Concrete Finishing.”
4. Section 050519 “Post-Installed Anchors and Reinforcing Bars” for testing of drilled in injection adhesive anchor system.
5. Section 055000 “Metal Fabrications” for product requirements for metal fabrications for placement by this Section.
6. Various Sections in Division 07: Product requirements for flashing reglets for placement by this Section.
7. Various Sections in Divisions 22 and 23 for product requirements for plumbing and HVAC items for placement by this Section.
8. Various Sections in Divisions 26 for product requirements for electrical items for placement by this Section.

1.3 DEFINITIONS

A. Structural Concrete: Concrete that is not architectural concrete.

1.4 COORDINATION

A. Coordinate Work of this Section with other Sections of Work in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

1.5 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information on void form materials and installation requirements.

B. Shop Drawings:

1. Indicate:

a. Formwork, shoring, and reshoring.
b. Pertinent dimensions, openings, details of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding, and bracing, and temporary supports.
c. Means of leakage prevention for concrete exposed to view in finished construction.
d. Notes to formwork erector showing size and location of conduits and piping embedded in concrete according to ACI 318.
e. Procedure and schedule for removal of shores and installation and removal of reshores.
f. Location and sequence of concrete placement.
g. Form release agent.
h. Form ties.

C. Review of submittals will be for appearance, performance, and strength of completed structure only. Approval by Engineer will not relieve Contractor of responsibility for the strength, safety, or correctness of methods used, the adequacy of equipment, or from carrying out the work as shown on Contract Documents.

1.6 DELEGATED DESIGN SUBMITTALS

A. Delegated Design Submittals:

1. Submit signed and sealed Shop Drawings with design calculations and assumptions for formwork shoring, and reshores.
2. Indicate loads transferred to structure during process of concreting, shoring, and reshoring.
3. Include signed and sealed structural calculations to support design for project records. Calculations will not be reviewed.

B. Delegated Design Structural Design Responsibility: Provide forms, shoring, and reshoring designed by a professional engineer registered in the State of Texas. Design formwork in accordance with the requirements of ACI 301, ACI 318 and ACI 347. Comply with all applicable regulations and codes. Consider any special requirements due to the use of plasticized and/or retarded set concrete.

1.7 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

C. Qualifications Statement:

1. Submit qualifications for licensed professional.

D. Certify form release agent is made for use in contact with potable water (non-toxic and free of taste and odor after 30 days). Certify that form release agent complies with Federal, State, and local VOC limitations.

E. Test Reports:

1. Compressive testing of degradable void forms – submit testing data for time-dependent compressive strength loss of degradable void forms exposed to a moist environment.

1.8 QUALITY ASSURANCE

A. Perform Work according to ACI 347, 301, and 318.

B. For wood products furnished for Work of this Section, comply with AF&PA.

C. Form liner manufacturer's representative: Be on-site during the initial installation of the form liner to instruct the Contractor on the proper methods of application and use of the liner. Be available to answer any questions on the liner that the Engineer may have.

D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in the State of the Project location.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Degradable Void Forms and Materials:

1. Inspection: Accept degradable void forms on Site in manufacturer's original packaging and inspect for damage.
2. Store in full compliance with the manufacturer’s recommendations.
3. Protect from the elements, wetting, moisture and dampness. Store in an elevated area off the ground under ventilated weathertight cover or in ventilated weathertight enclosures.
4. Do not use material that has become wet, damp, or otherwise damaged. Remove immediately from the site material which becomes wet, damp, or otherwise damaged and replace with new undamaged material at no additional cost to the Owner.

B. Store materials off ground in ventilated and protected manner to prevent deterioration from moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design formwork shoring, and reshores.

B. Design, engineer, and construct formwork, shoring, and bracing according to ACI 318 ACI 347, ACI 347.2R, conforming to Texas Building Code requirements to achieve concrete shapes, lines, and dimensions as indicated and required by project conditions.

C. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96, desiccant or water method.

2.2 FORMS, GENERAL

A. Make forms for cast-in-place concrete of wood, steel, or other approved materials. Design and construct all forms to provide a flat, uniform concrete surface requiring no grinding, repairs, or finishing except as specified in Section 033500 “Concrete Finishing.”

1. Construct wood forms of sound lumber or plywood free from knotholes and loose knots.
2. Construct steel forms to produce surfaces equivalent in smoothness and appearance to those produced by new plywood panels.

B. Provide rigid forms that will not deflect, move, or leak. Design forms to withstand high hydraulic pressures resulting from rapid filling of forms and heavy high frequency vibration of the concrete. Limit deflection to 1/400 of each component span. Lay out form joints in a uniform pattern or as indicated on Drawings.

C. Dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Tape, gasket, plug, or caulk joints and gaps in forms to provide watertight joints that will withstand placing pressures without exceeding specified deflection limit or creating surface patterns.

D. Provide 3/4 inch chamfer on form corners unless otherwise indicated.

2.3 FORMS FOR STRUCTURAL CONCRETE

A. Plywood Forms:

1. Make forms for exposed and non-submerged exterior and interior concrete of new and unused Plyform exterior grade plywood panels.
2. Species: Douglas fir or Spruce.
3. Grade: B grader or better.
4. Edges: Clean and true.
5. Exposed Concrete:

    a. Comply with APA/EWA PS 1.
    b. Panels: Full size, 4 by 8 feet.
    c. Label each panel with grade trademark of APA/EWA

6. Surfaces to Receive Membrane Waterproofing:

    a. Minimum Thickness: 5/8 inch.
    b. Grade: APA/EWA "B-B Plyform Structural I Exterior."

7. "Smooth Finish" Indicated on Drawings:

a. Minimum Thickness: 3/4 inch.
b. Grade: APA/EWA "HD Overlay Plyform Structural I Exterior."

8. Design and construct forms to provide a flat, uniform concrete surface requiring no grinding, repairs, or finishing, except as specified in Section 033500 “Concrete Finishing.”

B. Lumber Forms:

1. Applications: Edge forms and unexposed finish concrete.
2. Description:

a. Shiplapped or tongue and groove.
b. Surface boards on four sides.

3. Material: Standard grade, Douglas fir according to WCLIB Standard No. 17.
4. Width: 6 inches or 8 inches.

C. Preformed Steel Forms:

1. Description: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
2. Minimum Thickness: 16 gage.

D. FRP Forms: Matched, tightly fitted, and stiffened to support weight and pressure of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

E. Pan Forms:

1. Material: Steel.
2. Configuration: Size and profile as required.

F. Tubular Column Forms:

1. Description: Round spirally wound laminated fiber or wood.
2. Provide forms for circular structures that conform to circular shape of structure and where applicable the existing structure below. Straight panels may be substituted for circular panels if straight panels do not exceed two feet in width, deflect more than 3-1/2 degrees per joint, or conflict with specific notes indicated and panels conform with the existing structure below.

G. Void Forms:

1. Moisture-resistant treated paper faces; biodegradable.
2. Structurally sufficient to support weight of wet concrete and construction loads until concrete has attained specified design strength.
3. Thickness: 2 inches or 4 inches.

H. Steel Forms: Description: Sheet steel, suitably reinforced.

I. Smooth Form Liners: Smooth, durable, grainless, and non-staining hardboard unless otherwise indicated on Drawings.

J. Framing, Studding, and Bracing: Stud or No. 3 structural light-framing grade.

2.4 COATINGS

A. Coatings for Aluminum:

1. Polyamide epoxy finish coat with paint manufacturer's recommended primer for aluminum substrate.
2. One coat primer and one coat finish.

2.5 FORMWORK ACCESSORIES

A. Form Ties:

1. Type: Removable snap off; cone.
2. Material: Galvanized, carbon steel, or stainless steel.
3. Length: Adjustable.
4. Furnish waterproofing washer.
5. Free of defects capable of leaving holes larger than 1 inch in concrete surface.
6. Coil and Wire Ties: Provide ties manufactured so that after removal of projecting part, no metal remains within 1-1/2 inch of concrete face. The part of the tie to be removed shall be at least 1/2-inch diameter or be provided with a plastic or wooden cone at least 1/2 inch 1/2-inch diameter and 1-1/2 inch long. Provide cone washer type form ties in concrete exposed to view.
7. Flat Bar Ties for Panel Forms: Provide ties that have plastic or rubber inserts with a minimum depth of 1-1/2 inch and manufactured to permit patching of the tie hole.
8. Provide ties for liquid retaining structures and exterior below grade basement walls that have a steel waterstop tightly attached to each strut or that have a neoprene rubber washer on each strut.
9. Alternate form ties consisting of tapered through-bolts at least 1 inch in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of same minimum size may be used. Install in forms so that large end is, where applicable, on liquid or backfilled side of the wall. Clean, fill, and seal form tie hole with rubber plug installed from the liquid or backfilled side and non-shrink cement grout to provide watertight form tie holes. Make repairs needed to make watertight.
10. Alternate form ties specified in Paragraph above may be used when forms are to be set against previously placed or existing concrete walls. Use in conjunction with cast-in threaded inserts or drilled-in threaded anchors so that no metal remains within expansion joint upon removal of tapered through bolt. Conform to requirements specified in above Paragraph.

B. Spreaders:

1. Description: Standard, non-corrosive, metal-form clamp assembly of type acting as spreaders and leaving no metal within 1 inch of concrete face.
2. Wire ties, wood spreaders, or through bolts are not permitted.

C. Form Release Agent:

1. Description: Colorless mineral oil or form coating that will not stain concrete or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.
2. Form Release Agent. Coat form surfaces in contact with concrete with an effective, non-staining, non-residual, water based, bond-breaking form coating, unless otherwise indicated or specified. Use form release agent made for use in contact with potable water, non-toxic and free of taste and odor after 30 days. Form release agent shall not impair the bond of paint, sealant, waterproofing, dampproofing, or other coatings.
3. For concrete surfaces which are to be painted, use forms with high density overlay or a similar material which does not require a form release agent unless Contractor can substantiate to satisfaction of Engineer that form release agent will not remain on formed surface after it is stripped.

D. Bond Breaker:

1. Bond breakers for precast and tilt-up construction when cast against concrete shall be a non-staining, non-residual type, which will provide a positive bond prevention.
2. Acceptable Manufacturers: One of the following or equal:

    a. Dayton Superior Specialty Chemical Corporation: Sure-Lift (J-6).
    b. Universal Form Clamp Co: Super Clean and Tilt.
    c. Nox-Crete Products Group: Silcoseal Select.

E. Corners, Recesses for Joint Sealant, Rustications, and Drip Edges:

1. Type: Fillet,.
2. Provide rustications as indicated. Mill and plane smooth moldings for chamfers and rustications. Provide rustications and chamfer strips of nonabsorbent material, compatible with the form surface and fully sealed on all sides to prevent the loss of paste or water between the two surfaces.
3. Size: 3 inches on all sides.
4. Lengths: Maximum possible.

F. Dovetail Anchor Slot:

1. Material: Galvanized steel.
2. Thickness: 22 gage.
3. Filling: None.
4. Fasten slot to concrete formwork according to manufacturer instructions and insert foam filler to prevent concrete from entering slot during pour.

G. Flashing Reglets:

1. Material: Galvanized steel or Rigid PVC.
2. Thickness: 22 gage.
3. Lengths: Maximum possible.
4. Furnish alignment splines for joints.
5. Filling: None.
6. Fasten flashing reglet to concrete formwork according to manufacturer instructions, and insert foam to prevent concrete from entering reglet during pour.

H. Vapor Retarder:

1. Description: Polyethylene sheet.
2. Thickness: 8 mils.

I. Nails, Spikes, Lag Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines, levels, and centers before proceeding with formwork.

B. Verify that dimensions agree with Shop Drawings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Earth Forms: Not permitted.

B. Formwork:

1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Camber forms where necessary to produce level finished soffits unless indicated otherwise on Drawings.
4. Positioning:

    a. Carefully verify horizontal and vertical positions of forms.
    b. Correct misaligned or misplaced forms before placing concrete.

5. Complete wedging and bracing before placing concrete.
6. Erect formwork, shoring, and bracing according to ACI 301, ACI 318. and ACI 347.
7. Obtain approval of Engineer before framing openings in structural members not indicated on Drawings.
8. Install fillet and chamfer strips for corners, recesses for sealant, rustications, and drip edges on external exposed corners of beams, joists, columns, and walls.
9. Install void forms according to manufacturer instructions.
10. Form Release Agent:

    a. Apply according to manufacturer instructions.
    b. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

c. Do not apply form release agent if concrete surfaces are indicated to receive special finishes or applied coverings that may be affected by agent.
d. Soak inside surfaces of untreated forms with clean water, and keep surfaces coated prior to placement of concrete.
e. Apply form coatings before placing reinforcing steel.

11. Leave forms in place for minimum number of days according to ACI 347.
12. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and until the concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces.
13. Do not remove shores until concrete has attained at least 70 percent of its specified design strength and also sufficient to support safely its own weight and the construction live load on it.
14. Loosen forms carefully; do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
15. Stripping:

    a. Arrange and assemble formwork to permit dismantling and stripping.
    b. Do not damage concrete during stripping.
    c. Permit removal of remaining principal shores.

16. Be responsible for damage resulting from removal of forms and make repairs at no additional compensation. Leave in place forms and shoring for horizontal structural members in accordance with ACI 301 and ACI 347. Conform to requirements for form removal specified in Section 033000 “Cast-in-Place Concrete.”
17. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged.
18. Discard damaged forms.
19. Reuse and Coating of Forms:

    a. Thoroughly clean forms and reapply form coating before each reuse.
    b. For exposed Work, do not reuse forms with damaged faces or edges.
    c. Apply form coating to forms according to manufacturer instructions.
    d. Do not coat forms for concrete indicated to receive "scored finish."

20. Do not reuse wood formwork more than two times for concrete surfaces to be exposed to view.
21. Do not patch formwork.
22. Form Cleaning:

    a. Clean forms as erection proceeds to remove foreign matter within forms.
    b. Clean formed cavities of debris prior to placing concrete.
    c. Flush with water or use compressed air to remove remaining foreign matter.
    d. Ensure that water and debris drain to exterior through cleanout ports.
    e. Cold Weather:

        1) During cold weather, remove ice and snow from within forms.
        2) Do not use de-icing salts.

3) Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure; use compressed air or other dry method to remove foreign matter.

C. Forms for Smooth Finish Concrete:

1. Use steel, plywood, or lined-board forms.
2. Use clean and smooth plywood and smooth sheet form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install smooth sheet form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full-sized sheets of smooth sheet form liners and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Apply forming and strip wood forms in a manner to protect corners and edges.
7. Level and continue horizontal joints.

D. Forms for Surfaces to Receive Membrane Waterproofing:

1. Use plywood or steel forms.
2. After erection of forms, tape form joints to prevent protrusions in concrete.

E. Framing, Studding, and Bracing:

1. Framing, Studding, and Bracing: Stud or No. 3 structural light-framing grade.
2. Maximum Spacing of Studs:

    a. Boards: Maximum 16 inches o.c.
    b. Plywood: 12 inches o.c.

3. Size framing, bracing, centering, and supporting members for sufficient strength to maintain shape and position under imposed loads from construction operations.
4. Construct beam soffits of material minimum 2 inches thick.
5. Distribute bracing loads over base area on which bracing is erected.
6. When placed on ground, protect against undermining, settlement, and accidental impact.

F. Form Anchors and Hangers:

1. Do not use anchors and hangers leaving exposed metal at concrete surface.
2. Symmetrically arrange hangers supporting forms from structural-steel members to minimize twisting or rotation of member.
3. Penetration of structural-steel members is not permitted.

G. Inserts, Embedded Parts, and Openings:

1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Obtain installation and setting information for embedded items furnished under other Sections.
4. Securely anchor embedded items in correct location and alignment prior to placing concrete.

5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.
6. Install formed openings for items to be embedded in or passing through concrete Work.
7. Locate and set in place items required to be cast directly into concrete.
8. Install accessories straight, level, and plumb, and ensure that items are not disturbed during concrete placement.
9. Frame openings in concrete where indicated on Drawings.
10. Establish exact locations, sizes, and other conditions required for openings and attachment of Work specified under other Sections.
11. Coordinate Work to avoid cutting and patching of concrete after placement.
12. Temporary Openings:

    a. Provide temporary ports or openings in formwork as required to facilitate cleaning
    b. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
    c. Locate openings at bottom of forms to allow flushing water to drain.
    d. Remove chips, sawdust, and other debris.
    e. Thoroughly blow out forms with compressed air just before concrete is placed and inspection.
    f. Clean forms and surfaces against which concrete is to be placed.
    g. Close temporary openings with tight-fitting panels, flush with inside face of forms, and neatly fitted such that joints will not be apparent in exposed concrete surfaces.

H. Form Ties:

1. Provide sufficient strength and quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from edge of concrete.
3. Leave inner rods in concrete when forms are stripped.
4. Space form ties equidistant, symmetrical, and aligned vertically and horizontally unless indicated otherwise on Drawings.

I. Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

J. Construction Joints:

1. Install surfaced pouring strip where construction joints intersect on exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip, and tighten forms to conceal shrinkage.
3. Appearance:

    a. Show no overlapping of construction joints.
    b. Construct joints to present same appearance as butted plywood joints.

4. Arrange joints in continuous line straight, true, and sharp.

K. Embedded Items:

1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.

2. Do not embed wood or uncoated aluminum in concrete.
3. Obtain installation and setting information for embedded items furnished under other Sections.
4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.

L. Screeds:

1. Set screeds and establish levels for tops of and finish on concrete slabs.
2. Slope slabs to drain where required or as indicated on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete, thoroughly wet forms, and remove freestanding water.

M. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle-, pad-, or base-type screed supports that will not puncture membrane.
2. Staking through membrane is not permitted.

N. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
2. Clean forms and surfaces against which concrete is to be placed.
3. Remove chips, sawdust, and other debris.
4. Thoroughly blow out forms with compressed air just before concrete is placed.

3.3 TOLERANCES

A. Construct formwork to maintain tolerances according to ACI 301.

B. Camber:

1. According to ACI 301.

C. Formed Surface Including Mass Concrete, Pipe Encasement, Electrical Raceway Encasement and Other Similar Installations: No minimum requirements for surface irregularities and surface alignment. The overall dimensions of the concrete shall be plus or minus 1 inch from the intended surface indicated.

3.4 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect erected formwork, shoring, and bracing to ensure that Work complies with formwork design and that supports, fastenings, wedges, ties, and items are secure.
2. Notify Engineer after placement of reinforcing steel in forms at least six working hours prior to proposed concrete placement.

3. Schedule concrete placement to permit formwork inspection before placing concrete.
4. Failure of forms to comply with specified requirements or to produce concrete complying with requirements specified shall be grounds for rejection of that portion of concrete work. Repair or replace rejected work as directed by Engineer. Make required repair or replacement subject to requirements of these Specifications and approval of Engineer.

END OF SECTION 031000

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SECTION 031500 - CONCRETE JOINTS AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes construction of durable, watertight joints in concrete structures.

B. Related Requirements:

1. Section 031000 “Concrete Forming and Accessories” for formwork.
2. Section 032000 “Concrete Reinforcing” for reinforcing.
3. Section 033000 “Cast-In-Place Concrete” for cement, and related concrete products.
4. Section 033500 “Concrete Finishing” for concrete finish related work.
5. Section 033600 “Grout” for grout related work.
6. Section 030130.71 “Modifications to Existing Concrete”.
7. Section 055000 “Metal Fabrications” for various metal fabrications.

1.3 ACTION SUBMITTALS

A. Plastic Waterstops: Product data including sample, catalogue cut, dimensions, technical data, storage requirements, splicing methods, conformity to CRD standards, details, and samples of factory fabrications.

B. Thermoplastic Waterstops: Product data including sample, catalogue cut, dimensions, technical data, storage requirements, splicing methods, conformity to ASTM standards, details, and samples of factory fabrications.

C. Special Waterstops: Product data including location of use, sample, catalogue cut, technical data, storage requirements, splicing methods, installation instructions, and conformity to CRD, ASTM or FS standards, as applicable.

1. Injectable Waterstop Hose System: In addition to requirements specified above, submit applicator certification by manufacturer of injectable waterstop hose system. Submit manufacturer's specifications for cleaning and preparing surfaces to receive waterstop system and instructions for installation and injection. Include manufacturer product data confirming that materials are recommended for applications indicated and recommendations for inspection.

D. Premolded Joint Fillers: Product data including location of use, sample, catalogue cut, technical data, storage requirements, and conformity to ASTM standards.

E. Preformed Expansion Joint Material: Product data including location of use, catalogue cut, dimensions, technical data, storage requirements, installation instructions, and conformity to ASTM standards.

F. Bond Breaker: Product data including location of use, catalogue cut, technical data, storage requirements, and application instructions.

G. Expansion Joint Dowels: Product data on the complete assembly including dowel material, sizes and dimensions, coatings, expansion dowel caps, installation instructions and conformity to ASTM standards.

H. Sealant: Product data including location of use, catalogue cut, technical data, storage requirements, mixing and application instructions, and conformity to ASTM standards.

I. Neoprene Bearing Pads: Product data including location of use, sample, catalogue cut, dimensions, technical data, storage requirements, installation instructions, and conformity to AASHTO standards.

J. Shop Drawings:

1. Submit for injectable waterstop hose system.
2. Include layout, injection and, and details of hose system.

1.4 INFORMATIONAL SUBMITTALS

A. System and Material Certificates:

1. Certify that materials used within joint system are compatible with each other.
2. Certify that sealant is made for use in continuous immersion in contact with wastewater.

1.5 QUALITY ASSURANCE

A. Sealant Manufacturer’s Field Representative Qualifications:

1. Experience: Performed at least five projects of similar size and complexity within last five years. Be present at work site prior to mixing to instruct on mixing, application, and inspection procedures. Inspect finish of prepared surfaces prior to sealant application.
2. Make at least one additional visit to site as the work progresses and report on each visit to Contractor and the Engineer. Advise whether the application is in accordance with this Section and manufacturer's printed installation instructions.

B. Applicator Qualifications:

1. Install injectable waterstop hose system by an applicator certified by manufacturer.
2. Provide applicator of reinjectable waterstop hose system having a minimum of 5 years’ experience.

C. Installer Qualifications: Fabricator of products.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Use materials in a given joint that are compatible with one another. Coordinate selection of suppliers and products to provide compatibility. Do not use asphaltic bond breakers or asphaltic joint fillers in joints receiving sealant.

B. Product Experience: Provide plastic waterstops, thermoplastic waterstops, injectable waterstop hose system, expansive waterstops, and adhesive waterstops products specifically manufactured for intended purpose and have five years' successfully experience in similar applications.

2.2 MATERIALS - STANDARD WATERSTOPS

A. Plastic Waterstops: Conform to CRD C572, fabricate by extruding elastomeric plastic compound with virgin polyvinylchloride as basic resins and with compound containing no reprocessed materials. Incorporate an integral fastening system or provide with grommets or prepunched holes between outermost ribs at a spacing of 12 inches on center.

1. Waterstops For Expansion Joints:

    a. Type: Ribbed type waterstops with a center bulb.
    b. Minimum Tensile Strength: 1,750 psi per ASTM D638.
    c. Size: 9 inches by 3/8 inch.
    d. Acceptable Manufacturers: Provide products manufactured by one of the following or equal:

        1) Greenstreak Plastic Products: Style 696.
        2) Paul Murphy Plastics Co.: Style CR-9380.
        3) Vinylex Corp.: Style RLB9-38.

2. Waterstops For Non-Expansion Joints and Joints Indicated:

    a. Type: Ribbed type waterstops.
    b. Minimum Tensile Strength: 1,750 psi per ASTM D638.
    c. Size: 6 inches by 3/8 inch.
    d. Acceptable Manufacturers: Provide products manufactured by one of the following or equal:

        1) Greenstreak Plastic Products: Style 679.
        2) Paul Murphy Plastics Co.: Style FR-6380.
        3) Vinylex Corp.: Style R6-38.

3. Factory Fabrications:

    a. Provide factory fabrications for waterstop changes of direction, transitions, and intersections:

1) Intersections: Vertical ells, flat ells, vertical tees, flat tees, vertical crosses, flat crosses, and special, unusual, or complicated intersections including waterstop intersections of different sizes or configurations, and intersections due to joint offsets.

b. Make and inspect factory fabrications by waterstop manufacturer.
c. Provide stub ends of sufficient length to leave only straight butt joints for field splicing.

B. Thermoplastic Waterstops:

1. Waterstops: Fabricate from a fully vulcanized blend of EPDM and polypropylene, Thermoplastic Elastomeric Rubber (TPER), or Thermoplastic Vulcanizite (TPV). Provide material conforming to the following:

Tensile Strength:	2,000 psi per ASTM D638 (TPER) or 2,300 psi per ASTM D412 (TPV)
Elongation:	450 percent per ASTM D638 (TPER) or 530 percent per ASTM D412 (TPV)
100 percent Modulus:	1,000 psi per ASTM D638 (TPER) or 1,000 psi per ASTM D746 (TPV)
Brittle Temperature:	-70 degrees Fper ASTM D746
Hardness:	85 Shore A per ASTM D2240
Ozone Resistance:	Passed with no cracking at 450 pphm per ASTM D1171

1. Waterstops For Expansion Joints:

a. Type: Ribbed type waterstops with a center bulb.
b. Size: 9 inches by 3/8 inch.
c. Acceptable Manufacturers: Provide products manufactured by one of the following or equal:

1) JP Specialties: Earth Shield TPV, Style EYJP936 with brass eyelets at 12 inches on center.
2) Westec Barrier Technologies: Envirostop TPER, Style 620 with brass grommets at 12 inches on center.

2. Waterstops For Non-Expansion Joints and Joints Indicated:

a. Type: Ribbed type waterstops with a center bulb.
b. Size: 6 inches by 3/8 inch.
c. Acceptable Manufacturers: Provide products manufactured by one of the following or equal:

1) JP Specialties: Earth Shield TPV, Style EYJP636 with brass eyelets at 12 inches on center.
2) Westec Barrier Technologies: Envirostop TPER, Style 619 with brass grommets at 12 inches on center.

3. Factory Fabrications:

a. Provide factory fabrications for waterstop changes of direction, transitions, and intersections:

1) Intersections: Vertical ells, flat ells, vertical tees, flat tees, vertical crosses, flat crosses, and special, unusual, or complicated intersections including waterstop intersections of different sizes or configurations, and intersections due to joint offsets.

b. Make and inspect factory fabrications by waterstop manufacturer.
c. Provide stub ends of sufficient length to leave only straight butt joints for field splicing.

2.3 MATERIALS - SPECIAL WATERSTOPS

A. Base Seal PVC Waterstops:

1. Conform to CRD C572 and fabricate by extruding elastomeric plastic compound with virgin polyvinylchloride as basic resins with compound containing no reprocessed materials.
2. Minimum Tensile Strength: 1,750 psi per ASTM D638.
3. Basis-of-Design: Provide products as manufactured by Greenstreak Plastic Products, or equal:

a. Expansion Joints: Style 925.
b. Control Joints: Style 928.
c. Construction Joints: Style 927.

B. PVC Retrofit Waterstops for Non-Expansion Joints:

1. Conform to CRD C572 and fabricate by extruding elastomeric plastic compound with virgin polyvinylchloride as basic resins with compound containing no reprocessed materials.
2. Minimum Tensile Strength: 1,750 psi per ASTM D638.
3. Type: T profile.
4. Basis-of-Design: Provide products as manufactured by Greenstreak Plastic Products, or equal.

a. Style 609 system complete with Type 304 stainless steel batten bars and 1/4 inch diameter stainless steel expansion bolts.

C. Injectable Waterstop Hose System for Non-Expansion Joints Where Indicated.

1. System: Hose utilizing a spiral core enclosed within an exterior membrane, injectable grout or resin, anchoring clips, packers, and other required accessories.
2. Acceptable Manufacturers: Provide products manufactured by one of the following or equal:

a. BBZ USA, Inc.: Duroject Injection Hose with Multigel 850 Injection Resin.
b. De Neef Construction Chemicals, Inc.: Injecto Tube with Hydro Active Injecto Grout.

D. Expansive Waterstops for Construction Joints Where Indicated:

1. Type A - Preformed Bentonite and Butyl Rubber Based System:

a. Installation Adhesives: Use with expansive waterstops as recommended by waterstop manufacturer.
b. Acceptable Manufacturers: Provide products manufactured by one of the following or equal:

1) Colloid Environmental Technologies Company: Volclay Waterstop-RX101.
2) Greenstreak Plastic Products: 3/4-inch by 1-inch Swellstop.
3) W.R. Grace: Adcor ES.

2. Type B - Preformed Hydrophilic Rubber Strips:

a. Installation Adhesives: Use with expansive waterstops as recommended by waterstop manufacturer.
b. Acceptable Manufacturers: Provide products manufactured by one of the following or equal:

1) Greenstreak Plastic Products: Hydrotite CJ-1020-2K.
2) Mitsubishi: Adeka Ultraseal MC-2010MN.
3) W.R. Grace: Adcor ES.

E. Preformed Adhesive Waterstops for Construction Joints Where Indicated.

1. System: Rope type preformed plastic waterstop meeting requirements of Federal Specification SS-S-210A.
2. Cross-Sectional Area: Approximately one square inch, unless otherwise indicated.
3. Primer: As recommended by waterstop manufacturer.
4. Basis-of-Design: Provide products as manufactured by Henry Company, or equal:

a. Synko-Flex Waterstop SF-302.

2.4 MATERIALS - ACCESSORIES

A. Premolded Joint Filler - Structures: ASTM D1752, Type III, self-expanding cork.

1. Thickness: 1 inch, unless otherwise indicated.

B. Bond Breaker:

1. Bond Breaker Tape: Adhesive-backed glazed butyl or polyethylene tape that adheres to premolded joint filler or concrete surface. Provide tape of same width as the joint.
2. Bond breaker for concrete other than where tape is indicated or specified: Either bond breaker tape or a non-staining type bond prevention coating.

a. Acceptable Coating Manufacturers: Provide products manufactured by one of the following or equal:

1) Cresset Chemical Company: Crete-Lease Bond Breaker for Tilt-Up.

2) Dayton Superior: Sure-Lift J-6 WB.
3) Nox-Crete: Silcoseal Select.

3. Bond Breaker for Expansion Joint Dowels: ASTM C309, Type 2, Class A, water-based white pigmented curing compound.

C. Preformed Expansion Joint Material: Non-extrudable watertight strip material used to fill expansion joints between structures meeting following criteria:

1. Compressibility: Capable of being compressed at least 40 percent for 70 hours at 68 degrees F and subsequently recovering at least 20 percent of its original thickness in first 30 minutes after unloading.
2. Basis-of-Design: Provide products as manufactured by Chase Construction Products, or equal:

a. Phyzite 380.

D. Expansion Joint Dowels: Smooth undeformed steel bars conforming to ASTM A615, Grade 60.

1. Provide dowels straight and clean, free of loose flaky rust, and loose scale.
2. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04 inch of dowel diameter and extends no more than 0.04 inch from the end.
3. Coat bars with a bond breaker on expansion end of dowel. Provide expansion dowel caps on the expansion end.

a. Acceptable Manufacturers for Expansion Dowel Caps: Provide products manufactured by one of the following or equal:

1) Dayton Superior Corporation: Style K-11.
2) Heckmann Building Products, Inc.: No. 87.
3) Meadow Steel Products, Inc.: Style 3070 Expansion Tube.

E. Neoprene Bearing Pads: 50 durometer conforming to AASHTO Standard Specifications for Highway Bridges.

F. Grout: Non-metallic, non-shrinking as specified in Section 033600 “Grouting.”

2.5 MATERIALS - SEALANTS

A. Sealant:

1. Comply with ASTM C920 for following conditions:

a. Sealant for Joints in Horizontal Surfaces: Type S or M, Grade P or NS, Class 25.
b. Sealant for Joints in Sloping and Vertical Surfaces: Type S or M, Grade NS, Class 25.
c. Sealant in Pedestrian and Vehicular Traffic Areas: Use T_1.
d. Sealant in Non-Traffic Areas: Type S or M, Grade P, Use NT.

2. Provide sealants made for use in continuous immersion in contact with wastewater. Provide gray colored sealants unless otherwise indicated, specified, or approved.

PART 3 - EXECUTION

3.1 INSTALLATION - WATERSTOPS, GENERAL

A. Install waterstops for joints indicated and according to manufacturer's published installation instructions and approved submittals.

B. Include waterstops continuous around corners and intersections to provide a continuous seal.

C. Provide a minimum number of connections or splices. Replace connections or splices that do not meet specified requirements at no additional cost to Owner.

D. Secure waterstops in joints before concrete is placed.

E. Install plastic and thermoplastic waterstops so that half of width is embedded on each side of joint. Install waterstops with a center bulb in expansion joints so center bulb is within the joint width. Provide waterstops completely embedded in void-free concrete.

F. Terminate waterstops 2 inches below exposed top of walls. Plug center bulbs in expansion joint waterstops with foam rubber, 1 inch, at termination points.

G. Protect waterstops from damage in intervals between placing waterstops and subsequent placing of concrete. Replace damaged or punctured waterstops at no additional cost to Owner.

H. Protect plastic waterstops from sunlight when exposed more than 30 days between concrete placements.

I. Provide waterstops free from form release agent, bond breaker, dirt, concrete splatter, ice, mortar, paint, or other deleterious material that could reduce or destroy bond between waterstop and adjacent concrete.

3.2 INSTALLATION - PLASTIC AND THERMOPLASTIC WATERSTOPS

A. Field Splices: Make only straight butt joints. Fabricate splices on a bench.

1. Use a power saw and guide to cut straight ends to be spliced.
2. Heat fuse weld splices using a Teflon coated thermostatically controlled waterstop splicing iron following manufacturer's recommendations.
3. Provide finished splices having a cross-section that is dense and free of porosity. Engineer may conduct destructive tests of splices by cutting along one-half of splice length and by cutting perpendicular to splice at several locations on remaining half of splice length.
4. Completed Splices: Exhibit a continuous and uniform bead of excess melted material with welded material looking similar to parent material.
5. Show no misalignment of center bulbs or ribs greater than 1/16 inch, lack of fusion, porosity, pinholes, cracks, charred or burnt material, bubbles, or separation of cooled

splice when bent by hand. If a splice displays any of these defects, reject the splice, recut back at least 1 inch from rejected splice on each side, and reweld.

B. Secure waterstops in wall joints before concrete is placed. If waterstop does not incorporate an integral fastening system, grommets, or prepunched holes, drill holes in waterstops between outermost ribs at each edge. Center waterstop in the joint. Tie both edges of waterstop to reinforcing steel with tie wire as specified for tying reinforcing steel. Secure waterstop centered on and perpendicular to joint and to maintain its position during concrete placement.

C. Space waterstop ties to match spacing of adjacent reinforcing, but ties need not be spaced closer than 12 inches on center.

D. Clamp horizontal waterstops in slabs in position with form bulkhead, unless previously set in concrete. Lift waterstop edge while placing concrete below the waterstop. Manually force waterstop against and into placed concrete and cover with fresh concrete, to provide complete encasement of waterstop in concrete.

3.3 INSTALLATION - SPECIAL WATERSTOPS

A. Install special waterstops at joints only where specifically indicated on Drawings. Provide waterstops continuous around corners and intersections to provide a continuous seal.

B. Use waterstops of maximum practicable length to provide a minimum number of joints, connections, or splices. Make joints, connections, and splices conforming to manufacturer's recommended.

C. Terminate waterstops 2 inches below exposed top of walls.

D. Plug bulbs in PVC retrofit waterstops with foam rubber, 1 inch deep, at termination points.

E. Base Seal PVC Waterstops: Splice as specified for plastic waterstops. Set base seals for expansion joints on concrete sleepers, not less than 24 incheswide, and sleeper covered with two layers of sheet material such as vapor barrier material.

1. Do not fasten base seal by nails, but firmly hold in position by bulkhead form. Base seals at non-expansion joints may be set on vapor barrier material that extends at least two feet on each side of the joint.

F. PVC Retrofit Waterstops: Splice and secure projecting portion to reinforcing steel as specified for plastic waterstops. Clean existing concrete of foreign material and patch to form a smooth plane surface. Use adhesives, fastening devices, and fastener spacing conforming to manufacturer's recommendations.

G. Injectable Waterstops:

1. Use maximum hose length of 25 linear feet. Splice consecutive lengths of hose by overlapping in accordance with manufacturer's specifications.
2. Hold hose in place with anchor clips at manufacturer’s recommended spacing.
3. Do not fasten injection hoses to reinforcing steel.

4. Patch visible honeycombs at concrete surface prior to injection. Perform injection in compliance with manufacturer's specifications and ensure injection hose is properly sealed upon completion.

H. Expansive Type and Preformed Adhesive Waterstops:

1. Clean and prepare joint surfaces, install primers or adhesives, and install Type A expansive, Type B expansive, or preformed adhesive waterstops on dry surfaces in accordance with manufacturer's instructions, including concrete cure, temperature conditions, and splices.
2. Use mechanical fasteners to secure Type A expansive or Type B expansive waterstops to previously placed vertical and overhead concrete surfaces and other locations, as recommended by manufacturer. Protect installed waterstops from moisture and keep dry until subsequent placement of concrete.

3.4 INSTALLATION - CONSTRUCTION JOINTS

A. Make construction joints only at locations indicated or as approved by Engineer. Submit additional or relocation of construction joints proposed by Contractor to Engineer for written approval. Do not eliminate construction joints.

B. Locate additional or relocated joints where they least impair member strength. In general, locate joints within middle third of spans of slabs, beams, and girders.

1. If a beam intersects a girder at joint, offset joint a distance equal to twice the width of member being connected.
2. Locate joints in walls and columns at underside of floors, slabs, beams, or girders and at tops of footings or floor slabs.
3. Do not locate joints between beams, girders, column capitals, or drop panels and the slabs above them. Do not locate joints between brackets or haunches and walls or columns supporting them.

C. Unless otherwise indicated, provide joints perpendicular to main reinforcement. Continue reinforcing steel through joint as indicated. Provide inclined dowels at construction joints in beams, as detailed.

D. Provide waterstops in wall and slab construction joints in liquid retaining structures and at other locations indicated.

E. Roughened Construction Joints:

1. At construction joints and at concrete joints indicated, uniformly roughen concrete surface with chipping tools to expose a fresh face 1/4 inch of a full amplitude, distance between high and low points and side to side.
2. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding.
3. At least two hours before and again shortly before new concrete is deposited, saturate joints with water.

4. After glistening water disappears, coat joints with neat cement slurry mixed to consistency of very heavy paste. Apply a coating to surfaces at least 1/8 inch, scrubbed-in by means of stiff bristle brushes. Deposit new concrete before neat cement dries.

3.5 INSTALLATION - EXPANSION JOINTS

A. Make expansion joints at locations indicated. Do not eliminate or relocate expansion joints.

B. Provide expansion joints 1 inch in thickness, unless otherwise indicated.

C. Provide center bulb type waterstops, sealant grooves, and sealants in wall and slab expansion joints in liquid retaining structures and at other locations indicated.

D. Do not extend through expansion joints, reinforcement or other embedded metal items that are continuously bonded to concrete on each side of joint.

E. Where indicated, install smooth dowels at right angles to expansion joints. Align dowels parallel with finished surface. Rigidly hold in place and support during concrete placement.

1. Unless otherwise indicated, apply a bond breaker to one end of dowels through expansion joints.
2. Mask waterstops to prevent bond breaker from running or dripping onto them. Remove masking prior to concrete placement.
3. Provide expansion dowel caps on ends of expansion joint dowels to which bond breaker has been applied.

F. Place joint filler over joint face allowing for sealant grooves as indicated. Butt joint filler tight against waterstop, if present. Tape joint filler splices to prevent intrusion of mortar. Position premolded joint filler material parallel to finished surfaces. Secure joint filler against displacement during concrete placement and consolidation. Seal expansion joints as indicated.

3.6 INSTALLATION - PARTIAL CONTRACTION JOINTS

A. Make partial contraction joints at locations indicated. Do not eliminate or relocate partial contraction joints.

B. Provide waterstops, sealant grooves, and sealants in wall and slab partial contraction joints in liquid retaining structures and at other locations indicated.

C. Extend every other bar of reinforcing steel through partial contraction joints or as indicated on Drawings. Coat concrete surface with a bond breaker prior to placing new concrete against it as indicated on Drawings.

1. Do not coat reinforcement or waterstops with bond breaker. Mask waterstops and reinforcing passing through joint to prevent bond breaker from running or dripping on to them. Remove masking prior to concrete placement.

3.7 INSTALLATION - SEALANTS

A. Install sealants in clean dry recesses free of frost, oil, grease, form release agent, loose material, laitance, dirt, dust, and other deleterious materials that will impair bond.

B. Apply sealant conforming to manufacturer's recommendations including concrete cure, temperature, moisture, mixing, primer, primer cure time, joint and recess preparation, tooling, and curing.

C. Apply masking tape to each side of joint prior to sealant installation. Remove masking tape afterwards, along with any spillage to leave a sealant installation with neat straight edges.

3.8 INSTALLATION - PREFORMED EXPANSION JOINT MATERIAL

A. Install preformed expansion joint material in conformance with manufacturer's recommendations; including surface preparation, adhesive installation, heat welding, and set time.

3.9 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect system components verifying that installation conforms to manufacturer’s installation instructions.,

1. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

A. Clean adjacent surfaces removing excess spills.

B. Protect installed products until subsequent work is installed. For exposed materials, protect from damage until Substantial Completion.

END OF SECTION 031500

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Reinforcing bars.
2. Welded wire fabric.
3. Reinforcement accessories.

B. Related Requirements:

1. Section 031000 “Concrete Forming and Accessories” for form materials, and accessories required to form cast-in-place concrete.
2. Section 033000 “Cast-in-Place Concrete” for cast-in-place concrete.
3. Section 033500 “Concrete Finishing” for reinforcement for concrete floor toppings.

1.3 COORDINATION

A. Coordinate Work of this Section with placement of formwork, formed openings, masonry dowels, and other Work.

1.4 ACTION SUBMITTALS

A. Shop Drawings:

1. Indicate bar sizes, spacings, locations, splice locations, and quantities of reinforcing steel and welded wire fabric.
2. Indicate bending and cutting schedules.
3. Indicate supporting and spacing devices.
4. Placement Drawings:

    a. Walls: Show elevations from outside, looking towards the structure, at a minimum scale of 1/4 inch to one foot.
    b. Slabs: Show top and bottom reinforcement on separate plan views, as needed for clarity.
    c. Beams and Columns: Show schedules with sections, elevations, and stirrup/tie spacing.

d. Show additional reinforcement around openings, at corners and at other locations indicated, diagrams of bent bars, arrangements, and assemblies, all as required for the fabrication and placement of concrete reinforcement.
e. Reference bars to same identification marks shown on bar bending details. Identify bars to have special coatings or to be of special steel or special yield strength.

B. Samples: Two samples of each type of mechanical reinforcing steel coupling system.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Submit certified copies of mill test report of reinforcement materials analysis.

C. Certified copy of test reports for each foreign manufactured steel proposed for use. Provide tests specifically made for this project by a domestic independent testing laboratory certified to perform the tests. Test for conformity to applicable ASTM Standard.

D. Copy of CRSI certification for plant producing epoxy-coated reinforcement.

E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 QUALITY ASSURANCE

A. Perform Work according to CRSI 10-MSP, ACI 301, and ACI 318.

B. Prepare Shop Drawings according to ACI SP-66.

C. Maintain one copy of each standard affecting Work of this Section on Site.

D. Epoxy-coated Reinforcement. Produced by a plant certified by the CRSI Epoxy Plant Certification Program.

E. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Ship and store reinforcement with bars of same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing same "mark" designations as those shown on submitted placement drawings. Indicate that reinforcing is weldable on tags

for ASTM A706 reinforcing and for ASTM A615 reinforcing meeting specified requirements in PART 2.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture by storing off ground, in clean, and dry location.
2. Provide additional protection according to manufacturer instructions.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel:

1. Comply with ASTM A615.
2. Yield Strength: 60 ksi.
3. Billet Bars: Deformed.
4. Finish: Uncoated.

B. Deformed Reinforcement required on Drawings to be Field Bent or Welded:

1. Material: Steel bars.
2. Comply with ASTM A706.
3. Yield Strength: 60 ksi.
4. Finish: Uncoated.
5. ASTM A615, Grade 60 may be substituted for ASTM A706 subject to the following:

a. Actual yield strength of reinforcing steel based on mill tests does not exceed specified yield strength by more than 18,000 psi. Retests not to exceed this value by more than an additional 3,000 psi.
b. Ratio of actual ultimate tensile strength to actual tensile yield strength of reinforcement is not less than 1.25.
c. Carbon equivalency (CE) is 0.55 percent or less.

C. Spiral Reinforcement:

1. ASTM A615, Grade 60 for plain or deformed bars.
2. ASTM A1064 for cold-drawn wire.

D. Deformed Wire:

1. Comply with ASTM A1064.
2. Finish: Uncoated.

E. Plain Wire:

1. Comply with ASTM A1064.
2. Finish: Uncoated.

F. Fabricated Welded Deformed Wire Fabric:

1. Comply with ASTM A1064 and ASTM A615 Grade 60 deformed bars.
2. Configuration: Flat sheets.
3. Finish: Uncoated.

G. Welded Plain Wire Fabric:

1. Comply with ASTM A1064.
2. Configuration: Flat sheets.
3. Finish: Uncoated.

2.2 FABRICATION

A. Fabricate concrete reinforcement according to CRSI 10-MSP and ACI 318.

B. Form standard hooks for 180-degree bends, 90-degree bends, stirrups, and tie hooks as indicated.

C. Form reinforcement bends with minimum diameters according to ACI 318.

D. Bend bars cold. Do not straighten or rebend bars.

E. Bend bars around a revolving collar having a diameter not less than that recommended by the CRSI or ACI 318.

F. Saw cut bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded. Terminate saw cut ends in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

G. Fabricate column reinforcement with offset bends at reinforcement splices.

H. Form spiral column reinforcement from minimum 3/8-inch-diameter continuous deformed bar or wire.

1. Provide a minimum of 1-1/2 finishing turns at the top and bottom.
2. Splices. Provide tension lap splices at least 48 bar diameters, but not less than 12 inches in length. Do not use welded splices unless specifically approved by Engineer.
3. Provide spacers as recommended by the CRSI.

I. Form ties and stirrups as indicated

J. Weld reinforcement, only where indicated or specifically approved by Engineer. Weld reinforcement conforming to AWS D1.4.

2.3 ACCESSORY MATERIALS

A. Tie Wire:

1. Minimum 16 gage, annealed type. Use black wire to tie uncoated reinforcing.

B. Reinforcing Steel Accessories:

1. Plastic Protected Wire Bar Supports: CRSI Bar Supports, Class 1 - Maximum Protection.
2. Stainless Steel Protected Wire Bar Supports: CRSI Bar Supports, Class 2 - Moderate Protection with legs made wholly from stainless steel wire.
3. Precast Concrete Bar Supports: CRSI Bar Supports, Precast Concrete Bar Supports. Precast concrete blocks that have equal or greater strength than the surrounding concrete.

C. Reinforcing Splicing Devices:

1. Type: Exothermic welding type; full tension and compression. Use only where indicated.

D. Type: Mechanical threaded; full tension and compression.

1. Use only where indicated. Meet all ACI 318 requirements. Provide threaded type with cap on female end to exclude dirt, debris, and wet concrete. Torque couplers to manufacturer's recommended value.
2. Unless otherwise indicated, mechanical reinforcing splicing devices shall produce a splice strength in tension or compression of not less than 125 percent of ASTM specified minimum yield strength of reinforcing bar. Base yield strength on Grade 60 reinforcing unless otherwise indicated or specified.
3. Compression type mechanical splices shall provide concentric bearing from one bar to other bar.
4. Size: To fit joined reinforcing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with CRSI 10-MSP for surface condition, bending, spacing and tolerances of placement for reinforcement. Provide the amount of reinforcing indicated at the spacing and clearances indicated on the Drawings.

B. Coat uncoated reinforcement which will be exposed for more than 60 days after placement with a heavy coat of neat cement slurry.

C. Do not weld reinforcing steel bars either during fabrication or erection unless indicated or as specified herein, or unless prior written approval has been obtained from Engineer. Remove immediately all bars that have been welded, including tack welds, without such approval. Comply with AWS D1.4 when welding of reinforcement is indicated, specified, or approved.

D. Reinforcing steel interfering with the location of other reinforcing steel, piping, conduits, or embedded items may be moved within the specified tolerances or one bar diameter, whichever is greater. Obtain the approval of Engineer if greater displacement of bars to avoid interference is needed. Do not cut reinforcement to install inserts, conduits, mechanical openings, or other items without the prior approval of Engineer.

E. Place, support, and secure reinforcement against displacement. Secure dowels in place before placing concrete.

F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

G. Do not deviate from required position beyond specified tolerance.

H. Do not field bend reinforcing unless indicated or specifically authorized in writing by Engineer. Cold-bend bars indicated or authorized to be field bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. Replace, repair by cutting out damaged bars and splicing new bars using exothermic welding type reinforcing splicing devices, or otherwise repair damaged reinforcing bars as directed by Engineer without additional compensation. Do not bend reinforcement after it is embedded in concrete unless indicated.

I. Do not displace or damage vapor retarder.

J. Chairs, Bolsters, Bar Supports, and Spacers:

1. Size and Shape: To support reinforcement and prevent displacement of reinforcing during concrete placement conditions.
2. Furnish load-bearing pad on bottom to prevent vapor retarder puncture.
3. Use precast concrete blocks where reinforcing steel is to be supported over soil.
4. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by Engineer.

K. Spacing:

1. Space reinforcement bars with minimum clear spacing according to ACI 318.
2. If bars are indicated in multiple layers, place upper bars directly above lower bars.

L. Determine clear concrete cover based on exposure to the environment. Provide the following clear concrete cover over reinforcement, unless indicated otherwise:

1. Concrete cast against and permanently exposed to earth: 3 inches.
2. Concrete exposed to soil, water, sewage, sludge and/or weather:

    a. Slabs (top and bottom cover), walls: 2 inches.
    b. Beams and columns (ties, spirals, and stirrups): 2 inches.

3. Concrete not exposed to soil, water, sewage, sludge and/or weather:

    a. Slabs (top and bottom cover), walls, joists, shells, and folded plate members: 1 inch.

b. Beams and columns (ties, spirals, and stirrups): 1-1/2 inches.

M. Splicing:

1. Tension Members: Avoid splicing of reinforcing steel in concrete elements indicated as "tension members." However, if splices are required for constructability, splices in the reinforcement subject to direct tension shall be butted and joined with complete penetration welds to develop, in tension, at least 125 percent of the specified yield strength of the bar. Offset splices in adjacent bars the distance of a Class B splice or 30 inches, whichever is greater.
2. Welded Wire Fabric: Provide lap splices in accordance with the requirements of ACI 318 but not less than 12 inches. Tie the spliced fabrics together with wire ties spaced not more than 24 inches on center and lace with wire of the same diameter as the welded wire fabric. Offset splices in adjacent widths to prevent continuous splices.
3. Reinforcing Splicing Devices: Use only where indicated. Offset splices in adjacent bars by at least 30 bar diameters. Use only for special splice and dowel conditions indicated or approved by Engineer.
4. After installation of mechanical reinforcing steel coupling system, on reinforcement, repair coating damage in accordance with applicable ASTM standard. Coat all parts of mechanical connectors used on coated bars including steel splice sleeves, bolts, and nuts with same material used for repair of damaged coating.
5. Locate reinforcement splices at point of minimum stress, unless indicated otherwise.
6. Obtain approval of splice locations from Engineer.

N. Place dowels for concrete masonry units in accordance with approved placement drawings.

3.2 TOLERANCES

A. Install reinforcement within following tolerances for slabs, beams, girders, columns, walls, and, foundation elements:

1. Member Depth (or Thickness) Greater Than 12 Inches:

a. Reinforcement Location: Plus or Minus 1/2 inch.

2. Member Depth (or Thickness) Less Than or Equal to 12 Inches:

a. Reinforcement Location: Plus or Minus 3/8 inch.

3.3 FIELD QUALITY CONTROL

A. Inspection by Engineer: When reinforcing is complete and ready for inspection, notify Engineer at least six working hours prior to proposed concrete placement.

B. Do not cover reinforcing steel with concrete until reinforcement, including the size, spacing and position has been inspected by Engineer and Engineer's release to proceed with concreting has been obtained. Keep forms open until Engineer has completed inspection of the reinforcement.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Cast-in-Place Concrete for various items indicated in Contract Documents.

1. Furnish, as required to establish concrete mixes, all sampling and laboratory testing of products and materials performed by an independent testing laboratory engaged by and at the expense of Contractor. Provide field sampling, testing, inspection, and related laboratory tests.

B. Related Requirements:

1. Section 031000 “Concrete Forming and Accessories” for formwork and accessories.
2. Section 032000 “Concrete Reinforcing” for requirements for reinforcing steel and supports.
3. Section 032500 “Concrete Joint and Joint Accessories”.
4. Section 033500 “Concrete Finishing” for finishing of concrete floor and wall surfaces.
5. Section 033900 “Concrete Curing” for curing of concrete surfaces.
6. Various Sections in Divisions 22 and 23: Mechanical items for casting into concrete.
7. Various Sections in Divisions 26 and 27: Electrical items for casting into concrete.

1.3 COORDINATION

A. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

1.4 ACTION SUBMITTALS

A. Submit product data for:

1. Sources of cement, fly ash or ground granulated blast furnace slag, aggregates, and batched concrete. Indicate name and address of mill, quarry, or plant.
2. Air entrainment admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
3. Water reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.

4. Cold weather and hot weather concreting plans demonstrating how concrete will meet the requirements of this Section including but not limited to concrete mixes, placement, curing and protection.

B. Concrete Mixes: For each formulation of concrete proposed for use, submit constituent quantities per cubic yard, water cementitious ratio, air content, concrete slump, type, and manufacturer of cement and type and manufacturer of fly ash or ground granulated blast furnace slag. Provide either subparagraph 1. or 2., below, for each mix proposed.

1. Standard deviation data for each proposed concrete mix based on statistical records. Provide the following for each strength data point used in the calculation of the standard deviation for determination of the minimum required average strength:

   a. Date of sampling and name of testing laboratory.
   b. Name of concrete batch plant.
   c. Water cementitious ratio.
   d. Slump of batch.
   e. Air content of batch.
   f. Compressive strengths of all cylinders tested at that age in that batch.
   g. If available, temperature and unit weight of batch.
   h. Provide data from projects not more strictly controlled than outlined in these specifications. Provide summary sheet showing all pertinent data and the computation of the standard deviation.

2. Water cementitious ratio curve for concrete mixes based on laboratory tests. Provide average cylinder strength test results at 7, 14, and 28 days for laboratory concrete mix designs.

C. Concrete Mixes: Shrinkage.

D. High-range water-reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range and conformity to ASTM standards. Identify proposed locations of use.

E. Samples: Fine and coarse aggregates, if requested for examination by Engineer.

1.5 INFORMATIONAL SUBMITTALS

A. Test Reports:

1. Aggregates: Conformance to ASTM standards, including sieve analysis, mechanical properties, deleterious substance content, and mortar bar expansion test results.
2. Cement and fly ash or ground granulated blast furnace slag: Conformance to ASTM standards, including chemical analysis and physical tests.

B. Certifications:

1. Certify that admixtures used in the same concrete mix are compatible with each other and the aggregates.

2. Certify that Contractor is not associated with independent testing laboratory proposed for use by Contractor nor does Contractor or its officers have a beneficial interest in the laboratory.
3. Certify that cement is produced by a manufacturer that does not use hazardous waste derived fuel as an energy source for its kilns.

C. Qualifications:

1. Independent Testing Laboratory:

a. Name and address.
b. Names and positions of principal officers and the name, position, and qualifications of the responsible registered professional engineer in charge.
c. Listing of technical services to be provided. Indicate external technical services to be provided by other organizations.
d. Names and qualifications of the supervising laboratory technicians.
e. Statement of conformance provided by evaluation authority defined in ASTM C1077. Provide report prepared by evaluation authority when requested by Engineer.
f. Submit as required above for other organizations that will provide external technical services.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of embedded utilities and components concealed from view in finished construction.

1.7 QUALITY ASSURANCE

A. Comply with ACI 318 and ACI 350 and other stated specifications, codes, and standards. Apply the most stringent requirements of other stated specifications, codes, standards, and this Section when conflicts exist.

B. Independent Testing Laboratory: Meet requirements of ASTM E329 and ASTM C1077. Do not use laboratories affiliated and having a beneficial interest with Contractor or its officers.

C. Provide concrete uniform in color and appearance.

D. Preconstruction Meeting: At least 10 working days before first concrete placement, hold a meeting to review concrete placement requirements, waterstop placement, jointing, concrete curing, hot and cold weather concreting, and finishing. Review, with the attendance of the plasticizer manufacturer, the properties and techniques of batching and placing concrete containing high-range water-reducing admixture. Notify all parties involved, including Engineer, of the meeting at least 10 working days prior to its scheduled date. Prepare an agenda for the meeting. Take meeting minutes and distribute to meeting attendees.

E. If during work progress, it is impossible to secure concrete of the specified workability and strength with the materials being furnished, Engineer may order such changes in proportions or

materials, or both, as may be necessary to secure the specified properties. Make ordered changes without additional compensation.

F. If during work progress, materials from the sources originally accepted change in characteristics, make new acceptance tests of materials and establish new concrete mixes with assistance of an independent testing laboratory, without additional compensation.

G. Provide field testing and inspection services and related laboratory tests. Perform testing methods conforming to latest applicable ASTM methods. Test following items to verify conformity with this Section:

1. Concrete Placements: Compressive strength (cylinders), temperature, slump, and air content.
2. Other materials that may require field testing.

H. Concrete Placement: Compressive strength (cylinders), temperature, slump, and air content.

I. Provide laboratory tests of samples, constituents, and as-placed concrete. Materials incorporated in the work shall conform to accepted samples.

J. Perform Work according to ACI 301and 350.

K. Comply with ACI 305R when placing concrete during hot weather.

L. Comply with ACI 306.1 when placing concrete during cold weather.

M. Acquire cement and aggregate from one source for Work.

1.8 AMBIENT CONDITIONS

A. Maintain concrete temperature after installation at minimum 50 degrees F for minimum seven days.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96, desiccant or water method.

2.2 MATERIALS

A. Materials shall comply with this Section and any applicable State or local requirements.

B. Cement: Domestic portland cement conforming to ASTM C150. Cement shall be low alkali cement. Do not use air entraining cements. Do not use cement produced by a manufacturer that uses hazardous waste derived fuel as an energy source for its kilns. Cement brand must be approved by Engineer and one brand shall be used throughout the work.

1. Comply with ASTM C150, Type II - Moderate Sulfate Resistant.
2. Type: Portland.

C. Aggregates:

1. Fine Aggregate: Washed inert natural sand conforming to ASTM C33.
2. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to ASTM C33. Grading requirements are listed in ASTM C33, Table 3 for the specified coarse aggregate size number listed in Table 1. Limits of deleterious substances and physical property requirements are listed in ASTM C33, Table 4 for severe weathering regions. Do not use coarse aggregates known to be deleteriously reactive with alkalis in cement.
3. Fine and coarse aggregates used shall not cause expansion of mortar bars greater than 0.1 percent in 16 days when tested in accordance with ASTM C1260 and using project proposed cement. If aggregates proposed do not meet this requirement, then satisfy either subparagraph a. or b. below.

    a. Total equivalent alkali content of the cement: Do not exceed 0.60 percent as provided in the Optional Chemical Requirements of ASTM C150.
    b. Fine and coarse aggregates used shall not cause expansion of mortar bars greater than 0.1 percent in 16 days when tested in accordance with ASTM C1260 and using the cement and fly ash or ground granulated blast furnace slag proposed for the project. Proportions of cement-fly ash mix or cement-ground granulated blast furnace slag mix shall be the same as those proposed for the project.

D. Water:

1. Comply with ACI 318 and ACI 350 (350M).
2. Potable, without deleterious amounts of chloride ions.

E. Admixtures: Use admixtures free of chlorides and alkalis, except for those attributable to drinking water. Provide admixtures from same manufacturer when it is required to use more than one admixture in the same concrete mix. Use admixtures compatible with concrete mix including other admixtures and made for use in concrete in contact with potable water after 30 days of concrete curing. Do not use admixtures causing retarded or accelerated setting of concrete without written approval from Engineer. Use retarding or accelerating water reducing admixtures when so approved.

1. Air Entrainment: Comply with ASTM C260.
2. Chemical:

    a. Comply with ASTM C494.
    b. Type A - Water Reducing.
    c. Type F - Water Reducing, High Range.
    d. Type G - Water Reducing, High Range, and Retarding.

3. Plasticizing:

    a. Comply with ASTM C1017/(C1017M).
    b. Type I, plasticizing or II, plasticizing and retarding.

F. Supplementary Cementitious Materials:

1. Fly Ash: Class F fly ash complying with ASTM C618, including the requirements of Table 1 but with the Loss on Ignition (LOI) limited to 3 percent maximum and the optional physical requirements of Table 3. Test in compliance with ASTM C311 with a minimum of one sample weighing four pounds taken from each 200 tons of fly ash supplied for the project.
2. Ground Granulated Blast Furnace Slag: Grade 100 or Grade 120 ground granulated blast furnace slag complying with ASTM C989. Provide ground granulated blast furnace slag from a single source and uniform in color. Mill test reports submitted must be within 6 months of submittal date.
3. Silica Fume: Comply with ASTM C1240.

2.3 CONCRETE MIX

A. Engage an independent testing laboratory to establish concrete mixes and perform sampling and laboratory testing of products and materials.

B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce placeable, durable concrete conforming to these specifications. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing free water to collect on the surface.

C. Base concrete mixes on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if not available, develop concrete mixes by laboratory tests using the materials proposed for the work.

1. For concrete mixes based on standard deviation data of prior mixes, submit standard deviation data of prior mixes with essentially the same proportions of the same constituents in accordance with ACI 318 and ACI 350 and based on the modification factors for standard deviation tests contained in ACI 318 and ACI 350.
2. For concrete mixes developed by laboratory testing, base cementitious content of the concrete on curves showing the relation between water cementitious ratio and 7, 14 and 28-day compressive strengths of concrete made using the proposed materials. Determine curves by four or more points, each representing an average value of at least three test specimens and one water-cementitious ratio at each age. Provide curves with a range of values sufficient to yield the desired data, including the compressive strengths specified, without extrapolation. Cementitious content of the concrete mixes to be used, as determined from the curve, shall correspond to the required average compressive strength in Table 5.3.2.2 of ACI 318. Resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content specified in Table 1.

D. Test fly ash or ground granulated blast furnace slag and concrete mixture to provide test data confirming that materials in combination with the cement meet strength requirements and are compatible with other concrete additives.

E. Test aggregates for potential alkali reactivity in accordance with ASTM C1260. If initial testing indicates aggregates are not potentially reactive repeat test at 3 month intervals.

F. Compression Tests: Provide testing of the proposed concrete mixes to demonstrate compliance with compression strength requirements in conformity with the provisions of ACI 318.

G. Entrained Air: Measure by ASTM C231 as shown in Table 1.

1. If proposed air entrainment admixture requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in admixture submittal.

H. Concrete Slump: Measure by ASTM C143 as shown in Table 1. If a high-range water-reducing admixture (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 inches to 10 inches.

I. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of the other admixture(s).

TABLE 1

Class	Design Strength 1	Cement 2	Fine Aggregate 3	Coarse Aggregate 3	Cementitious Content 4
A	2500	Type II	Sand	57 (9)	440
E1	4500	Type II	Sand	467	560
E2	4500	Type II	Sand	57	580
E3	4500	Type II	Sand	67	610

Class	W/C Ratio 5	SCM 6	AE Range 7	WR 8	HRWR 10	Slump Range Inches
A	0.62 max.	Yes	3.5 to 5	Yes	No	1-4
E1	0.42 max.	Yes	3.5 to 5	No	Yes	7-10
E2	0.42 max.	Yes	3.5 to 5	No	Yes	7-10
E3	0.42 max.	Yes	3.5 to 5	No	Yes	7-10

TABLE NOTES:

1. Minimum compressive strength in psi at 28 days.
2. ASTM designation in ASTM C150.
3. Size Number in ASTM C33.
4. Minimum cementitious content in pounds per cubic yard where fly ash or ground granulated blast furnace slag is used cementitious content is defined as cement content plus fly ash or ground granulated blast furnace slag content.
5. W/C is Maximum Water Cementitious ratio by weight.

6. Supplementary Cementitious Material (SCM) fly ash content in the range of 23 - 25 percent of the total cement content plus fly ash content, by weight. If ground granulated blast furnace slag is used in lieu of fly ash, the content of ground granulated blast furnace slag shall be in the range of 25 - 45 percent of the total cement plus ground granulated blast furnace slag content, by weight.
7. AE is percent air entrainment.
8. WR is water reducing admixture.
9. Except as specified in Section 260543 for concrete electrical raceway encasement.
10. HRWR is high-range water-reducing admixture.

J. Shrinkage Tests: Perform shrinkage tests on the design mix for all Class D and Class E concrete. The tests shall conform to ASTM C157 as modified by ASTM C596 for curing, storage, and comparator readings. Use concrete specimens. Do not use mortar specimens.

1. Average Shrinkage: At 25 days of air storage do not exceed 0.036 percent.
2. Make tests with at least three different brands of cement. Only brands demonstrating a shrinkage value within 10 percent of the brand with the lowest shrinkage value at 25 days of air storage will be acceptable.

K. Admixtures:

1. Include admixture types approved by Engineer and their quantities in concrete mix designs.
2. Cold Weather:

    a. ASTM C494 Type E admixture may be used in cold weather, if approved by Engineer.
    b. Use of admixtures will not relax cold-weather placement requirements.

3. Hot Weather:

    a. ASTM C494 Type D admixture may be used in hot weather, if approved by Engineer.
    b. Use of admixtures will not relax hot-weather placement requirements.

4. Add air entrainment admixture to all concrete.
5. Add water reducing admixture to all concrete.

L. Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C94.

PART 3 - EXECUTION

3.1 MEASURING MATERIALS

A. Provide concrete composed of portland cement, fly ash or ground granulated blast furnace slag, fine aggregate, coarse aggregate, water, and admixtures as specified and produced by a plant complying with ACI 318 and ASTM C94. Batch all constituents, including admixtures, at the plant. High-range water reducing admixtures may be added in the field.

B. Measure materials for batching concrete by weighing in conformity with and within tolerances given in ASTM C94 except as otherwise specified. Use scales last certified by the local Sealer of Weights and Measures within one year of use.

C. Weigh cement and fly ash or ground granulated blast furnace slag in individual weigh batchers that are separate and distinct from weigh batchers used for other materials. When cement and fly ash or ground granulated blast furnace slag are weighed in a cumulative weigh batcher, the cement shall be weighed first.

D. Measure the amount of free water in fine aggregates within 0.5 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record number of gallons of water as-batched on printed batch tickets.

E. Dispense admixtures either manually using calibrated containers or measuring tanks or by means of an automatic dispenser approved by the manufacturer of the specific admixture.

1. Charge air entrainment and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
2. Inject multiple admixtures separately during the batching sequence.

3.2 MIXING AND TRANSPORTING

A. Provide ready-mixed concrete produced by equipment complying with ACI 318 and ASTM C94 and produced by a plant certified by the NRMCA. Do not hand-mix. Use truck mixers carrying a rating plate conforming to TMMB 100. Clean each transit mix truck drum and reverse drum rotation before truck proceeds under the batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.

B. Transport ready-mix concrete to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.

C. Keep water tank valve on each transit truck locked at all times. Any addition of water must be directed by Engineer. Incorporate water directed to be added by additional mixing of at least 50 revolutions at mixing speed after the addition of all water. Meter all added water and show the amount of water added on each delivery ticket.

D. Comply with ACI 318 and ASTM C94 for central plant and rolling stock equipment and methods.

E. Select equipment of size and design to provide continuous flow of concrete at the delivery end. Use metal or metal-lined non-aluminum discharge chutes with slopes not exceeding one vertical to two horizontal and not less than one vertical to three horizontal. Chutes more than 20 feet long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.

F. Do not retemper (mix with or without additional cement, aggregate, or water) concrete or mortar which has partially hardened.

G. Handle concrete from mixer to placement providing concrete of specified quality in the placement area and not exceeding the maximum time interval specified in Paragraph 3.2 I.4. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required to avoid excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms. Remix for a minimum of 5 minutes prior to discharge or testing.

H. Furnish a delivery ticket for ready mixed concrete to Engineer as each truck arrives. Provide a printed record of the weight of cement and each aggregate as batched individually on each ticket. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Indicate for each batch the weight of fine and coarse aggregate, cement, fly ash or ground granulated blast furnace slag, and water, moisture content of fine and coarse aggregate at time of batching, and types, brand and quantity of each admixture, the quantity of concrete delivered, the time any water is added and the amount, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of transit mix truck.

I. Temperature and Mixing Time Control:

1. In cold weather (see Paragraph 3.8, C) maintain the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms as indicated in Table 3.
2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.
3. In hot weather (see Paragraph 3.8, D), cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. Well-crushed ice may be substituted for all or part of the mixing water.
4. Maximum time interval between the addition of mixing water and/or cement to the batch and the final placing of concrete in the forms shall not exceed the values shown in the following Table 2:

TABLE 2

AIR OR CONCRETE TEMPERATURE (WHICHEVER IS HIGHER)	MAXIMUM TIME
(27 Degrees C) 80 Degrees F to 90 Degrees F (32 Degrees C)	45 minutes
(21 Degrees C) 70 Degrees F to 79 Degrees F (26 Degrees C)	60 minutes
(5 Degrees C) 40 Degrees F to 69 Degrees F (20 Degrees C)	90 minutes

5. If an approved high-range water-reducing admixture (plasticizer) is used to produce plasticized concrete, the maximum time interval between the addition of mixing water and/or cement to the batch and the final placing of concrete in the forms shall not exceed 90 minutes.

3.3 EXAMINATION

A. Verify requirements for concrete cover over reinforcement.

B. Verify that anchors, seats, plates, reinforcement, piping, electrical conduits, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

C. At all times batch, mix, transport, place, and cure concrete to the inspection of Engineer. Advise Engineer of readiness to proceed at least 24 hours prior to each concrete placement. Engineer will inspect the preparations for concreting, including preparation of previously placed concrete, reinforcing and alignment, cleanliness, and tightness of formwork. Do not place concrete without the inspection and acceptance of Engineer.

3.4 EMBEDDED ITEMS

A. Secure to forms as required or set for embedment as required, miscellaneous metal items, sleeves, reglets, anchor bolts, anchors, inserts, and other items furnished under other Sections and required to be embedded into concrete. Set and secure such items in the locations and alignments needed so they are not displaced by concrete placement.

B. Clean embedded items free of rust, mud, dirt, grease, oil, ice, or other contaminants which would reduce or prevent bonding with concrete.

C. Coat or isolate all aluminum embedments to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.

D. Do not embed piping in concrete unless indicated on Drawings.

E. Do not embed electrical conduits in concrete unless indicated on Drawings.

F. Fabricate piping and conduit such that cutting, bending, or relocation of reinforcing steel is not required. Satisfy the following for pipes and conduits embedded within a slab or wall (other than those merely passing through), unless otherwise indicated on Drawings or approved:

1. Maximum outside dimension of pipe or conduit: Be not greater than one third the overall thickness of slab or wall.
2. Spacing of pipes or conduits: Be greater than or equal to three diameters or widths on center.

G. Close open ends of piping, conduits, and sleeves embedded in concrete with caps or plugs prior to placing concrete.

H. Ensure specified tests and inspections on embedded piping are completed and satisfactory before starting concrete placement. Ensure mechanical or electrical tests and inspections are completed and satisfactory prior to starting concrete placement. Do not place concrete until unsatisfactory items and conditions have been corrected.

I. Position embedded anchor bolts using templates.

J. Correct embedded items not installed in the location or alignment needed or displaced by concrete placement without additional compensation.

3.5 PREPARATION

A. Previously Placed Concrete:

1. Prepare joints as specified in Section 031500 “Concrete Joints and Accessories”.

B. Remove debris and ice from formwork, reinforcement, and concrete substrates.

C. Remove water from areas receiving concrete before concrete is placed.

3.6 CONCRETE APPEARANCE

A. Remix concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Reject remixed concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Make, at no additional cost to Owner, changes in the concrete mix design for future deliveries only by adjusting one or more of the following if the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finish ability are observed:

1. Gradation of aggregate.
2. Proportion of fine and coarse aggregate.
3. Percentage of entrained air, within the allowable limits.

B. Provide concrete having a homogeneous structure which, when hardened, will have the specified strength, durability, and appearance. Provide mixtures and workmanship such that concrete surfaces, when exposed, will require no finishing except as specified in Section 033500 “Concrete Finishing”.

3.7 INSTALLATION

A. Placing Concrete:

1. Place concrete according to ACI 301, 318, and 350.
2. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.
3. Ensure that reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.
4. Install vapor retarder under interior slabs on grade according to ASTM E1643.
5. Lap vapor retarder joints minimum 6 inches and seal watertight by adhesive applied between overlapping edges and ends.
6. Repairs:

    a. Repair vapor retarder damaged during placement of concrete reinforcement.
    b. Using vapor retarder material, lap over damaged areas minimum 6 inches and seal watertight.

7. Verify that formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, standing water, dirt, debris, and other foreign materials from forms and exposed joint surfaces. Confirm that reinforcement and other embedded items are securely in place. Have a worker at the location of the placement who can check that reinforcement and embedded items remain in designated locations and alignments while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Do not place concrete on frozen subgrade, snow, or ice.
8. Deposit concrete as near its final position as possible to prevent segregation due to rehandling or flowing. Place concrete continuously at a rate that allows the concrete

previously placed to be integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.

9. Pumping of concrete will be permitted. Use a mix design and aggregate sizes chosen for pumping and submit for approval. Do not use pipelines made of aluminum or aluminum alloy. When concrete is pumped, determine slump at point of truck discharge and determine air content at point of placement.
10. Remove temporary spreaders from forms when the spreader is no longer needed. Temporary spreaders may remain embedded in concrete only when made of galvanized steel or concrete and if prior approval has been obtained.
11. Do not place concrete for supported elements until concrete previously placed in the supporting element has attained design strength.
12. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms to bring the full surface of the mortar against the form. Prevent the formation of surface voids.
13. Slabs:

    a. After bulkheads, screeds and jointing materials have been positioned, place concrete continuously between joints beginning at a bulkhead, edgeform, or corner. Place each batch into the edge of the previously placed concrete to avoid stone pockets and segregation.
    b. Avoid delays in placement. If there is a delay in placement, spade and consolidate concrete placed after the delay at the edge of previously placed concrete to avoid cold joints. Bring concrete to correct level and strike off with a straightedge. Use bullfloats or darbies to smooth the surface, leaving it free of humps or hollows.
    c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow one hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep top surface of the wall moist to prevent cold joints.

14. Formed Concrete:

    a. Place concrete in forms using tremie tubes taking care to prevent segregation. Maintain bottom of tremie tubes near the surface of concrete already placed. Do not permit concrete to drop freely more than 4 feet. Place concrete for walls in 12 inch to 24 inch lifts, keeping the surface horizontal. If a high-range water-reducing admixture is used do not permit concrete to drop freely more than 15 feet; maximum lift thickness not to exceed 7 feet.
15. Bollards: Conform to requirements specified above for formed concrete and completely fill pipe with concrete as indicated.
16. Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.
17. Place floor slabs in indicated checkerboard pattern.

B. Compacting:

1. Consolidate concrete by vibration and puddling, spading, rodding, or forking so that concrete is completely worked around reinforcement, embedded items, and openings and into corners of forms. Continuously perform puddling, spading, rodding, and forking

along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting, or planes of weakness.

2. Compact concrete with mechanical vibrators. Do not order concrete until vibrators (including standby units in working order) are on the job.
3. Use mechanical vibrators having a minimum frequency of 8000 vibrations per minute. Insert vibrators and withdraw at points from 18 inches to 30 inches apart. Vibrate sufficiently at each insertion to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep standby vibrators on the site during concrete placing operations.
4. Concrete Slabs: Vibrate concrete slabs less than 8 inch thick by vibrating screeds. Vibrate concrete slabs 8 inches and thicker by internal vibrators and (optionally) with vibrating screeds. Place vibrators into concrete vertically. Do not lay vibrators horizontally or lay over.
5. Walls and Columns: Use internal vibrators rather than form vibrators, unless otherwise approved by Engineer. General: for each vibrator needed to level the batch at the point of discharge, use one or more additional vibrators to densify, homogenize, and perfect the surface. Insert vibrators vertically at regular intervals, through fresh concrete and slightly into the previous lift, if any.
6. Amount of Vibration: Use vibrators to consolidate properly placed concrete. Do not use vibrators to move or transport concrete in the forms. Continue vibration until:

    a. Frequency of vibrator returns to normal.
    b. Surface appears liquefied, flattened and glistening.
    c. Trapped air ceases to rise.
    d. Coarse aggregate has blended into surface, but has not disappeared.

3.8 PROTECTION

A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.

B. Protect finished surfaces and slabs whenever ambient conditions of humidity, temperature, sunlight, and wind may result in the rapid evaporation of water from the concrete, to prevent checking and crazing, until the beginning of curing.

C. Cold Weather Concreting:

1. For this Specification, ‘cold weather’ is defined as a period when for more than three successive days, the average daily outdoor temperature drops below 40 degrees F. Calculate average daily temperature as the average of highest and lowest temperature during the period from midnight to midnight.
2. Batch, deliver, place, cure, and protect concrete during cold weather in compliance with the recommendations of ACI 306R and the additional requirements of this Section.
3. Review cold weather concreting plan at preconstruction meeting. Include methods and procedures for use during cold weather including the production, transportation, placement, protection, curing, and temperature monitoring of concrete and procedures to be implemented upon abrupt changes in weather conditions or equipment failures.
4. Maintain minimum temperature of concrete immediately after placement and during the protection period as indicated in Table 3. The temperature of the concrete in place and

during the protection period shall not exceed these values by more than 20 degrees F. Prevent overheating and non-uniform heating of the concrete.

TABLE 3

Minimum Concrete
Temperatures For
Section Dimensions

Minimum Concrete Temperature:	< 12 inches 55 degrees F	12 - 36 inches 50 degrees F

5. Protect concrete during periods of cold weather to provide continuous warm, moist curing (with supplementary heat when required by weather conditions) for a total of at least 350 degree-days of curing.

    a. Degree-days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the surface of the concrete, where 7 days at an average 50 degrees F equals 350 degree-days.
    b. To calculate the weighted average daily air temperature, sum hourly measurements of air temperature in the shade at concrete surface taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.

6. Do not use salt, manure, or other chemicals for protection.
7. At the end of the protection period, allow the concrete to cool gradually to the ambient temperature. If water curing has been used, do not expose concrete to temperatures below those shown in Table 3 until at least 24 hours after water curing has been terminated and air-dry concrete for at least 3 days prior to first exposure to freezing temperatures.
8. During periods not defined as cold weather, but when freezing temperatures are expected or occur, protect concrete surfaces from freezing for the first 24 hours after placing.

D. Hot Weather Concreting:

1. For this Specification, ‘hot weather’ is defined as any combination of high air temperatures, low relative humidity, and wind velocity which produces a rate of evaporation as estimated in ACI 305R, approaching or exceeding 0.2 pounds per square foot per hour.
2. Batch, deliver, place, cure, and protect concrete during hot weather in compliance with the recommendations of ACI 305R and the additional requirements of this Section.

    a. Temperature of concrete being placed shall not exceed 90 degrees F. Maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall not cause loss of slump, flash set or cold joints.
    b. Promptly deliver concrete to the site and promptly place the concrete upon its arrival at the site, not exceeding the maximum time interval specified in Paragraph 3.2 I.4. Provide vibration immediately after placement.
    c. Engineer may direct Contractor to immediately cover concrete with sheet curing material.

3. Review hot weather concreting plan at preconstruction meeting. Include methods and procedures for use during hot weather, including production, placement, and curing.

3.9 REMOVAL OF FORMS

A. Do not remove forms before concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces, nor before reaching the following number of day-degrees of curing, whichever is longer.

TABLE 4

Forms for	Degree Days
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of degree-days in Paragraph 3.8C).

B. Do not remove shores until concrete has attained at least 70 percent of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.

C. In cold weather when temperature of concrete exceeds ambient air temperature by 20 degrees F at the end of the protection period, loosen forms and leave in place for at least 24 hours to allow concrete to cool gradually to ambient air temperature.

3.10 FIELD QUALITY CONTROL

A. Inspection and Testing: Performed by Owner's testing laboratory according to ACI 318.

B. Provide unrestricted access to Work and cooperate with appointed testing and inspection firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review and approval prior to commencement of Work.

D. Concrete Inspections:

1. Continuous Placement Inspection: Inspect for proper installation procedures.
2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.

E. Strength Test Samples:

1. Sampling Procedures: Comply with ASTM C172.
2. Cylinder Molding and Curing Procedures:

    a. Comply with ASTM C31.
    b. Cylinder Specimens: Standard cured.

3. Sample concrete and make one set of five cylinders for every 75 cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and walls. Form specimens in 6 inch diameter by 12 inch long non-absorbent cylindrical molds.

4. If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch, if less than five batches are used.
5. Make one additional cylinder during cold weather concreting and field cure.

F. Field Testing:

1. Slump Test Method: Comply with ASTM C143.
2. Air Content Test Method: Comply with ASTM C173.
3. Temperature Test Method: Comply with ASTM C1064.
4. Compressive Strength Concrete:

    a. Measure slump and temperature for each sample. When concrete is pumped, slump will be determined at point of truck discharge. If the slump is outside the specified range, the concrete will be rejected.
    b. Measure air content in air-entrained concrete for each sample. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If aggregates with high absorptions are used, use the latter test method. When concrete is pumped, air content will be determined at point of placement.

G. Cooperate in the making of tests by allowing free access to the work for the selection of samples. Provide four firmly braced, insulated, heated, closed wooden curing boxes, each sized to hold ten specimens, complete with cold weather temperature and hot weather temperature control thermostat for initial curing and storage from time of fabrication until shipment to the testing lab. Protect the specimens against injury or loss through construction operations.

H. Cylinder Compressive Strength Testing:

1. Test Method: Comply with ASTM C39.
2. Test Acceptance: According to ACI 318.
3. Test one cylinder at seven days.
4. Test one cylinder at fourteen days.
5. Test two cylinders at 28 days.
6. Retain one cylinder for 56 days for testing when requested by Engineer.
7. Dispose of remaining cylinders if testing is not required.
8. When the average 28 day compressive strength of the cylinders in any set falls below the required compressive strength or below proportional minimum seven-day or 14-day strengths (where proper relation between seven, 14 and 28 day strengths have been established by tests), change proportions, cementitious content, or temperature conditions to achieve the required strengths without additional compensation.

I. Core Compressive Strength Testing:

1. Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. Use results of tests on such cores as basis for acceptance, rejection, or determining the continuation of concrete work. Right of Engineer to take such cores shall not be construed as creating any obligation to take such cores, and not exercising this right to do so shall not relieve Contractor from meeting specification requirements. Cooperate in

obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding, and such incidental equipment as may be required. Repair core holes with non-shrink grout as specified in Section 036000 “Grouting”. Work of cutting, testing, and repairing the cores will be at the expense of Contractor if defective work is uncovered. If no defective work is found, such cost will be at the expense of Owner.

2. Sampling and Testing Procedures: Comply with ASTM C42.
3. Test Acceptance: According to ACI 318.
4. Drill three cores for each failed strength test from failed concrete.

J. Patching:

1. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
2. It is the intent of these Specifications to require quality work including forming, mixing, and placement of concrete and curing so completed concrete surfaces will require no patching or repairs.
3. As soon as forms have been stripped and concrete surfaces exposed: remove fins and other projections; fill recesses left by the removal of form ties; and repair surface defects which do not impair structural strength. Clean exposed concrete surfaces and adjoining work stained by leakage of concrete.
4. Immediately after removal of forms, remove tie cones and metal portions of ties as specified in Section 031000 “Concrete Forming and Accessories”. Fill holes promptly upon stripping as follows: Moisten the hole with water, followed by a 1/16 inchbrush coat of neat cement slurry mixed to consistency of a heavy paste. Immediately plug hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer grout into the hole until dense, and an excess of paste appears on the surface in the form of a spider web. Trowel smooth with heavy pressure. Avoid burnishing.
5. When filling tie cone holes and patching or repairing exposed surfaces use the same source of cement and sand as used in the parent concrete. Adjust color to match by addition of white cement. Rub lightly with a fine carborundum stone at an age of one to five days as necessary to bring surface down with parent concrete. Do not damage or stain virgin skin of surrounding parent concrete. Wash thoroughly to remove rubbed matter.
6. For very heavy (generally formed) patches, Engineer may order the addition of pea gravel to the mixture and the proportions modified as follows:

Material	Volumes	Weights
Cement	1.0	1.0
Sand	1.0	1.0
Pea Gravel	1.5	1.5

7. Patch imperfections according to ACI 301.
8. Defective concrete and honeycombed areas: Chip down square and at least 1 inch 1-inch deep to sound concrete with hand chisels or pneumatic chipping hammers. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded in the parent concrete. If honeycomb exists around reinforcement, chip to provide a clear space at least 3/8 inch wide around the steel. For areas less than 1-1/2 inches deep, the patch may be made in the same manner as described above for filling form tie holes, care being exercised to use adequately dry (non-trowelable) mixtures and to avoid sagging. Thicker repairs will require build-up in successive 1-1/2 inch layers on successive days, each layer being applied with slurry as described above.

K. Defective Concrete:

1. Description: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
2. Repair or replacement of defective concrete will be determined by Engineer.
3. Do not patch, fill, touch up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.11 FAILURE TO MEET REQUIREMENTS

A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, Engineer may require changes in proportions or materials, or both, to apply to the remainder of the work in accordance with Paragraph 1.8E. Furthermore, Engineer may require additional curing on those portions of the structure represented by the test specimens which fall below the values given in Table 1. The cost of such additional curing shall be at no additional cost to Owner. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. Coring and testing and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, without additional compensation. In such cases of failure to meet strength requirements, Contractor and Owner shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is Contractor.

B. When the tests on control specimens of concrete fall below the required strength, Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In cases where tests of cores fall below the values given in Table 1, Engineer, in addition to other recourses, may require load tests on any one of the slabs, walls, beams, and columns in which such concrete was used. Test need not be made until concrete has aged 60 days. Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. Perform coring and testing, load tests, and any strengthening or concrete replacement required because strengths of test specimens are below that specified, without additional compensation.

C. Should the strength of test cylinders fall below 60 percent of required minimum 28 day strength, concrete shall be rejected, removed, and replaced without additional compensation.

3.12 SCHEDULE

A. Following Table 5 are general applications for various concrete classes and design strengths:

TABLE 5

Class	Design Strength (psi)	Description
A	2,500	Concrete fill, concrete fill for bollards, electrical raceway encasement and pipe encasement.
E1	4,500	Structural concrete foundation mats and slabs, walls, and footings 24 inches and greater in thickness.
E2	4,500	Except as noted above for Class E1 concrete: Structural concrete greater than 10 inches in thickness including walls, slabs on grade, elevated slab and beam systems, columns, grade beams, and all other structural concrete greater than 10 inches in thickness.
E3	4,500	Structural concrete 10 inches or less in thickness including walls, slabs on grade, elevated slab and beam systems, columns and all other structural concrete 10 inches or less in thickness.

END OF SECTION 033000

SECTION 033500 - CONCRETE FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Finishing of concrete.
2. Floor surface treatment.

B. Related Requirements:

1. Section 031000 “Concrete Forming and Accessories” for cast-in-place concrete formwork, form ties and form release agent.
2. Section 031500 “Concrete Joints and Accessories” for waterstops, premolded joint filler, sealant and neoprene bearing pads.
3. Section 033000 “Cast-in-Place Concrete” for cast-in-place concrete.
4. Section 033900 “Concrete Curing” for procedures for curing horizontal and vertical concrete surfaces.
5. Section 079200 “Joint Sealants” for sealants, sealers, and backing for sealing joints.

1.3 COORDINATION

A. Coordinate Work of this Section with concrete placement and concrete curing.

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information on sealer, curing compounds, curing papers, compatibilities, and limitations.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

C. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.

2. Submit manufacturer's approval of applicator.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit information on maintenance renewal of applied coatings.

1.7 QUALITY ASSURANCE

A. Perform Work according to ACI 301 and 302.1.

B. Maintain one copy of each standard affecting Work of this Section on Site.

C. Provide the services of a qualified field representative of the manufacturer of sealer or hardener to instruct the contractor on the proper application of the product under prevailing job conditions.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.9 RESPONSIBILITY FOR CHANGING FINISHES

A. Surface finishes specified for concrete to receive coatings or other finish materials are those required for the proper application of the products specified under other Sections. Where products different from those specified are approved for use, determine if changes in finishes are required and provide the proper finishes to receive these products.

B. Perform changes in finishes made to accommodate products different from those specified at no additional compensation. Submit proposed new finishes to Engineer for approval.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.11 AMBIENT CONDITIONS

A. Temporary Heat: Maintain minimum ambient temperature of 50 degrees F.

B. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources from affecting personnel or concrete.

PART 2 - PRODUCTS

2.1 COMPOUNDS - HARDENERS AND SEALERS

A. Cementitious and component materials required for finishing concrete surfaces: As specified in Section 033000 “Cast-in-Place Concrete”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that floor surfaces are acceptable to receive Work of this Section.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FORMED SURFACES

A. Form Removal: Conform to Sections 031000 “Concrete Forming and Accessories” and 033000 “Cast-In-Place Concrete”.

B. Clean exposed concrete surfaces and adjoining work stained by leakage of concrete.

C. Off-Form Finish:

1. Remove fins and other projections and fill tie cones and defects as specified in Section 031000 “Concrete Forming and Accessories” and 033000 “Cast-In-Place Concrete”.

D. Rubbed Finish:

1. Immediately upon stripping forms and before concrete changes color, carefully remove fins with a hammer. While surface is still damp apply a thin coat of medium consistency neat cement slurry using bristle brushes to provide a bonding coat within pits, air holes or blemishes in parent concrete. Do not coat large areas of the surface with this slurry.
2. Before slurry dries or changes color, apply a dry (almost crumbly) grout consisting of one volume cement to 1-1/2 volumes of clean masonry sand having a fineness modulus of approximately 2.25 and complying with gradation requirements of ASTM C144. Apply grout uniformly using damp (neither dripping wet nor dry) pads of coarse burlap approximately 6 inch square used as a float. Scrub grout into pits and air holes to provide a dense mortar in concrete imperfections to be patched.

3. Allow mortar to partially harden for one or two hours depending upon weather. If the air is hot and dry, keep surface damp during this period using a fine, fog spray. When grout has hardened sufficiently so it can be scraped from the surface with perpendicular edge of a steel trowel without damaging the grout in small pits or holes, cut off grout that can be removed with a trowel. Grout allowed to remain on surface too long will get too hard and will be difficult to remove.
4. Allow the surface to dry and rub it vigorously with clean dry burlap to completely remove dried grout. No visible film of grout should remain after this rubbing. Entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow grout to dry after it has been cut off with trowel so it can be wiped off clean with the burlap.
5. On the day following repair of pits, air holes, and blemishes, wipe surfaces clean with dry, used pieces of burlap containing old hardened mortar, which will act as a mild abrasive. After this treatment, there should be no built-up film remaining on the parent surface; if however a built-up film remains, use a fine abrasive stone to remove such material without breaking through original concrete surface film. Scrub lightly to remove excess material without working up a lather or mortar or changing concrete texture.
6. Follow final bagging or stoning operation with a thorough wash-down with stiff bristle brushes to remove extraneous materials from the surface. Spray surface with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after repair grout application.
7. Rubbed Finish application may be deleted by Engineer if unfinished concrete surface is of superior quality and without surface voids.

E. Abrasive Blast Finish:

1. Coordinate with Rubbed Finish application. Do not begin until materials applied during Rubbed Finish operation have cured or before concrete has reached minimum 7-day strength. Apply abrasive blast finish only where indicated on Contract Documents.
2. Prepare a sample area of minimum 4 feet high by 16 feet wide Blast Finish as directed by Engineer on a portion of new wall construction which will not be exposed in the final work. Sample area shall contain a variety of finishes obtained with different nozzles, nozzle pressures, grit materials, and blasting techniques for selection by Engineer. Leave final accepted sample exposed until completion of all Blast Finish operations.
3. Perform Blast Finish operations meet regulatory agency requirements. Obtain required permits or licenses to perform the work.
4. Perform abrasive blast finishing in as continuous an operation as possible, utilizing same work crew to maintain continuity of finish on each surface or area of work. Maintain patterns or variances in depths of blast as present on the accepted sample.
5. Use an abrasive grit of proper type and gradation, as well as equipment and technique to expose aggregate and surrounding matrix surfaces as follows:

    a. Medium: Generally expose coarse aggregate to a 1/4 inch to 3/8 inch reveal.

6. Abrasive blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure and blasting techniques required to match the approved mock-up.
7. Upon completion of Blast Finish operation, thoroughly flush finished surfaces with clean clear water to remove residual dust and grit.
8. After concrete has cured for a minimum of 28 days, apply a clear acrylic sealer as directed by manufacturer.

3.3 FLOORS AND SLABS

A. Consider the potential for longer setting time in concrete containing fly ash or ground granulated blast furnace slag.

B. Compact with internal vibrators as specified in Section 033000 “Cast-In-Place Concrete” and screed to established grades.

C. Following screeding as specified above, float slabs as approved by the Engineer. Continue floating operation until sufficient mortar is brought to surface to fill voids. Test surfaces with a straightedge to detect and eliminate high and low spots. Do not overwork concrete as evidenced by excess water and fine material on its surface.

D. Do not use "jitterbugs" or other special tools designed for the purpose of forcing the coarse aggregate away from the surface and allowing a layer of mortar to accumulate on any slab finish. Do not dust surfaces with dry materials. Round off edges of slabs and tops of walls with a steel edging tool. Use steel edging tool with radius of 1/4 inchfor slabs subject to wheeled traffic.

E. Measure floor flatness the day after a concrete floor is finished and before the shoring is removed, in order to eliminate any effects of shrinkage, curling, and deflection.

F. Finish Descriptions:

1. Steel Trowel Finish:

    a. Finish by screeding and floating with straightedges to bring the surfaces to indicated elevations. While concrete is still green, but sufficiently hardened to bear a person's weight without deep imprint, wood float surface to a true and even plane with no coarse aggregate visible.
    b. Apply sufficient pressure on wood floats to bring moisture to the surface. After surface moisture has disappeared, hand steel trowel to produce a smooth, impervious surface, free from trowel marks.
    c. Trowel the surface again for the purpose of burnishing. Final troweling shall produce a ringing sound from the trowel.
    d. Do not use dry cement or additional water in troweling.

2. Wood Float Finish:

    a. Finish by screeding with straightedges to bring the surfaces to indicated elevations.
    b. Use a wood float to compact and seal surface. Remove laitance and leave a clean surface.

3. Light Broomed Finish:

    a. Steel trowel finish, as specified above, but omit final troweling and finish by drawing a fine-hair broom lightly across concrete surface.
    b. Broom in direction and parallel to expansion joints, or in the case of inclined slabs, perpendicular to slope or as directed otherwise.

4. Broomed Finish:

a. Steel trowel finish, as specified above, but omit the final troweling
b. While the concrete is still soft enough, finish the surface with a stiff coarse fiber broom to produce the pattern and depth of scoring as approved by the Engineer.

5. Power Machine Finish:

a. In lieu of hand steel trowel finishing, use an approved power machine for finishing concrete floors and slabs in accordance with directions of machine manufacturer and as approved by the Engineer.
b. Do not use a power machine until the concrete has attained necessary set to allow finishing without introducing high and low spots in the slab.
c. Hand steel trowel those areas of slabs not accessible to power equipment. Provide a final steel troweling done by hand over all areas.

3.4 APPLICATION

A. Floor Surface Treatment:

1. Apply sealer on floor surfaces in accordance with manufacturer's recommendations.

3.5 TOLERANCES

A. Provide floors and slabs level with a tolerance of 1/8 inch when checked with a 10 foot straightedge, except where drains occur, in which case pitch floors to drains as indicated. When either of above criteria are not met, remove, grind, or make other corrections as directed by the Engineer, at no additional compensation.

B. Measure floor flatness the day after a concrete floor is finished and before shoring is removed, in order to eliminate any effects of shrinkage, curling, and deflection. Support a 10 foot long straightedge at each end with steel gauge blocks whose thickness are equal to tolerance specified. Have no floor surface crowns so high as to prevent a 10 foot straightedge from resting on two end blocks, or low spots so that a third block of twice the tolerance in thickness can pass under the supported straightedge. Compliance with designated limits in four of five consecutive measurements will confirm compliance, unless obvious faults are observed. Make a check for adequate slope and drainage to confirm compliance.

C. Maximum Variation of Surface Flatness for Exposed Concrete Floors and Slabs: 1/4 inch in 10 feet.

D. Maximum Variation of Surface Flatness under Seamless Resilient Flooring: 1/4 inch in 10 feet.

E. Measure for FF and FL tolerances for floors and slabs according to ASTM E1155, within 48 hours after slab installation.

F. Finished Concrete:

1. Exposed to View and Foot Traffic: FF 75 and FL 40.
2. Correct slab surface when actual FF or FL number for floor installation measures less than required.

3.6 FIELD QUALITY CONTROL

A. Acceptance:

1. Areas requiring corrective Work will be identified by Engineer.
2. Correct defects in defined floor or slab by grinding or removal and replacement of defective Work.
3. Remeasure corrected areas by procedure as specified in TOLERANCES Article.

3.7 SCHEDULE OF FINISHES

A. Finish concrete in various specified manners either to remain as natural concrete or to receive an additional applied finish or material under another Section. Where products different from those specified are approved for use, comply with requirements of PART 1 Article entitled "Responsibility for Changing Finishes."

B. Finish base concrete for following grouped conditions as scheduled in following Paragraphs and as further specified in this Section.

C. Exposed Exterior Concrete:

1. Concrete for exterior on stairs and other horizontal areas: Broomed finish, non-slip.
2. Tops of curbs and pads: Steel trowel finish.

D. Exposed Interior Concrete:

1. Exposed interior concrete including underside slabs, beams, walls, columns and stairs and sides of openings, beams, and stairs: Rubbed finish.
2. Concrete for interior walking surfaces, excluding stairs: Wood float finish.
3. Concrete for interior stairs and metal pan stairs: Light broomed finish, non-slip.

E. Concrete Associated with Structures:

1. Exposed exterior concrete excluding slabs and walking surfaces: Rubbed finish. Rub open tank walls above and to 1 foot below normal water line.
2. Walls of open topped tanks: Rubbed finish above and to 1 foot below normal water line. Off-form finish from 1 foot below normal water line to base of wall.
3. Concrete stairs, landings and platforms below normal water level in liquid retaining structures: Broomed finish, non-slip.
4. Concrete on which liquids flow or are contained: Steel troweled finish.
5. Concrete tank bottoms to be covered with grout: Broom finish as approved. Refer to Section 036000 "Grouting" for additional requirements.

F. Miscellaneous Concrete:

1. Ribbed Concrete: Off-form finish.
2. Concrete not exposed in finished work and not scheduled to receive an additional applied finish or material: Off-form finish at vertical surfaces, consolidate, and screed to grade at horizontal surfaces.

3. Concrete to have an abrasive blast finish: Refer to appropriate Paragraph in above PART 3 Article entitled “Formed Surfaces.”

END OF SECTION 033500

SECTION 033900 - CONCRETE CURING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Initial and final curing of horizontal and vertical concrete surfaces.

B. Related Requirements:

1. Section 033000 “Cast-in-Place Concrete” for coordination of the Work of this Section with concrete placement, including Hot and Cold Weather and other environmental factors affecting concreting procedures.
2. Section 033500 “Concrete Finishing” for surface finishing of concrete slabs and walls.

1.3 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's information on curing compounds, mats, paper, sheets, and film, including compatibilities and limitations.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

C. Qualifications Statement:

1. Submit qualifications for manufacturer.

D. Certifications:

1. Certify curing compound is suitable for use in contact with potable water after 30 days and is non-toxic and free of taste or odor.

1.5 QUALITY ASSURANCE

A. Perform Work according to ACI 301, 318, and 350.

B. Maintain one copy of each standard affecting Work of this Section on Site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Membrane-Curing Compound, Type A:

1. Comply with ASTM C309, Type 1D, Class A, containing no wax, paraffin or oil and be non-yellowing.
2. Comply with Federal, State, and local VOC limits.

B. Absorptive Mats, Type D:

1. Description:

a. Material: Burlap-polyethylene (PE).
b. Minimum Weight: 9 oz./sq. yd.
c. Bonded to prevent separation during handling and placing.

2. Description: Comply with ASTM C171.

C. Water: Potable; not detrimental to concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to be cured.

3.2 APPLICATION

A. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain a temperature of at least 50 degrees F at concrete surface for a minimum of seven days after placement. Use the following curing methods as specified:

1. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling, or covered with saturated burlap. Begin water curing as soon as concrete attains an initial set and maintain water curing 24 hours a day. Do not permit concrete surface to dry out at any time during curing period. Provide temperature of curing water within 20 degrees Fof concrete temperature.
2. Sheet Material Curing: Cover entire surface with sheet material. Anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
3. Membrane Curing: Apply over entire concrete surface except as follows.

    a. Do not apply curing compound on any concrete surface where additional concrete or grout is to be placed, where concrete sealers or surface coatings are to be used, or where concrete finish requires an integral floor product.
    b. Apply curing compound as soon as free water on the surface has disappeared and no water sheen is visible.
    c. Do not apply after the concrete is dry or when curing compound can be absorbed into the concrete. Apply in compliance with manufacturer's recommendations.

B. Specified Applications of Curing Methods:

1. Slabs for Liquid Retaining Structures: Water cure only.
2. Slabs on Grade and Footings (not used to retain liquids): Water cure or sheet material cure.
3. Structural Slabs (other than Liquid Retaining Structures): Water cure.
4. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water cure.
5. Formed Surfaces:

    a. No curing, if nonabsorbent forms are left in place seven days.
    b. Water cure if absorbent forms are used.
    c. Water cure if forms are removed prior to seven days.
    d. Sheet cure or membrane cure if forms are removed prior to seven days.
    e. Water cure exposed horizontal surfaces of formed walls or columns for seven days or until next placement of concrete is made.

6. Surfaces of Concrete Joints: Water cure or sheet material cure.

C. Protect finished surfaces and slabs whenever ambient conditions of humidity, temperature, sunlight, and wind may result in the rapid evaporation of water from the concrete, to prevent checking and crazing, until the beginning of curing.

3.3 PROTECTION

A. Do not permit traffic over unprotected surfaces.

B. Reference Section 033000 “Cast-In-Place Concrete” for additional protection requirements.

END OF SECTION 033900

SECTION 036000 - GROUTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Portland cement grout.
2. Cement grout.
3. Rapid-curing epoxy grout.
4. Nonshrink epoxy grout.
5. Nonshrink cementitious grout.

B. Related Requirements:

1. Section 031000 “Concrete Forming and Accessories.”
2. Section 033000 “Cast-in-Place Concrete.”
3. Section 033200 “Concrete Reinforcing.”
4. Section 051200 “Structural Steel Framing” for grout related to structural framing members.
5. Section 055000 “Metal Fabrications” for grout related to miscellaneous metals.

1.3 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information regarding grout and surface preparation, mixing and installation.

1. Commercially manufactured nonshrink cementitious grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, and conformity to the specified ASTM standards.
2. Commercially manufactured nonshrink epoxy grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, and conformity to the specified ASTM standards.
3. Cement grout. Include the type and brand of cement, the gradation of fine aggregate, product data on any proposed admixtures and the proposed grout mix.
4. Concrete grout. Include data as required for concrete and for fiber reinforcement as delineated in Section 033000 “Cast-In-Place Concrete.”

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Manufacturer Instructions: Submit instructions for mixing, handling, surface preparation, and placing epoxy-type and nonshrink grouts.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 QUALITY ASSURANCE

A. Maintain one copy of each standard affecting Work of this Section on Site.

B. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience in production and use of provided grouts.

C. Independent testing laboratory shall meet the requirements of ASTM E329 and ASTM C1077 and be acceptable to the Engineer. Laboratories affiliated with the Contractor or in which the Contractor or officers of the Contractor's organization have beneficial interest are not acceptable.

D. Pre-installation Meeting: At least ten working days before grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing and curing procedures for each product proposed for use. Notify all parties involved with grouting, including the Engineer, of the meeting at least ten working days prior to its scheduled date.

E. Services of Manufacturer's Representative: Provide services of a field technician of the nonshrink grout manufacturer [epoxy grout manufacturer] who has performed at least five projects of similar size and complexity during the last five years, to attend the pre-installation meeting, to be present for the initial installation of each type of nonshrink grout, and to correct installation problems.

F. Field testing of concrete grout will be as specified for concrete in Section 033000 “Cast-In-Place Concrete.”

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions. Limit total storage time from date of manufacture to date of installation to six months or the manufacturer’s recommended storage time, whichever is less.

C. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location.
2. Provide additional protection according to manufacturer instructions.

1.7 AMBIENT CONDITIONS

A. Maximum Conditions: Do not perform grouting if temperatures exceed 90 degrees F.

B. Minimum Conditions: Do not perform grouting if the minimum temperature of base plates, supporting concrete and grout are less than 40 degrees F. Maintain minimum temperature of 40 degrees F before, during, and after grouting, until grout has set.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT GROUT

A. Portland Cement: Comply with ASTM C150/C150M, Type I and II.

B. Water:

1. Potable.
2. No impurities, suspended particles, algae, or dissolved natural salts in quantities capable of causing:

a. Corrosion of steel.
b. Volume change increasing shrinkage cracking.
c. Efflorescence.
d. Excess air entraining.

C. Fine Aggregate:

1. Washed natural sand.
2. Gradation:

a. Comply with ASTM C33/C33M.
b. Represented by smooth granulometric curve within required limits.

3. Free from injurious amounts of organic impurities according to ASTM C40/C40M.

D. Mix:

1. Portland cement, sand, and water.
2. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 RAPID-CURING EPOXY GROUT

A. Description:

1. High-strength, three-component epoxy grout formulated with thermosetting resins and inert fillers.
2. Rapid-curing, high adhesion, and resistant to ordinary chemicals, acids, and alkalis.

B. Performance and Design Criteria:

1. Compressive Strength:

   a. 12,000 psi at seven days.
   b. Comply with ASTM C579.

2. Minimum Tensile Strength:

   a. 2,000 psi.
   b. Comply with ASTM C307.

3. Coefficient of Expansion:

   a. $30x10^{-6}$ inch per degree F.
   b. Comply with ASTM C531.

4. Shrinkage:

   a. None.
   b. Comply with ASTM C827/C827M.

2.3 NONSHRINK EPOXY GROUT

A. Description:

1. Pre-proportioned, prepackaged, three-component, nonshrink epoxy grout, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate.

B. Performance and Design Criteria:

1. Minimum Compressive Strength:

   a. 10,000 psi at seven days.
   b. Comply with ASTM C579.

2. Coefficient of Expansion:

   a. $30x10^{-6}$ inch per degree F.
   b. Comply with ASTM C531.

3. Minimum Tensile Strength:

   a. 1,800 psi.
   b. Comply with ASTM C307.

C. Product: Provide one of the following or equal:

1. Masterflow 648 CP; by BASF Building Systems.
2. Five Star HP Epoxy Grout; by Five Stars Products, Inc.
3. Sikadur 42 Grout-Pak; by Sika Corp.
4. E3-G Epoxy Grout; by Euclid Chemical Co.

2.4 NONSHRINK CEMENTITIOUS GROUT

A. Description:

1. Pre-mixed and ready-for-use formulation requiring only addition of water.
2. Nonshrink, non-corrosive, nonmetallic, non-gas forming, not containing expansive cement and no chlorides.
3. No shrinkage when tested in conformity with ASTM C827/C827M.

B. Performance and Design Criteria:

1. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to ASTM C1107/C1107M for Grades B, C, D and CRD-C621 nonshrink grout:

a. Setting Time:

1) Initial: Approximately two hours.
2) Final: Approximately three hours.
3) Comply with ASTM C191.

b. Maximum Expansion: 0.10 to 0.40 percent.
c. Minimum Compressive Strength:

1) One-Day: 4,000 psi.
2) Seven-Day: 7,000 psi.
3) 28-Day: 10,000 to 10,800 psi.
4) Comply with CRD-C621.

2.5 CONCRETE GROUT

A. Description: Conform to the requirements of Section 033000 “Cast-In-Place Concrete”, except as follows. Proportion with Type II cement, coarse and fine aggregates, water, water reducing admixture, and air entraining agent to produce specified mix performance:

1. Average Strength (ASTM C579): 3,500 psi nominal strength.
2. Maximum Coarse Aggregate Size: 3/8-inch.
3. Minimum Cement Content: 540 lbs. per cubic yard.
4. Maximum Water to Cement Ratio: 0.45.
5. Maximum Slump: 5 inches.

B. Add synthetic reinforcing fibers as specified in Section 032000 “Concrete Reinforcing” to the concrete grout mix at the rate of 1.5 lbs. of fibers per cubic yard of grout. Add fibers from

manufacturer's pre-measured bags and according to manufacturer's recommendations to ensure complete dispersion of fiber bundles as single monofilaments within the concrete grout.

2.6 FORMWORK

A. As specified in this Section and in Section 031000 “Concrete Forming and Accessories”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify areas to receive grout.

3.2 PREPARATION

A. Place grout where indicated or specified over existing concrete and cured concrete which has attained its specified design strength unless otherwise approved by Engineer.

B. Remove defective concrete, ice, laitance, dirt, oil, grease, form release agents, paints, and other foreign material from concrete surfaces, which may affect the bond or performance of the grout by brushing, hammering, chipping, sand blasting or other similar dry mechanical means until sound and clean concrete surface is achieved. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

1. Air compressors used to clean surfaces in contact with grout shall be the oil-less type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.

C. Roughen concrete lightly, but not to interfere with placement of grout.

D. Remove foreign materials from metal surfaces in contact with grout.

E. Align, level, and maintain final positioning of components to be grouted.

F. Wash concrete surfaces clean and then keep moist for at least 24 hours prior to the placement of nonshrink cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, flooding the surface or other method acceptable to Engineer. Upon completion of the 24 hour period, remove visible water from the surface prior to grouting.

G. Nonshrink epoxy grouts do not require saturation of concrete substrate. Do not wet concrete surfaces to receive nonshrink epoxy grout. Completely dry surfaces in contact with epoxy grout before grouting.

H. Support equipment during alignment and installation of grout by shims, wedges, blocks, or other approved means. Prevent bond of shims, wedges and blocking devices by bond breaking coatings and remove after grouting unless otherwise approved by Engineer. Grout voids created by the removal of shims, wedges, and blocks.

3.3 INSTALLATION - GENERAL

A. Formwork:

1. Construct leakproof forms anchored and shored to withstand grout pressures.
2. Install formwork with clearances to permit proper placement of grout.
3. As specified in Section 031000 “Concrete Forming and Accessories”.

B. Mixing - Portland Cement Grout:

1. Use proportions of two parts sand and one part cement, measured by volume.
2. Prepare grout with water to obtain consistency to permit placing and packing.
3. Mix water and grout in two steps:

    a. Premix using approximately 2/3 of water.
    b. After partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing two to three minutes.

4. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
5. Do not add additional water after grout has been mixed.
6. Minimum Compressive Strength (ASTM C579):

    a. In 48 hours: 2,400 psi.
    b. In 28 days 7,000 psi.

C. Placing of Grout:

1. Place grout material quickly and continuously.
2. Do not use pneumatic-pressure or dry-packing methods.
3. Apply grout from one side only to avoid entrapping air.
4. Do not vibrate placed grout mixture or permit placement if area is being vibrated by nearby equipment.
5. Thoroughly compact final installation and eliminate air pockets.
6. Do not remove leveling shims for at least 48 hours after grout has been placed.

D. Curing:

1. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or by using wet burlap bags, soaker hoses or ponding.
2. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
3. After grout has attained its initial set, keep damp for minimum three days.

E. Reflect existing underlying expansion joints, partial contraction joints, and construction joints through the grout.

3.4 INSTALLATION - CONCRETE GROUT

A. Inspect slabs finished under Section 033500 “Concrete Finishing” and scheduled to receive concrete grout. ICRI CSP 6 (medium scarification). Protect and keep the surface clean until placement of concrete grout.

B. Remove debris and clean the surface by sweeping and vacuuming of all dirt and other foreign materials. Pressure wash the surface. Do not flush debris into tank drain lines.

C. Saturate the concrete surface for at least 24 hours prior to placement of the concrete grout by use of saturated burlap bags, soaker hoses or ponding. Remove excess water just prior to placement of the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry over the surface with a broom until it is coated with approximately 1/16 to 1/8-inch thick cement paste.

D. Place concrete grout to final grade using the scrapers of the installed mechanical equipment as a guide for surface elevation and to eliminate high and low spots. Unless specifically approved by the equipment manufacturer, do not use mechanical scraper mechanisms powered by their motors as a finishing machine or screed to push grout.

E. Steel trowel finish as specified in Section 033500 “Concrete Finishing.” Cure the concrete grout as specified for cast-in-place concrete in Section 033000 “Cast-In-Place Concrete.”

3.5 INSTALLATION - NONSHRINK EPOXY GROUTS

A. Mix in accordance with manufacturer's recommendations. Mix full batches only, to maintain proper proportions of resin, hardener, and aggregate. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Do not entrain air bubbles by mixing too quickly.

B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 degrees F or above 90 degrees F.

C. Place grout rapidly and continuously to avoid cold joints. Place grout in lifts in accordance with manufacturer's recommendations.

D. Provide forms as specified in Paragraph 3.3A. Place grout into the designated areas and prevent entrapment of air. Fill all spaces and provide full contact between grout and adjoining surfaces. Provide grout holes and vent holes as necessary.

E. Minimize ‘shoulder’ length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.

F. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth top surface of grout in conformity with manufacturer's recommendations.

G. Epoxy grouts are self-curing and do not require the application of water. Maintain formed grout within its recommended placement temperature range for at least 24 hours after placement, until grout compressive strength reaches 1,000 psi or as recommended by manufacturer, whichever is longer.

H. Provide grout control joints as indicated on Drawings.

3.6 SCHEDULE

A. Use particular types of grout as follows:

1. General Purpose Nonshrink Cementitious Grout (CRD-C621 Grade D): Use at locations where nonshrink grout is indicated, except for base plates greater in area than 3-feet wide by 3-feet long.
2. Flowable (precision) Nonshrink Cementitious Grout (CRD-C621 Grade B or C): Use under base plates greater in area than 3-feet wide by 3-feet long. Use at locations indicated to receive flowable (precision) nonshrink grout. Flowable (precision), nonshrink, cementitious grout may be substituted for general purpose nonshrink cementitious grout.
3. Nonshrink Epoxy Grout: Use at locations specifically indicated to receive nonshrink epoxy grout.
4. Cement Grout: Use where indicated.

END OF SECTION 036000

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SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Split-faced concrete masonry units.
2. Mortar and grout materials.
3. Reinforcement.
4. Accessories.
5. Mortar and grout mixes.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R. Indicate elevations of reinforced walls.

C. Samples for Initial Selection:

1. Split-faced CMUs, in the form of small-scale units.

D. Samples for Verification: For each type and color of the following:

1. Split-faced CMUs.

1.5 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Engineer and approved in writing.

B. Material Certificates: For each type of the following:

1. Integrally colored CMUs.
2. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
3. Grout mixes. Include description of type and proportions of ingredients.
4. Reinforcing bars.
5. Joint reinforcement.

C. Qualification Statements: For testing agency.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not

B. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain exposed masonry units and mortar aggregate from single source manufacturer.

B. For exposed masonry units, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Masonry to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

B. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 602.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. Decorative CMUs: ASTM C90, normal weight.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Best Block.
b. Texas Building Products.
c. York Building Products.

2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3,050 psi.
3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph above.
4. Pattern and Texture: Standard pattern, split-face finish.
5. Colors: As selected by Engineer from manufacturer's full range.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cemex S.A.B. de C.V.
b. Holcim (US) Inc; LafargeHolcim.
c. QUIKRETE.

E. Mortar Cement: ASTM C1329/C1329M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Lafarge North America Inc.

F. Colored Cement Products: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Argos USA LLC.
2) Holcim (US) Inc; LafargeHolcim.
3) Lehigh Hanson; HeidelbergCement Group.

2. Colored Masonry Cement:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cemex S.A.B. de C.V.
2) Holcim (US) Inc; LafargeHolcim.
3) Lafarge North America Inc.

3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
4. Pigments do not exceed 10 percent of portland cement by weight.
5. Pigments do not exceed 5 percent of masonry cement or mortar cement by weight.

G. Preblended Dry Mortar Mix: Packaged blend made from masonry cement or mortar cement, sand, mortar pigments, water repellents, and admixtures and complying with ASTM C1714/C1714M.

1. Preblended Dry Portland Cement Mortar Mix:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) QUIKRETE.
2) SAKRETE of North America LLC.
3) SPEC MIX, LLC.

2. Preblended Dry Masonry Cement Mortar Mix

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Amerimix.
2) SPEC MIX, LLC.

H. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Aggregate for Grout: ASTM C404.

J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Euclid Chemical Company (The); an RPM company.
b. GCP Applied Technologies Inc.

K. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Heckmann Building Products, Inc.
b. Hohmann & Barnard, Inc.
c. Wire-Bond.

C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hohmann & Barnard, Inc.
b. Wire-Bond.

2.7 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from urethane or PVC.

B. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
b. EaCo Chem, Inc.
c. PROSOCO, Inc.

2.8 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. For exterior masonry, use masonry cement or mortar cement mortar.

3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2,000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in grouted masonry, including starting course on footings.
3. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 REINFORCED UNIT MASONRY

A. Placing Reinforcement: Comply with requirements in TMS 602.

B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Special inspections: As indicated on Drawings.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.

E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

F. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for compressive strength.

G. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

H. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 7 days and at 28 days.

3.9 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Engineer's approval of sample cleaning before proceeding with cleaning of masonry.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
6. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

3.10 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 050519 - POST-INSTALLED ANCHORS AND REINFORCING BARS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Post-installed adhesive and expansion anchors for concrete substrates.
2. Post-installed reinforcing bar dowels using adhesive anchoring system.
3. Performance and proof testing of post-installed adhesive anchoring system for anchors and reinforcing bar dowels.

B. Related Requirements:

1. Section 033000 “Cast-In-Place Concrete” and related Sections for concrete, reinforcement, and accessories.
2. Various Sections in Division 05 related to metals.
3. Section 067413 “Fiberglass Reinforced Plastic Components”.
4. Various Sections in Divisions 22, 23, 26, and 27 related to facility utilities.
5. Various Sections in Divisions 40, 41, 43, and 46 related to process mechanical equipment.

1.3 ACTION SUBMITTALS

A. Post-Installed Expansion Anchors:

1. Design Data: Submit manufacturer’s specifications and data including recommended design values and physical characteristics for expansion anchors.
2. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, materials and finishes for post-installed expansion anchors installed into cracked concrete.
3. Installation Procedures: Submit procedures stating product proposed for use, and complete installation method.

B. Post-Installed Adhesive Anchoring System:

1. Design Data: Submit manufacturer’s specifications and data including recommended design values and physical characteristics, including temperature, humidity, and moisture limitations for adhesive anchoring system.

2. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, materials and finishes for post-installed adhesive anchoring system installed into cracked concrete.
3. Installation Procedures: Submit procedures stating method of drilling, product proposed for use, and complete installation method.

C. Post-Installed Adhesive Anchoring System Testing:

1. Equipment Data: Manufacturer's information for equipment to be used to conduct performance and proof tests on adhesive anchoring system. Submit diagrams showing geometry of performance and proof test equipment relative to the anchors and reinforcing bar dowels to be tested and calibration data for system of jacks and gauges, including:

a. Calibration: Conducted by a certified testing laboratory, of the complete performance and proof test assembly, together as a unit. Conduct assembly calibration within one month prior to conducting first test and present in the form of a plot of gauge pressure versus actual jack force.
b. Project Specific Diagram: Laboratory's proposed test equipment setups for monitoring elongation of anchors and reinforcing bar dowels during performance and proof tests. Meet the requirements of ASTM E488 and ASTM E3121. Have proposed test equipment completely independent of the jack and include a micrometer dial gauge capable of measuring anchor extension to nearest 0.001 inch having 3 inchesof travel and be mounted on an adjustable tripod or other device with flexible extension arms or a goose neck to permit rapid alignment of the dial gauge axis with the axis of the anchor.

1.4 INFORMATIONAL SUBMITTALS

A. Installation procedure: Submit installation procedure for post-installed adhesive anchoring system; including method of drilling.

B. Certificates:

1. Installer Qualifications for Adhesive Anchoring System: Submit installer and testing agency qualifications as stated in following Paragraph of this Article.
2. Submit current International Code Council (ICC) Evaluation Service Reports (ESR) for expansion anchors and adhesive anchoring system, for installation into cracked concrete, as applicable, indicating conformance with current ICC Evaluation Service (ICC-ES) Acceptance Criteria.

C. Qualification Data:

1. Installer: Indicate manufacturer’s training date and a list of personnel trained on installation of adhesive anchoring system.
2. Testing Agency:

a. Laboratory: Meet requirements of ASTM E329. Prior to testing, submit qualifications of proposed testing laboratory for approval that includes:

1) Name and address.
2) Names and positions of principal officers and name, position, and qualifications of responsible registered professional engineer in charge.
3) List technical services provided, indicating external technical services to be provided by other organizations.
4) Names and qualifications of the supervising laboratory technicians.
5) Provide report prepared by laboratory evaluations authority when requested by Engineer.
6) Submit as required above for other organizations that will provide external technical services.

b. Include in submittal a list of five projects in which the laboratory has performed testing in accordance with ASTM E488. Include following information for each project:

1) Project name and location.
2) Project Owner.
3) Owner's representative including address and phone number.
4) Brief description of work.

3. Submit qualifications of other laboratory or laboratories until approved.

D. Performance and Proof Test Reports of Adhesive Anchoring System – Each Procedure: For each diameter of post-installed anchors and reinforcing bar dowels , for tests performed by manufacturer and witnessed by a qualified testing agency. Submit a report stamped and sealed by a Professional Engineer registered in State of Texas for each test procedure, including whether additional tests or design modifications are required. Based on the results of the reports, Engineer will determine if any additional tests or modifications to the design are required. Prepare each inspection report complying with ASTM E488 and ASTM E575 that includes:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing laboratory.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making the inspection or test.
6. Designation of the work and test method.
7. Complete inspection or test data.
8. Test results and an interpretation of test results.
9. Ambient conditions at time of testing.
10. Comments or professional opinion on whether inspected or tested work complies with Contract Document requirements.
11. Name and signature of laboratory inspector.
12. Recommendations on retesting.
13. Design data.
14. Test reports.
15. Field reports.

E. Evaluation Reports: From ICC-ES for expansion anchors and adhesive anchoring system, for installation of post-installed anchors into cracked concrete, as applicable, indicating conformance with current ICC ES Acceptance Criteria.

1.5 QUALITY ASSURANCE

A. General: Coordinate with the work of other Sections, field verifying dimensions and work of other trades adjoining items of work before installing items specified in this Section.

B. Representatives of post-installed anchor system manufacturer:

1. Performance Testing: Be on site for installation of anchor and performance testing of adhesive anchoring system of their respective products system, subsystem, or component. Observe, guide, and provide instruction on Contractor's assembly, erection, installation or application procedures during the drilling, placement, injection and testing. Inspect, check, and make adjustments as required for the product to function as warranted by the manufacturer and as necessary to furnish the Manufacturer's Certification of Proper Installation.
2. Proof Testing: Be on site periodically for assistance during installation and testing/inspection of their respective products system, subsystem, or component. Observe, guide, and provide instruction on Contractor's assembly, erection, installation or application procedures during the drilling, placement, injection, and testing. Inspect, check, and make adjustments as required for the product to function as warranted by the manufacturer and as necessary to furnish the Manufacturer's Certification of Proper Installation.

C. Adhesive Anchoring System:

1. Installer Training: Conduct thorough training by the manufacturer or the manufacturer's representative. Training shall consist of the complete installation process for post-installed anchors and reinforcing bar dowels, including but not limited to:

    a. Tool selection.
    b. Hole drilling procedure.
    c. Hole preparation and cleaning techniques.
    d. Adhesive injection technique and dispenser training and maintenance.
    e. Anchor preparation and installation.
    f. Reinforcing bar dowels preparation and installation.
    g. Proof loading and torqueing.
    h. Temperature, humidity, and moisture limitations.
    i. Working time limitations.
    j. Setting time.

2. Include training for anchors and reinforcing bar dowels installed horizontally or upwardly inclined to support sustained tension loads. Install horizontally or upwardly inclined anchors and reinforcing bar dowels by personnel certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Anchor Installer Certification program, or equivalent.
3. Manufacturer's Certificate of Proper Installation: Submit upon completion of work, for the post-installed anchors and reinforcing bar dowels, including non-production and production anchors, and reinforcing bar dowels.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.

B. Handle materials with cranes or derricks. Do not dump material off transportation vehicles or handle in ways that will cause damage.

C. Store materials elevated above grade and block up so they will not become bent or otherwise damaged.

D. Repair items that have become damage or corroded to satisfaction of the Engineer prior to incorporating them into the work.

PART 2 - PRODUCTS

2.1 EXPANSION ANCHORS

A. Fastening to Concrete Substrate: Zinc plated carbon steel wedge type anchors, complete with zinc plated nuts and washers, unless otherwise noted.

B. Submerged or Weather Exposed Substrates: ASTM A276 Type 316 stainless steel wedge type anchors, complete with Type 316 stainless steel nuts and washers, unless otherwise noted.

C. Meet ICC ES AC01 or ICC ES AC193.

D. Length: When length or anchor embedment is not indicated, provide length sufficient to place the wedge and expansion cone portion of the anchor at least 1 inch behind concrete reinforcing steel.

E. Basis-of-Design:

1. Anchorage designs indicated are based on Hilti, Kwik-Bolt TZ2, unless otherwise noted.
2. Acceptable Anchors: Hilti Kwik-Bolt TZ2; Simpson Strong-Tie Strong Bolt 2 Wedge Anchor; DeWalt Power-Stud+ SD1; or equal.

2.2 ADHESIVE ANCHORING SYSTEM

A. Fastening to Concrete Substrate: Manufactured system consisting of post installed threaded rods, nuts, washers, other anchoring hardware, and chemical dispenser for installation in hammer drilled holes.

1. Anchors: Meet ICC ES AC308.
2. Injection Adhesive: Two-component epoxy system consisting of a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep both components separate.
3. Adhesive Cartridge: Side-by-side design to accept a static mixing nozzle which thoroughly blends both components and allows injection directly into a drilled hole.
4. Anchor: Type 316 stainless steel as indicated consisting of an all-thread anchor rod with nut and washer, of matching material to anchor rod.

a. Basis-of-Design:

1) Anchorage designs indicated are based on Hilti HIT- RE 500 V3, unless otherwise noted.
2) Acceptable Manufacturers: Hilti HIT- RE 500 V3; Simpson Strong Tie SET-XP; ITW Ramset Red Head Epcon G5; or equal.

5. Reinforcing Bar Dowels: Reinforcing bar, per Section 032000 “Concrete Reinforcing”.

a. Basis-of-Design:

1) Anchorage designs indicated are based on Hilti HIT- RE 500 V3, unless otherwise noted.
2) Acceptable Manufacturers: Hilti HIT- RE 500 V3; Simpson Strong Tie SET-XP; ITW Ramset Red Head Epcon G5; or equal.

2.3 PERFORMANCE REQUIREMENTS

A. Performance: design anchors and reinforcing bar dowel anchorage for all anticipated loads and load combinations per ASCE/SEI 7 including omega-naught (Ωo) factors as applicable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install anchoring system in strict compliance with manufacturer's published installation instructions and approved Shop Drawings. Comply with recommended surface preparation, temperature, and moisture of substrate and ambient conditions.
2. Coordinate installation with Special Inspector.
3. Use drill bit of correct diameter and drill to required depth using rotary impact type hammer drills with carbide-tipped bits.
4. Drill holes perpendicular to concrete surface, unless otherwise indicated.
5. Use oil free compressed air to blast out loose particles and dust from drilled holes.

B. Expansion anchors:

1. Check expansion anchors for tightness a minimum of 24 hours after initial installation.

C. Adhesive anchoring system:

1. Perform installation only by personnel trained in anchor installation and having certification required in PART 1 - GENERAL.
2. Inject adhesive and install anchors and reinforcing bar dowels that are clean and free of dirt, oil, grease, ice or other deleterious material which would reduce bond.

3.2 TESTING OF ADHESIVE ANCHORING SYSTEM

A. Performance Testing:

1. Prior to demolition of existing work at locations of concrete to be removed, conduct performance testing of approved adhesive anchoring system at locations indicated.
2. Locate existing reinforcing bars with the use of a reinforcing bar locator prior to installation of post-installed anchors and reinforcing bar dowels to be used for performance testing. Mark existing reinforcing bars on concrete indicating spacing and direction within test area. Do not cut existing reinforcing bars without prior approval by Engineer.
3. Use post-installed anchors and reinforcing bar dowels matching those of the approved adhesive anchoring system with the embedment length indicated. In the event an alternate adhesive anchoring system is approved, the embedment length will be determined by Engineer.
4. Design Strength of Existing Concrete: 3,000 psi at 28 days in.
5. Install and test post-installed anchors and reinforcing bar dowels, as indicated.

    a. For each diameter of post-installed anchors install and test one group of five anchors.
    b. For each diameter of post-installed reinforcing bar dowels install and test one group of five reinforcing bar dowels.
    c. Perform static tensile test in accordance with ASTM E488 using defined incremental load application and failure criteria. Test to failure.
    d. Test Results: For each of the one group of five anchors and reinforcing bar dowels, test three and average the results. If the result of any one test in a group varies by more than 15 percent from the group average, perform two additional tests at locations determined by Engineer. Average the five test results.

6. Advise Engineer at least 14 working days prior to Performance Testing.
7. Do not use post-installed anchors and reinforcing bar dowels installed for performance testing as part of production anchors and bars.
8. Do not demolish existing construction or perform new work until Performance Testing is complete and approved by Engineer.

B. Proof Testing:

1. Perform proof tests in accordance with ASTM E488.
2. During the progress of the work perform periodic proof test of post-installed anchors.

    a. Threaded Rod Size: 3/4 inch diameter.
    b. Post-installed Anchors: During progress of the work, randomly chose for Proof Testing 5 percent of each anchor diameter, embedment length, and adhesive bonding material system. Select test anchors at random. Test the anchors for the static tension test only, to the allowable test load of 10,000 pounds for 3/4 inch diameter.

3. During progress of the work, perform periodic proof test of post-installed reinforcing bar dowels.

    a. Bar sizes: #4, #5, #6, #7, #8.

b. Initial Reinforcing Bar Dowel Test Group: During progress of the work, randomly select five post-installed reinforcing bar dowels, for Proof Testing. Select from first 50 post-installed reinforcing bar dowels installed.

c. Subsequent Reinforcing Bar Dowel Test Groups: In addition, randomly select and test one post-installed reinforcing bar dowel from every 20 post-installed bars installed of remaining post-installed bars.

4. Post-installed Reinforcing Bar Dowels: Test for static tension only to Allowable Test Load indicated in Table 1.

TABLE 1

Post-installed Reinforcing Bar Dowels Test Loads

Rebar Size	Yield Strength	Allowable Test Load
#4	12,000 lbs	4,800 lbs
#5	18,600 lbs	7,440 lbs
#6	26,400 lbs	10,560 lbs
#7	36,000 lbs	14,400 lbs
#8	47,400 lbs	18,980 lbs

NOTE: Test loads are based on Hilti. Engineer may modify Table values based on approved adhesive anchoring system.

3.3 TEST FAILURE - ADHESIVE ANCHORING SYSTEM

A. Failure Defined: Observance of any one or any combination of failure modes in ASTM E488.

B. Performance Testing: If results show a failure of the adhesive system, not yielding of anchor or reinforcing bar dowel, Engineer will require greater embedment, changes in installation technique, or require the use of another adhesive anchoring system, at no additional cost to Owner.

C. Proof Testing of Anchors: If any of the tested anchors failed, perform two additional tests on adjacent untested anchors, one each side. Continue additional tests until no more tests fail, or all anchors installed that day are tested. Engineer may require greater embedment, changes in installation technique, or require the use of another adhesive anchoring system, at no additional cost to Owner.

D. Proof Testing of Reinforcing Bar Dowels: If the bond strength of a post-installed reinforcing bar dowel falls below the Allowable Test Load indicated in Table 1, Engineer may require greater embedment, changes in installation technique, or require the use of another adhesive anchoring system, at no additional cost to Owner.

E. If installations fail to produce the required strength performance, Engineer will require additional post-installed anchors and require modified or enlarged base plates or additional

metal connecting pieces or reinforcing bar dowels and additional reinforced concrete to meet the required design strength. Perform this additional work and additional tests to correct deficient installations, at no additional cost to Owner.

3.4 REPAIRS

A. At testing completion, repair damaged concrete, post-installed anchors, reinforcing bar dowels and other damaged construction as required to match conditions prior to testing.

B. Repair in accordance with provisions of Section 030130.71 “Modifications to Existing Concrete”, including but not limited to:

1. Saw cutting and removal of damaged, loose, or unsound concrete.
2. Removal of damaged anchors and reinforcing bar dowels.
3. Cleaning and preparing concrete surface and reinforcing bar dowels.
4. Place new repair material.
5. Install new anchors or reinforcing bar dowels to replace anchors or reinforcing bar dowels that are found to be unacceptable or deficient.
6. Perform repairs at no additional cost to Owner.

END OF SECTION 050519

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SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Prefabricated building columns.
3. Field-installed shear connectors.
4. Delegated Design.

B. Related Requirements:

1. Section 036000 “Grouting” for grouting.
2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099679 “Atmospheric Protection and Plant Service Areas Coating” for surface-preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Erection drawings, detailed shop drawings, anchor bolt placement drawings, schedules, and data for all structural steel
2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
3. Include embedment Drawings.
4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
6. Identify members and connections of the Seismic-Load-Resisting System.
7. Indicate locations and dimensions of protected zones.
8. Identify demand critical welds.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

1.7 DELEGATED DESIGN SUBMITTAL

A. Delegated Design Submittal: For structural-steel connections indicated to comply with design loads, include calculations signed and sealed by the qualified professional engineer responsible for their preparation.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For erector and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.

F. Survey of existing conditions.

1.9 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).

B. Erector Qualifications: A qualified erector who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.10 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F1852 fasteners and for retesting fasteners after lubrication.

C. Store welding electrodes as recommended by the manufacturer and to avoid damage by moisture or contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Delegated Design: Engage a qualified professional engineer, as defined in Sections 013300 “Submittal Procedures” and 014000 “Quality Requirements”, to submit the items listed in the DELEGATED DESIGN SUBMITTALS Article.

B. Connections: Provide details of connections not fully detailed on the Drawings, including comprehensive engineering calculations by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated. Provide connections as shown in Table 10-1, Part 10 of the AISC Steel Construction Manual, unless otherwise noted.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use Allowable Stress Design; data are given at service-load level.

C. Design connections for diagonal bracing for tension and compression forces noted on Drawings. Indicate work points for bracing, unless otherwise approved. Bolt or weld shop connections and bolt field connections.

D. Moment Connections: Type PR, partially and Type FR, fully restrained.

E. Construction: Combined system of moment frame, braced frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles, M, S-Shapes: ASTM A36/A36M.

C. Plate and Bar: ASTM A36/A36M.

D. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A588/A588M, Grade 50.

E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B, structural tubing.

F. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A847/A847M, structural tubing.

G. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

1. Finish: Galvanized.

H. Steel Castings: ASTM A216/A216M, Grade WCB with supplementary requirement S11.

I. Steel Forgings: ASTM A668/A668M.

J. Welding Electrodes: AWS A5.1, E70XX.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade C, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959, Type 325, compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM F3125, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F959, Type 490, compressible-washer type with plain finish.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

D. Threaded Rods: ASTM A36/A36M.

1. Nuts: ASTM A563 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

E. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A108, Grade 1035.

F. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1030.

G. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1018.

2.4 PRIMER

A. Primer: Comply with Section 099679 “Atmospheric Protection and Plant Service Areas Coating”.

B. Primer: SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.

C. Primer: SSPC-Paint 25 BCS, Type I, zinc oxide, alkyd, linseed oil primer.

D. Primer: SSPC-Paint 23, latex primer.

E. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

F. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A6/A6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 PREFABRICATED BUILDING COLUMNS

A. Prefabricated building columns consisting of load-bearing structural-steel members protected by concrete fireproofing encased in an outer non-load-bearing steel shell.

B. Fire-Resistance Ratings: Provide prefabricated building column listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for ratings indicated, based on testing according to ASTM E119.

1. Fire-Resistance Rating: As indicated.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Grout in accordance with Section 036000 “Grouting”.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in

permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work. Do no welding when surfaces are wet, exposed to rain, snow or wind, or when welders are exposed to inclement conditions that will hamper good workmanship.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

C. Assign each bolting crew and each welder an identification mark. Make this mark at each completed connection with a paint stick.

1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 PREFABRICATED BUILDING COLUMNS

A. Install prefabricated building columns to comply with AISC 360, manufacturer's written recommendations, and requirements of testing and inspecting agency that apply to the fire-resistance rating indicated.

3.6 FIELD QUALITY CONTROL

A. Allow the Engineer or testing agency engaged by Owner free access to the work. Notify the Engineer in writing 4 working days in advance of high strength bolting and field welding operations, including pre-installation verification of high strength bolt assemblies. The Engineer will inspect the following or Owner will engage a testing agency.

1. Structural-steel materials and inspect steel frame joint details.
2. Weld materials and inspect welds.
3. Connection materials and inspect high-strength bolted connections.

B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

C. Welded Connections: Welded connections will be visually inspected according to AWS D1.1/D1.1M.

1. In addition to visual inspection, welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at Owner’s testing agency's option:

a. Liquid Penetrant Inspection: ASTM E165.
b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E164.
d. Radiographic Inspection: ASTM E94.

D. In addition to visual inspection, field-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Testing according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.7 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 051200

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Steel beams, not included in Section 051200.
4. Steel angles.
5. Steel lintels.
6. Steel support brackets.
7. Steel base plates for other than structural steel or equipment.
8. Steel holddown straps and lugs.
9. Steel splice plates.
10. Steel subframing at roof openings.
11. Shelf angles.
12. Miscellaneous items fabricated from steel aluminum or stainless steel.
13. Aluminum beams.
14. Aluminum angles.
15. Aluminum closure angles.
16. Aluminum grates.
17. Aluminum diamond plate and floor plate.
18. Aluminum stop plates.
19. Aluminum stair nosings.
20. Aluminum stair treads
21. Aluminum nosing.
22. Steel pipe pieces for sleeves.
23. Metal ladders.
24. Metal ships' ladders and pipe crossovers.
25. Metal floor plate and supports.
26. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 036000 “Grouting” for non-shrink grout.
3. Section 050519 “Post-Installed Anchors and Reinforcing Bars” for anchors in various substrates.
4. Section 051200 "Structural Steel Framing" for structural steel components.
5. Section 055313 “Bar Gratings” for various types of bar grating assemblies.
6. Various Sections in Divisions 40 - 46 for process mechanical work scopes.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Prefabricated building columns.
3. Metal nosings and treads.
4. Paint products.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Prefabricated building columns.
4. Shelf angles.
5. Metal ladders.
6. Metal ships' ladders and pipe crossovers.
7. Metal floor plate and supports.
8. Loose steel lintels.
9. Miscellaneous steel items.
10. Miscellaneous aluminum items.

11. Miscellaneous stainless steel items.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Mill Certificates: Signed by aluminum, steel and stainless-steel manufacturers, certifying that products furnished comply with requirements.

C. Welding certificates.

1. Certify that welders have been qualified under AWS, within previous 12 months, to perform welds required under this Section.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless steel."

C. Evaluation Reports: Post-installed concrete anchors, from ICC-ES for expansion anchors and adhesive anchor system, for installation into cracked concrete, as applicable, indicating conformance with current ICC ES Acceptance Criteria.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance of Aluminum Ladders: Aluminum ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

B. Structural Performance of Alternating Tread Devices: Alternating tread devices shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft.
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Alternating Tread Device Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 degrees F, ambient; 180 degrees F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Wide Flange Shapes: ASTM A992.

C. Steel Other Shapes, Plates, Shapes, and Bars: ASTM A36/A36M.

D. Stainless steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 316.

E. Stainless steel Bars and Shapes: ASTM A276, Type 316.

F. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

G. Rolled-Stainless Steel Floor Plate: ASTM A793.

H. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.

I. Steel Tubing: ASTM A500/A500M, Grade B cold-formed steel tubing.

J. Steel Pipe: ASTM A53/A53M, Type S Grade B Standard Weight (Schedule 40) unless otherwise indicated.

K. Zinc-Coated Steel Wire Rope: ASTM A741.

1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

L. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

M. Aluminum Extruded Pipe: ASTM B429, Alloy 6063 T6 and Alloy 6061 T6 as indicated.

N. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.

O. Aluminum Extrusions: ASTM B221, Alloy 6061 T6.

P. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

Q. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

R. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).

S. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

T. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.

U. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

V. Gray Iron Castings: ASTM A48, Class 35.

W. Ductile Iron Castings: ASTM A536, Grade 65-45-12.

X. Stainless steel Bolts: ASTM F593, Type 316.

Y. Stainless steel Nuts: ASTM F594, Type 316.

Z. Carbon Steel Bolts and Studs: ASTM A307, Grade A (hot dip galvanized nuts and washers where noted)

AA. High Strength Steel Bolts, Nuts and washers: ASTM F3125, Grade A325 (mechanically galvanized per ASTM B695, Class 50, where noted).

1. Elevated Temperature Exposure: Type I.
2. General Application: Type I or Type II.

BB. Galvanizing: ASTM A123, Zn w/0.05 percent minimum Ni.

CC. Galvanizing, hardware: ASTM A153, Zn w/0.05 percent minimum Ni.

DD. Galvanizing, anchor bolts: ASTM F2329, Zn w/0.05 percent minimum Ni.

EE. Welding electrodes, steel: AWS A5.1 E70xx.

2.3 FASTENERS

A. Unless otherwise noted, provide steel machine bolts for the connection of carbon steel or iron; galvanized steel or stainless steel machine bolts for the connection of galvanized steel or iron; and stainless steel machine bolts for the connection of aluminum or stainless steel.

B. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum.
2. Provide stainless steel fasteners for fastening stainless steel.
3. Provide stainless steel fasteners for fastening nickel silver.
4. Provide bronze fasteners for fastening bronze.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

D. Mechanically Galvanized Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM F3125, Grade A325, Type 3; with hex nuts, ASTM A563, Grade C3; and, where indicated, flat washers.

E. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.

F. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Provide standard headed bolts with heavy hex nuts and Grade A washers.
2. Where galvanized anchor bolts are indicated or specified, provide standard headed bolts with heavy hex nuts and Grade A washers, galvanize in accordance with ASTM F2329.

G. Machine bolts and nuts conforming to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers, and related appurtenances shall be Type 316 stainless steel.

H. Toggle Bolts: Hilti, Toggler Bolt or equal.

I. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488, conducted by a qualified independent testing agency.

J. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47 malleable iron or ASTM A27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.

K. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts

2.4 MISCELLANEOUS ALUMINUM

A. Miscellaneous Aluminum: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and Accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints and jointed where least conspicuous. Conceal threads on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and smooth. Weld on unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Miscellaneous Aluminum Items: Beams, angles, closure angles, grates, floor plates, stop plates, stair nosings, and other miscellaneous aluminum indicated and not otherwise specified.

D. Angle Frames for Roof Hatches, Beams, Grates, and Similar Items: Complete with welded strap anchors attached.

E. Stair Treads for Aluminum Stairs: As specified for grating and having cast abrasive non-slip nosing as approved.

F. Aluminum Nosing at Concrete Stairs: Furnish with wing type anchors and flat head stainless steel machine screws, 12 inches on center. Provide nosing at concrete ladder openings. Single piece nosing for each step extending to within 3 inches at each side of stair. Set nosing flush with stair tread finish at concrete stairs. Furnish treads with heavy duty protective tape cover.

   1. Basis-of-Design: Wooster Products, Inc.; Alumogrit Treads, Type 116; similar by Barry Pattern and Foundry Co.; Andco or equal.

G. Aluminum Finishes:

   1. Mill Finish: Have a cleaned and degreased mill finish on other aluminum items.

2.5 MISCELLANEOUS STEEL

A. Miscellaneous Steel Work: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and Accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints and jointed where least conspicuous. Conceal thread on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Miscellaneous Steel Items: Beams, angles, lintels, metal stairs detailed on the Drawings, support brackets, base plates for other than structural steel or equipment, closure angles, bridge crane rails, monorail hoist beams, holddown straps and lugs, door frames, splice plates, subframing at roof openings and any other miscellaneous steel indicated and not otherwise specified.

D. Structural steel angle and channel door frames: Galvanized. Fabricated with not less than three anchors on each jamb.

E. Steel pipe pieces for sleeves, lifting attachments and other functions: Schedule 40 pipe unless otherwise indicated. Wall and floor sleeves, of steel pipe: Provide welded circumferential steel waterstops at mid-length.

F. Lintels, relief angles or other steel supporting masonry or embedded in masonry: Galvanized.

G. Steel Finish Work: Thoroughly cleaned, by effective means, of loose mill scale, rust and foreign matter. Provide one shop coat of primer compatible with finish coat after fabrication but before shipment. Omit paint within 3 inches of proposed field welds. Apply paint to dry surfaces and be thoroughly and evenly spread and well worked into joints and other open spaces.

H. Galvanizing, where required: Use hot-dip zinc process after fabrication, coating not less than 2 oz/sq.ft. of surface.

2.6 MISCELLANEOUS STAINLESS STEEL

A. Miscellaneous Stainless Steel Work: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints, jointed where least conspicuous. Conceal threads on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Beams, angles, bar racks, and other miscellaneous stainless steel.

2.7 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099679 “Atmospheric Protection and Plant Service Areas Coating”.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

2.8 CASTINGS:

A. General: Good quality, strong, tough, even-grained, smooth, free from scale, lumps, blisters, sand holes, and other defects. Thoroughly clean castings to remove foreign matter, and deleterious films. Castings will be subjected to a hammer inspection in the field by the Engineer. Damaged castings may be rejected and replaced at no cost to the Owner.

B. Matching Surfaces: Machine to a true plane surface allowing contact surfaces to seat without rocking. Provide allowances in patterns so specified thickness is not reduced to obtain finished surfaces. Castings will not be acceptable if actual weight is less than 95 percent of theoretical weight computed from dimensions. Provide facilities for weighing castings in the presence of the Engineer.

2.9 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/4 inch by 1 inch, with a minimum 6 inch embedment and 1 1/2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.10 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with primer specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coating” where indicated.

2.11 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. Galvanize shelf angles located in exterior walls.

C. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.12 METAL LADDERS

A. General:

1. Comply with ANSI A14.3.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 18 inches apart, unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 1-inch- diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
8. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
9. Galvanizeladders, including brackets.
10. Prime exterior ladders, including brackets and fasteners.

C. Aluminum Ladders:

1. Space siderails minimum 18 inches apart, unless otherwise indicated.
2. Siderails: Continuous aluminum bars Schedule 80, 1-1/2 inch I.D. continuous extruded aluminum pipe.
3. Rungs: Solid extruded-aluminum tubes, 3/4 inch diameter.
4. Fit rungs in centerline of siderails; fasten as indicated.
5. Wall Support Brackets: Type 316 stainless steel spaced 4 feet on center with Type 316 stainless steel fasteners. Fasten side rails to floor with 1/2 inch diameter Type 316 stainless steel expansion anchors.
6. Platforms: Fabricate from pressure-locked aluminum bar grating or extruded-aluminum plank grating, supported by extruded-aluminum framing. Limit openings in gratings to no more than 1/2 inch in least dimension.
7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted aluminum brackets.
8. Provide minimum 72-inch- high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.

D. Stainless Steel Ladders:

1. Material: Fabricate from Type 316 stainless steel.

2. Siderails: Continuous 1/2-inch by 2-1/2-inch, spaced at minimum of 18 inches unless otherwise indicated.
3. Rungs: 3/4 inch diameter stainless steel rods spaced 12-inches on center.

    a. Fit rungs in centerline of siderails; fasten as indicated.

4. Wall Support Brackets: Type 316 stainless steel spaced 4 feet on center with Type 316 stainless steel fasteners. Fasten side rails to floor with 1/2 inch diameter Type 316 stainless steel expansion anchors.
5. Platforms: Fabricate from pressure-locked aluminum bar grating or extruded-aluminum plank grating, supported by extruded-aluminum framing. Limit openings in gratings to no more than 1/2 inch in least dimension.

2.13 LADDER SAFETY SYSTEM

A. Provide a ladder safety system at each ladder more than 20 feet high and as indicated.

1. Provide an aluminum or stainless steel vertical rigid rail, rail brackets for continuous travel, rail extension, stainless steel mounting hardware and fasteners, two non-corrosive metal sliding fall prevention devices, two full body harnesses with "D" rings, accessories and other materials required for complete installation and operation of ladder safety system in accordance with manufacturer's recommendations.
2. Provide 36 inch minimum height permanent aluminum or stainless steel rail extension compatible with sliding fall prevention device to ensure worker is attached to ladder safety system while mounting and dismounting from a platform or landing. Provide removable ladder extensions at manholes, hatches, and roof scuttles. Provide stainless steel hardware and fasteners, accessories, and other materials required for complete installation to ladders in accordance with manufacturer's recommendations.
3. Provide alignment between successive pieces of rail. Provide allowance for expansion and contraction on long runs.
4. In addition to "D" ring used for attachment to sliding fall prevention device, provide harnesses with at least two "D" rings for attachment of safety straps and lanyards.
5. Attach ladder safety system to installed ladders. Provide sliding fall prevention device allowing worker to climb up and down using both hands, and move freely up and down the rail with worker in normal climbing position. Do not allow connection between sliding fall prevention device and harness attachment point to exceed 9 inches. Fabricate ladder safety system to stop the fall of a worker independently from offset ladders, platforms, or safety cages.
6. Conform to OSHA Regulation 1910.21 for ladder safety system. Rope or cable systems will not be allowed.
7. Basis-of-Design - Ladder Safety System: Saf-T-Climb by Honeywell International Inc.; Railok 90 by 3M Fall Protection; GlideLoc System by Honeywell International Inc.; or equal.
8. Provide ladder safety post extensions on fixed ladders 20 feet or less in height located below hatches and roof scuttles and as indicated. Locking aluminum telescoping safety post extension in its vertical position and extend a minimum of 36-inches above opening and be secured to ladder rungs with stainless steel fasteners and brackets.

    a. Basis-of-Design: Ladder UP Safety Post, Model LU-4 by Bilco Co.; Series L1E Safety Extension by Halliday Products; or equal.

2.14 COVER PLATE

A. Fabricate aluminum diamond plate and floor plate having a minimum thickness of 3/8 inch. Fabricate frames and supports of aluminum construction. Fastening devices and hardware shall be Type 316 stainless steel. Plates shall have a mill finish.

B. Provide aluminum angle supports as indicated.

C. Include aluminum angle stiffeners, and fixed and removable sections as indicated.

D. Provide flush stainless steel bar drop handles for lifting removable sections, one at each end of each section.

2.15 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize miscellaneous steel trim.

2.16 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

2.17 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles, shapes, and plates of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings of 8 inches unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with primer specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coating”.

2.18 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.19 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.20 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products. Limit maximum nickel (Ni) content of galvanizing zinc to 0.05 percent.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

2.21 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.

B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 03 and Division 04 respectively. Install items to be attached to concrete or masonry after such work is completed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.

B. Touch up abrasions in the shop primer immediately after erection. Paint areas left unprimed for welding after welding.

C. Clean and repair, after installation, zinc coating which has been burned by welding, abraded, or otherwise damaged. Thoroughly clean damaged area and remove all traces of welding flux and loose or cracked zinc coating prior to painting. Paint the cleaned area per the requirements of ASTM A780.

D. Install specialty products in accordance with the manufacturer's recommendations.

E. Weld headed anchor studs in accordance with manufacturer's recommendations.

F. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

G. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

H. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

I. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

J. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

K. Corrosion Protection: Coat concealed surfaces of aluminum and steel that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Aluminum Contacting a Dissimilar Metal: Apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.
2. Aluminum Contacting Masonry or Concrete: Apply a heavy coat of approved alkali resistant paint to the masonry or concrete.
3. Aluminum Contacting Wood: Apply two coats of aluminum metal and masonry paint to the wood.
4. Steel Contacting Exposed Concrete or Masonry: Apply heavy bitumastic troweling mastic.
5. Between aluminum stair treads, and steel supports, insert 1/4 inch thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

C. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING PIPE GUARDS

A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch bolts at each pipe guard. Mount pipe guards with top edge 26 inches above driving surface.

3.4 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

A. Center nosings on tread widths unless otherwise indicated.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

3.5 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coating”.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION 055000

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SECTION 055313 - BAR GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metal bar gratings.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for structural-steel framing system components.
2. Section 055000 “Metal Fabrications” for grating supports.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of grating with installation of related items. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Clips and anchorage devices for gratings.
2. Paint products.
3. Manufacturers' published load tables.

B. Shop Drawings: Include plans, sections, details, and attachments to other work. Identify size, material, and location of supporting members and forward requirements to Section 055000 “Metal Fabrications”.

C. Samples for Verification:

1. Submit 12-inch by 12 -inch samples of metal grating, illustrating surface finish, color, texture, and jointing details.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by manufacturers of aluminum, steel, and stainless steel certifying that products furnished comply with requirements.

B. Welding certificates, qualified in the previous 12 months.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide grating conforming to ANSI/NAAMM MBG 531, Type P-19-4, size of grating as shown on Drawings. Do not exceed fabricator’s maximum recommended grating span.

B. Limit grating deflection to 1/4 inch maximum for a uniform live load of 100 psf on maximum span.

2.2 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual " and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

B. Pressure-Locked, Rectangular-Bar Aluminum Grating ANSI/NAAMM MBG 531 Type P-19-4: Fabricate by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.

1. Traffic Surface: Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive.
2. Aluminum Finish: Class I, clear, anodized finish.

C. Pressure-Locked, Aluminum I-Bar Grating: Fabricated by swaging crossbars between bearing bars.

1. Bearing Bar Spacing: 1-3/16 inches o.c.
2. Bearing Bar Depth: As required to comply with structural performance requirements.
3. Bearing Bar Flange Width: 1/4 inch.
4. Crossbar Spacing: 4 inches o.c.
5. Traffic Surface: Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive.
6. Aluminum Finish: Class I, clear, anodized finish.

2.3 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Bars for Bar Gratings: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

C. Wire Rod for Bar Grating Crossbars: ASTM A510.

D. Uncoated Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30.

E. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, Grade 33, with G90 coating.

2.4 ALUMINUM

A. General: Provide alloy and temper recommended by aluminum producer for type of use indicated, with not less than the strength and durability properties of alloy, and temper designated below for each aluminum form required.

B. Extruded Bars and Shapes: ASTM B221/B221M, alloys as follows:

1. Grating Bearing Bars: 6061-T6 or 6063-T6.
2. Grating Crossbars: 6061-T1.

C. Aluminum Sheet: ASTM B209/B209M, Alloy 5052-H32.

D. Welding Electrode, Aluminum: 5356 filler alloy.

2.5 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum.
2. Provide stainless steel fasteners for fastening stainless steel.

B. Grating clamps, nuts, bolts, washers, and other fastening devices for grating shall be Type 316 stainless steel. Anchor blocks, when used, shall be of the same material as the grating. Anchor grating to supporting system using saddle clips.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.7 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type specified; coordinate with supporting structure.

1. Fabricate toeplates to fit grating units and weld to units in shop, unless otherwise indicated.
2. Toeplate Height: 4 inches, unless otherwise indicated.

G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
2. Provide no fewer than four saddle clips for each grating section with each clip designed and fabricated to fit over two bearing bars.
3. Provide no fewer than four weld lugs for each grating section containing rectangular bearing bars 3/16 inch or less in thickness and spaced less than 15/16 inch o.c., with each lug shop welded to two or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
4. Provide no fewer than four flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.
5. Furnish threaded bolts with nuts and washers for securing grating to supports.
6. Furnish self-drilling fasteners with washers for securing grating to supports.

7. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.

H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

I. Additional Fabrication:

1. Edge-band openings in grating that interrupt one or more bearing bars with bars of same size and material as bearing bars.
2. Do not notch bearing bars at supports to maintain elevation.
3. For openings 2 inches or greater in diameter or dimension, band grating edges with a bar of same depth and thickness as bearing bars. Weld cut bearing bars or cross bars to banding bar.
4. Provide trench grating with symmetrical cross bar arrangement.
5. Fabricate metal frames and supports for grating of same material as grating, unless otherwise indicated.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I.

B. Mill finish.

2.9 STEEL FINISHES

A. Finish gratings.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate locations and elevations of grating supports provided under provisions of Section 055000 “Metal Fabrications.” Verify that members are properly installed to support bar gratings specified in this Section.

B. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install assemblies in accordance with manufacturer's installations instructions. Install products plumb, level, and square, unless otherwise required by the design.

B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction and grating supports.

C. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

D. Provide additional supports at penetrations through grating in order to meet design criteria.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Attach toeplates to gratings by welding at locations indicated.

G. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

H. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners as specified.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0 -mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coating”.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055313

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SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Standing-seam metal roof panels.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for structural support of roof panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For standing-seam metal roof panels. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For standing-seam metal roof panels, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including rupturing, cracking, or puncturing.
    b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Delta E units when tested according to ASTM D2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft.

D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Berridge Manufacturing Company.
    b. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
    c. MBCI; Cornerstone Building Brands.
    d. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.040 inch.
    b. Surface: Smooth, flat finish.
    c. Exterior Finish: Three-coat fluoropolymer.
    d. Color: Match Architect's samples.

3. Joint Type: As standard with manufacturer.
4. Panel Coverage: 16 inches.
5. Panel Height: 1.5 inches.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 degrees F; ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 degrees F; ASTM D1970.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ATAS International, Inc.

b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
c. Owens Corning.

B. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.

C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

C. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match roof fascia and rake trim.

D. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

E. Panel Fasteners: Self-tapping screws designed to withstand design loads.

F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply over the entire roof metal deck, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

3.4 INSTALLATION OF STANDING-SEAM METAL ROOF PANELS

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
4. Stainless Steel Panels: Use stainless steel fasteners.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
4. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.

c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from column; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.16

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Urethane joint sealants.
3. Immersible joint sealants.
4. Butyl joint sealants.
5. Latex joint sealants.

B. Related Requirements:

1. Section 321373 "Concrete Paving Joint Sealants" for sealing joints in paved roads, parking lots, walkways, and curbing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

F. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 degrees F.
2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Pecora Corporation.
    b. Sika Corporation Joint Sealants.
    c. The Dow Chemical Company.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Bostik; Arkema.
    b. Pecora Corporation.
    c. Tremco Incorporated.

B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Pecora Corporation.
    b. Polymeric Systems, Inc.
    c. Sherwin-Williams Company (The).

C. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. LymTal International, Inc.

2.4 IMMERSIBLE JOINT SEALANTS

A. Immersible Joint Sealants. Suitable for immersion in liquids; ASTM C1247, Class 1; tested in deionized water unless otherwise indicated

B. Urethane, Immersible, S, P, 25, T, NT, I: Immersible, single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T, NT, and I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Sika Corporation Joint Sealants.
    b. Tremco Incorporated.
    c. W. R. Meadows, Inc.

2.5 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Bostik; Arkema.
    b. Everkem Diversified Products, Inc.
    c. Pecora Corporation.

2.6 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Pecora Corporation.
    b. Sherwin-Williams Company (The).
    c. Tremco Incorporated.

2.7 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Alcot Plastics Ltd.
    b. Construction Foam Products; a division of Nomaco, Inc.
    c. Master Builders Solutions.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

    a. Perform 2 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

    a. Whether sealants filled joint cavities and are free of voids.
    b. Whether sealant dimensions and configurations comply with specified requirements.
    c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
   a. Isolation and contraction joints in cast-in-place concrete slabs.
   b. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, M, P, 50, T, NT.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion.

1. Joint Locations:

   a. Joints as indicated on Drawings.

2. Joint Sealant: Urethane, immersible, S, P, 25, T, NT, I.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

   a. Construction joints in cast-in-place concrete.
   b. Joints between metal panels.
   c. Joints between different materials listed above.
   d. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
   e. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

   a. Isolation joints in cast-in-place concrete slabs.
   b. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, P, 25, T, NT.

3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.
b. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

G. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

a. Door thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Exterior standard steel doors and frames.
2. Glazing for full lite doors.

B. Related Requirements including, but not limited to:

1. Section 079200 “Joint Sealants” for sealants around door frames.
2. Section 087100 "Door Hardware" for door hardware of hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware.

C. Coordinate and field verify installation of doors and frames with existing door openings at Control and Blower Building. Verify openings by field measurements before fabrication and indicate measurements on shop drawings.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition, including existing door openings at Control and Blower Building.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

C. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.

D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.7 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.

1.8 CLOSEOUT SUBMITTALS

A. Record Documents: List of door numbers and applicable room name and number to which door accesses.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door; AADG, Inc.; ASSA ABLOY Group.
2. Curries, AADG, Inc.; ASSA ABLOY Group.
3. Steelcraft; Allegion plc.

2.2 PERFORMANCE REQUIREMENTS

A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.61 deg Btu/F x h x sq. ft. when tested according to ASTM C518.

2.3 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
d. Edge Construction: Model 2, Seamless.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: Manufacturer's standard complying with performance requirement.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
b. Construction: Full profile welded.

3. Exposed Finish: Factory.

2.4 BORROWED LITES GLAZING

A. Clear laminated glass with two plies of heat-strengthened float glass (Main Entrance of Existing Operations Building).

1. Basis-of-Design Product: Vitro Architectural Glass; Starphire Solar Control Laminated Glass.
2. Conformance: ASTM C1172 and complying with testing requirements.
3. Outboard Lite: Starphire float glass as manufactured by Vitro Architectural Glass.

    a. Conformance: ASTM C 1036, Type I, Class 1, Quality q3.
    b. Thickness: 1/4-inch.
    c. Heat-Treatment: Heat-strengthened, ASTM C 1048, Kind HS.

4. Interlayer:

    a. Type: PVB.
    b. Thickness: 0.060-inch.
    c. Color: Clear.

5. Inboard Lite: Solargray Clear float glass as manufactured by Vitro Architectural Glass.

    a. Conformance: ASTM C 1036, Type I, Class 2, Quality q3.
    b. Thickness: 1/4-inch.
    c. Heat-Treatment: Heat-strengthened, ASTM C 1048, Kind HS.
    d. Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C1376.
    e. Coating: Solarban 70 on Surface # 3.

6. Overall Thickness: 9/16-inch.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

E. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.7 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.

4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.8 STEEL FINISHES

A. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with ANSI/SDI A250.3.

1. Color and Gloss:

a. Existing Operations Building Doors and Frames: Match existing doors and frames color and semi-gloss.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
b. Install frames with removable stops located on secure side of opening.

2. Floor Anchors: Secure with postinstalled expansion anchors.
3. Solidly pack mineral-fiber insulation inside frames.
4. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.

D. Glazing: Comply with installation requirements per hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Engineer.

B. Inspections:

1. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 REPAIR

A. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

END OF SECTION 081113

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.

1.3 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

C. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.

B. Keying Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:

    a. Flow of traffic and degree of security required.
    b. Preliminary key system schematic diagram.
    c. Requirements for key control system.
    d. Address for delivery of keys.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each exposed product in each finish specified, in manufacturer's standard size.

1. Tag Samples with full product description to coordinate Samples with door hardware schedule.

C. Samples for Initial Selection: For each type of exposed finish.

D. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

    a. Identification number, location, hand, size, and material of each door and frame.
    b. Locations of each door hardware set, cross-referenced to Drawings on floor plans.
    c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
    d. Fastenings and other installation information.
    e. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
    f. Mounting locations for door hardware.
    g. List of related door devices specified in other Sections for each door and frame.

E. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware and keying schedule.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Engineer, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

    a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

B. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" and 2012 Texas Accessibility Standards.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
3. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allegion plc.
    b. Hager Companies.
    c. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.

2.3 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Backset: 2-3/4 inches unless otherwise indicated.

C. Lock Trim:

1. Description: As indicated on door hardware schedule.
2. Levers: Cast.
3. Escutcheons (Roses): Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

D. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

E. Mortise Locks: BHMA A156.13; Operational Grade 1 and Security Grade 1; stamped steel case with steel or brass parts; Series 1000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
c. SARGENT Manufacturing Company; ASSA ABLOY.

2.4 AUXILIARY LOCKS

A. Mortise Auxiliary Locks: BHMA A156.36; Grade 1; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. SARGENT Manufacturing Company; ASSA ABLOY.
c. STANLEY; dormakaba USA, Inc.

2.5 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable.

2.6 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. Existing System:

a. Master key or grand master key locks to Owner's existing system.

2. Keyed Alike: Key all cylinders to same change key.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: "DO NOT DUPLICATE."

2.7 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
c. Trimco.

2.8 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Norton Door Controls; ASSA ABLOY.
c. SARGENT Manufacturing Company; ASSA ABLOY.

2.9 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. Rixson Specialty Door Controls; ASSA ABLOY.
c. SARGENT Manufacturing Company; ASSA ABLOY.

2.10 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.

b. National Guard Products, Inc.
c. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.

B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg, as follows:

1. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.

2.11 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. National Guard Products, Inc.
b. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
c. Rixson Specialty Door Controls; ASSA ABLOY.

2.12 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
c. Trimco.

2.13 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not

permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
2. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.14 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. For mounting height of door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" and 2012 Texas Accessibility Standards.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be

painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.

E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

F. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

G. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

H. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

3.8 DEMONSTRATION

A. Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.9 DOOR HARDWARE SCHEDULE

Hardware Sets

Set: 1.0

Doors: As Indicated on Drawings.

Description: EXTERIOR SINGLE HM DOOR (Match existing doors and frames configurations as indicated on Drawings).

1 Continuous Hinge	CFM x Height Required x SLI-HD1		PE	087100
1 Storeroom Lock	10 8204 LNL	US32D	SA	087100
1 Surface Closer	281 CPS	EN	SA	087100
1 Threshold	2005AT		PE	087100
1 Rain Guard	346C + 4" Overall Door Width		PE	087100
1 Gasketing	2891AV		PE	087100
1 Sweep	345CNB		PE	087100

END OF SECTION 087100

SECTION 099676.23 – WASTEWATER PRELIMINARY TREATMENT COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of high-performance coating systems on the following substrate:

2

1. Ductile iron pipes at Filtrate Lift Station Wet Well.

B. Related Requirements:

1. Section 099679 “Atmospheric Protection and Plant Service Coatings” for non-submerged ductile iron pipes coating protection.
2. Section 400519 “Ductile Iron Process Pipe” for ductile pipe.
3. Section 400551 “Common Requirements for Process Valves” for factory finish valves.

1.3 DEFINITIONS

A. MPI Gloss Levels: Following define gloss levels according to ASTM D523:

1. MPI Gloss Level 6 - Traditional Gloss: 70 to 85 units at 60 degrees.

B. Moderate Exposure: An atmosphere that can be characterized as corrosive, within reasonable limits, is considered a moderate environment. In an industrial setting, a moderate environment indicates intermittent exposure to high humidity and condensation with occasional development of mold and mildew. Exposure to heavy concentrations of chemical fumes or mist and accidental chemical spills or splash occurs occasionally in a moderate environment. Regular use of strong chemicals rather than standard commercial cleaning agent also changes a mild environment into a moderate one. Metal corrosion is common in a moderate environment.

C. Severe Exposure: An aggressively corrosive industrial or predominantly chemical environment with regular exposure to strong chemical fumes, mists, and dust is considered a severe environment. In an industrial setting, a severe environment is one with sustained exposure to high humidity and condensation that results in heavy development of mold and mildew. Frequent spilling and splashing of strong chemicals (acids, alkalis, oxidizers, and solvents) are also characteristic of a severe environment. Metal corrosion can be expected in a severe environment. Immersion conditions, marine environment with sustained exposure to saltwater spray, and arctic environment with long periods of extremely low temperature are considered severe environments. These are areas where if no high-performance coatings are applied on steel or concrete, very early failure and structural damage will be evident.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on actual substrate material to be coated, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Use same designations indicated on Drawings and in Preliminary Treatment Coating Schedule. Include color designations and product runs (batch numbers).

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, (batch number) that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Engineer will select one surface to represent surfaces and conditions for application of each coating system. Engineer will designate items or areas required.
2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Engineer at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.
3. Deliver materials on site in factory sealed containers from the manufacturer. Do not use materials from previous jobs.

1.8 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are within the coatings manufacturer's recommendations.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point and rising; or to damp or wet surfaces.

C. Lead Paint: It is not expected that lead paint will be encountered in the Work.

1. If suspected lead paint is encountered, do not disturb; immediately notify Engineer and Owner.

D. Do not apply exterior coatings in snow, rain, fog, mist, and in conditions that do not meet the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Carboline Company (CAR).
2. PPG Paints (PPG).
3. The Sherwin-Williams Company (SWC).
4. Tnemec Company, Inc. (TNE).

2.2 HIGH-PERFORMANCE COATINGS

A. Material Compatibility:

1. Each coating system within indicated substrates uses compatible material with one another, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Topcoat manufacturer recommends products in writing for use in each coating system coat and on indicated substrate.
3. Use products from same manufacturer for each coat in coating system.

B. Colors: As indicated in color schedule.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, both coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

1. Application of coating indicates acceptance of surfaces and conditions.

C. Proceed with coating application only after unsatisfactory conditions have been corrected. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be coated.

1. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
2. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed.
3. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by manufacturer.

1. NAPF 500-03, “Surface Preparation Standard for Ductile Iron Pipe and Cast Ductile Iron Fittings.”

3.3 APPLICATION

A. Apply high-performance coatings in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

D. Film Thickness: Apply paint in wet film thickness (WFT) recommended by high-performance manufacturer to achieve required dry film thickness (DFT) for each coat of paint. Since DFT varies among manufacturers, this reference is not included in Article “Preliminary Treatment Coating Schedule.”

3.4 FIELD QUALITY CONTROL

A. General: Field quality control referenced in this Article includes testing of both pre-application quality assurance and post-installation quality control of high-performance coatings. Employ quality approved testing agency to perform testing.

1. Perform Quality Control Testing in the order identified in the following subparagraph.

a. Testing Order: Dry Film Thickness testing, followed by Adhesion Testing, followed by Holiday testing.

2. Contractor shall touch up and restore coated surfaces damaged by testing.
3. If test results show that dry film thickness, holiday, and pull-off strength of applied coating does not comply with coating manufacturer’s written instructions, pay for testing and apply additional coats as needed to provide dry film thickness, pull-off strength that complies with coating manufacturer's written instructions.
4. Owner or Owner’s representative will conduct random independent inspections and tests for the final acceptance or rejection of pipe coating.

B. Quality Assurance Testing:

1. Surface Preparation Testing:

    a. Test surface profile of abrasive blasted surfaces with "Press-O-Film" tester tape or equivalent in accordance with NACE RP0287.
    b. Provide tester tape suitable for the intended profile height.
    c. Measure profile to a minimum tolerance of 0.1 mils, maximum.
    d. Use electronic surface profilometers necessary to verify tester tape measurements.

C. Quality Control Testing:

1. Dry Film Thickness Testing: Engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
2. Adhesion Testing:

    a. General:

        1) Test a minimum of two pipes for adhesion from each lot of pipes to be coated up to 3,000 square feet of pipe. Conduct an additional adhesion test on every increment up to 2,000 square feet of pipe coated in excess of the first 3,000 square feet of pipe (i.e. if one workday of production is 7,000 square feet of pipe, four adhesion tests will be conducted on the pipe lot.). Conduct adhesion testing on not less than 50 percent of each pipe produced within a lot.
        2) A pipe lot is defined as the quantity of pipe that is coated by a single crew within a work shift, but not to exceed 12 hours.
        3) Perform adhesion tests not less than 24 hours after coating application. Tests conducted prior to 24 hours will be acceptable only if the test meets or exceeds the adhesion criteria specified and the test was requested by the Owner.
        4) Randomly select pipe for adhesion testing. The Owner reserves the right to perform adhesion testing at any time or location.

    b. Rejection of Coating:

        1) If any coatings within a lot fails to meet the test criteria specified for the coating type, that coatings are considered rejected along with all other coatings within the lot. Each coating within the rejected pipe lot will then be individually tested and rejected on a pipe-by-pipe basis in conformance with the test procedures and criteria specific for the coating type.
        2) All rejected coatings shall have all coating removed from the full-length pipe and the pipe abrasive blasted and recoated.

3. Holiday Testing:

    a. Conduct holiday tests on completed coatings after cure or 24-hours, whichever is less. Provide a high voltage testing equipment and test in accordance with NACE SP0274 and the Specifications.
    b. Use actual coating thickness for holiday testing.
    c. Provide the holiday detector with an audible signal when contact is made between the pipeline and electrode at holidays (defects) in the coating. Provide a good

ground and a low electrical resistance between the pipeline and the detector. Make only direct connections to uncoated areas or to the pipe ends at holdback areas.

d. Clean and dry pipe surface when testing. Always keep electrode in motion and in firm contact with the coated surface while test voltage is being applied. Move the electrode evenly over the surface at approximately 0.5 to 1 fps. Do not exceed 1 fps of travel time.

e. Mark location of detected holidays for repair. Retest after repair.

3.5 CLEANING AND PROTECTION

A. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 PRELIMINARY TREATMENT COATING SCHEDULE

A. Ductile or Cast-Iron Substrates: Submerged Pipes in Wastewater..

1. Moderate to Severe Exposure:

a. 100% Solids Amine Cured Epoxy System:

1) Prime Coat:

a) CAR: Carboguard 890.
b) PPG: Raven 405.
c) SWC: Duraplate UHS.
d) TNE: Self Priming.

2) Topcoat: (MPI Gloss Level 6).

a) CAR: Hydroplate 1100.
b) PPG: Raven 405.
c) SWC: Duraplate UHS.
d) TNE: Series 22.

END OF SECTION 099676.23

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SECTION 099679 – ATMOSPHERIC PROTECTION AND PLANT SERVICE AREAS COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of high-performance coating systems for water and wastewater treatment on the following substrates:

1. Exterior Non-submerged Substrates:

a. Ductile iron piping at Filtrate Lift Station Valve Vault.

B. Related Requirements:

1. Section 099676.23 “Wastewater Preliminary Treatment Coatings” for submerged ductile iron pipes coating protection.
2. Section 400519 “Ductile Iron Process Pipe” for ductile pipe.
3. Section 400551 “Common Requirements for Process Valves” for factory finish valves.

1.3 DEFINITIONS

A. MPI Gloss Levels: Following define gloss levels according to ASTM D523:

1. MPI Gloss Level 6 - Traditional Gloss: 70 to 85 units at 60 degrees.

B. Mild Exposure: Normal outdoor weathering and standard industrial exposures are considered mild environments. A normal industrial setting is one with low to moderate levels of humidity and condensation and little development of mold and mildew. A mild environment has only limited exposure to chemical fumes or mist, and occasional occurrences of chemical spills or splash. Regular cleaning with standard commercial chemical cleaning agents, with only occasional use of stronger chemical cleaning agents, is also characteristics of a mild environment. Metal corrosion will occur in a mild environment, but it is minimal. These are generally dry areas with little to no Hydrogen Sulfide (H2S), Chlorine, or other corrosive chemicals, or the area is damp.

C. Moderate Exposure: An atmosphere that can be characterized as corrosive, within reasonable limits, is considered a moderate environment. In an industrial setting, a moderate environment indicates intermittent exposure to high humidity and condensation with occasional development of mold and mildew. Exposure to heavy concentrations of chemical fumes or mist and accidental chemical spills or splash occurs occasionally in a moderate environment. Regular use

of strong chemicals rather than standard commercial cleaning agent also changes a mild environment into a moderate one. Metal corrosion is common in a moderate environment.

D. Severe Exposure: An aggressively corrosive industrial or predominantly chemical environment with regular exposure to strong chemical fumes, mists, and dust is considered a severe environment. In an industrial setting, a severe environment is one with sustained exposure to high humidity and condensation that results in heavy development of mold and mildew. Frequent spilling and splashing of strong chemicals (acids, alkalis, oxidizers, and solvents) are also characteristic of a severe environment. Metal corrosion can be expected in a severe environment. Immersion conditions, marine environment with sustained exposure to saltwater spray, and arctic environment with long periods of extremely low temperature are considered severe environments. These are areas where if no high-performance coatings are applied on steel or concrete, very early failure and structural damage will be evident.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on actual substrate material to be coated, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Use same designations indicated on Drawings and in Atmospheric Protection Coating Schedule and Plant Service Areas Coating Schedule. Include color designations and product runs (batch numbers).

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run (batch number), that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 gallon of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Engineer will select one surface to represent surfaces and conditions for application of each coating system.

    a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
    b. Other Items: Engineer will designate items or areas required.

2. Final approval of color selections will be based on mockups.

    a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Engineer at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.
3. Deliver materials on site in factory sealed containers from the manufacturer. Do not use materials from previous jobs.

1.8 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are within the coatings manufacturer’s recommendations.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point and rising; or to damp or wet surfaces.

C. Lead Paint: It is not expected that lead paint will be encountered in the Work.

1. If suspected lead paint is encountered, do not disturb; immediately notify Engineer and Owner.

D. Do not apply exterior coatings in snow, rain, fog, mist, and in conditions that do not meet the manufacturer’s recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Carboline Company (CAR).
2. PPG Paints (PPG).
3. The Sherwin-Williams Company (SWC).
4. Tnemec Company, Inc. (TNE).

2.2 HIGH-PERFORMANCE COATINGS

A. Material Compatibility:

1. Each coating system within indicated substrates uses compatible material with one another, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Topcoat manufacturer recommends products in writing for use in each coating system coat and on indicated substrate.
3. Use products from same manufacturer for each coat in coating system.

B. Colors: As selected by Engineer from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, both coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

1. Application of coating indicates acceptance of surfaces and conditions.
2. Recoating of Previously Coated Surfaces: Verify conditions and compatibility between new and existing high-performance coating products.

C. Proceed with coating application only after unsatisfactory conditions have been corrected. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be coated.

1. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
2. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed.
3. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by manufacturer but not less than the following:

1. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
2. SSPC-SP 10/NACE No. 2, "Near White Blast Cleaning."
3. SSPC-SP 6/NACE No. 3, "Power Tool Cleaning."
4. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
5. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
6. NAPF 500-03, "Surface Preparation Standard for Ductile Iron Pipe and Cast Ductile Iron Fittings."
7. SSPC-SP 16, "Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

E. Galvanized-Steel Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

A. Apply high-performance coatings in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

D. Film Thickness: Apply paint in wet film thickness (WFT) recommended by high-performance manufacturer to achieve required dry film thickness (DFT) for each coat of paint. Since DFT varies among manufacturers, this reference is not included in Article “Atmospheric Protection Coating Schedule and Plant Service Areas Coating Schedule.”

3.4 FIELD QUALITY CONTROL

A. General: Field quality control referenced in this Article includes testing of both pre-application quality assurance and post-installation quality control of high-performance coatings. Employ quality approved testing agency to perform testing.

1. Perform Quality Control Testing in the order identified in the following subparagraph.

    a. Testing Order: Dry Film Thickness testing, followed by Adhesion Testing, followed by Holiday testing.

2. Contractor shall touch up and restore coated surfaces damaged by testing.
3. If test results show that dry film thickness, holiday, and pull-off strength of applied coating does not comply with coating manufacturer’s written instructions, pay for testing and apply additional coats as needed to provide dry film thickness, pull-off strength that complies with coating manufacturer's written instructions.
4. Owner or Owner’s representative will conduct random independent inspections and tests for the final acceptance or rejection of pipe coating.

B. Quality Assurance Testing:

1. Surface Preparation Testing:

    a. Test surface profile of abrasive blasted surfaces with “Press-O-Film” tester tape or equivalent in accordance with NACE RP0287.
    b. Provide tester tape suitable for the intended profile height.
    c. Measure profile to a minimum tolerance of 0.1 mils, maximum.
    d. Use electronic surface profilometers necessary to verify tester tape measurements.

C. Quality Control Testing:

1. Dry Film Thickness Testing: Owner engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

2. Adhesion Testing:

    a. General:
        1) Test a minimum of two pipes for adhesion from each lot of pipes to be coated up to 3,000 square feet of pipe. Conduct an additional adhesion test on every increment up to 2,000 square feet of pipe coated in excess of the first 3,000 square feet of pipe (i.e. if one workday of production is 7,000 square feet of pipe, four adhesion tests will be conducted on the pipe lot.). Conduct adhesion testing on not less than 50 percent of each pipe produced within a lot.
        2) A pipe lot is defined as the quantity of pipe that is coated by a single crew within a work shift, but not to exceed 12 hours.
        3) Perform adhesion tests not less than 24 hours after coating application. Tests conducted prior to 24 hours will be acceptable only if the test meets or exceeds the adhesion criteria specified and the test was requested by the Owner.
        4) Randomly select pipe for adhesion testing. The Owner reserves the right to perform adhesion testing at any time or location.

    b. Rejection of Coating:

        1) If any coatings within a lot fails to meet the test criteria specified for the coating type, that coatings are considered rejected along with all other coatings within the lot. Each coating within the rejected pipe lot will then be individually tested and rejected on a pipe-by-pipe basis in conformance with the test procedures and criteria specific for the coating type.
        2) Remove all rejected coatings from the full-length pipe and the pipe abrasive blasted and recoated.

3. Holiday Testing:

    a. Conduct holiday tests on completed coatings after cure or 24-hours, whichever is less. Provide a high voltage testing equipment and test in accordance with NACE SP0274 and the Specifications.
    b. Use actual coating thickness for holiday testing.
    c. Provide the holiday detector with an audible signal when contact is made between the pipeline and electrode at holidays (defects) in the coating. Provide a good ground and a low electrical resistance between the pipeline and the detector. Make only direct connections to uncoated areas or to the pipe ends at holdback areas.
    d. Clean and dry pipe surface when testing. Always keep electrode in motion and in firm contact with the coated surface while test voltage is being applied. Move the electrode evenly over the surface at approximately 0.5 to 1 fps. Do not exceed 1 fps of travel time.
    e. Mark location of detected holidays for repair. Retest after repair.

3.5 CLEANING AND PROTECTION

A. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 ATMOSPHERIC PROTECTION COATING SCHEDULE

A. Exterior Weathering and Protection: Non-submerged and atmospheric service.

1. Steel Substrates: Moderate to Severe Exposure.

a. Pigmented Polyurethane over Zinc-Rich Primer and Epoxy Intermediate System:

1) Prime Coat:

a) CAR: Carbozinc 859.
b) PPG: Amercoat 68HS.
c) SWC: Corothane I Galvapac.
d) TNE: Series 94-H2O.

2) Intermediate Coat:

a) CAR: Carboguard 890.
b) PPG: Amerlock 2/400.
c) SWC: Macropoxy 646.
d) TNE: Series 66.

3) Topcoat: (MPI Gloss Level 6).

a) CAR: Carbothane 134UV.
b) PPG: Pitthane Ultra.
c) SWC: Acrolon Ultra weathering urethane .
d) TNE: Series 1094.

2. Ductile Iron or Cast-Iron Substrates: Moderate to Severe Exposure.

a. Polysiloxane System:

1) Prime Coat:

a) CAR: Carboguard 890.
b) PPG: Amerlock 400BF.
c) SWC: Macropoxy 646 FC Epoxy.
d) TNE: Series 66.

2) Topcoat: (MPI Gloss Level 6).

a) CAR: Carboxane 2000 Series.
b) PPG: PSX700.
c) SWC: Sher-Loxane 800.
d) TNE: Series 690.

3. Galvanized Steel Substrates:

a. Polysiloxane over Epoxy System:

1) Prime Coat:

a) CAR: Carboguard 890.
b) PPG: Amerlock 2/400.
c) SWC: Macropoxy 646.
d) TNE: Series 66.

2) Topcoat: (MPI Gloss Level 6).

a) CAR: Carboxane 2000 Series.
b) PPG: PSX700.
c) SWC: Sher-Loxane 800.
d) TNE: Series 690.

END OF SECTION 099679

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SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. General requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V.
2. Install at equipment manufacturer's factory or ship separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 degrees C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material:

1. Motor Frame Sizes 324T and Larger: Cast iron.
2. Motor Frame Sizes Smaller than 324T: Rolled steel.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers:

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. Provide grounding rings or straps on motors with variable frequency controller.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Provide pumps so they are specified or scheduled with ECM.

1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
6. Integrated motor protection verified by UL to protect the pump against over-/undervoltage, overtemperature of motor and/or electronics, overcurrent, locked rotor, and dry run (no-load condition).

PART 3 - EXECUTION (NOT USED)

END OF SECTION 230513

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SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Fastener systems.
3. Equipment supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

C. Qualification Data: For professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hilti, Inc.
b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
c. MKT Fastening, LLC.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cooper B-line; brand of Eaton, Electrical Sector.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
e. MKT Fastening, LLC.

2. Indoor Applications: stainless-steel.
3. Outdoor Applications: Stainless steel.

2.4 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.5 MATERIALS

A. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.

B. Stainless Steel: ASTM A240/A240M.

PART 3 - EXECUTION

3.1 APPLICATION

A. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B.

C. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 HANGER AND SUPPORT SCHEDULE

A. Use stainless-steel pipe hangers and stainless steel attachments for applications.

B. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

END OF SECTION 230529

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

    a. Constant-volume air systems.

2. Testing, Adjusting, and Balancing Equipment:

    a. Motors.
    b. Condensing units.
    c. Heat-transfer coils.
3. Control system verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.4 ACTION SUBMITTALS

A. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.7 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine operating safety interlocks and controls on HVAC equipment.

K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete, and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.

d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.6 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.

7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.7 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.8 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.9 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Engineer's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.

2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Filter static-pressure differential in inches wg.
    f. Preheat-coil static-pressure differential in inches wg.
    g. Cooling-coil static-pressure differential in inches wg.
    h. Heating-coil static-pressure differential in inches wg.
    i. Outdoor airflow in cfm.
    j. Return airflow in cfm.
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

F. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

    a. System identification.
    b. Location.
    c. Coil identification.
    d. Capacity in Btu/h.
    e. Number of stages.
    f. Connected volts, phase, and hertz.
    g. Rated amperage.
    h. Airflow rate in cfm.
    i. Face area in sq. ft.
    j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

    a. Heat output in Btu/h.
    b. Airflow rate in cfm.
    c. Air velocity in fpm.
    d. Entering-air temperature in degrees F.
    e. Leaving-air temperature in degrees F.
    f. Voltage at each connection.
    g. Amperage for each phase.

3.11 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner and Construction Manager.

B. Engineer, Owner or Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, Owner or Engineer may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

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SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:

1. Plastic pipe and fittings.
2. Joining materials
3. Transition fittings.
4. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe.
2. Fittings.
3. Joining materials.
4. Bypass chemical feeder.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Field quality-control reports.

D. Welding inspection certificates

E. Preconstruction Test Reports:

1. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping, gaskets, and covering shall comply with ASTM 25/50, Flame Spread/Smoke Developed testing.

B. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Cooling Coil Condensate-Drain Piping: 150 deg F.

2.2 PLASTIC PIPE AND FITTINGS

A. PVC Plastic Pipe: ASTM D1785, with wall thickness as indicated in "Piping Applications" Article.

1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D2466 for Schedule 40 pipe; ASTM D2467 for Schedule 80 pipe.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solvent Cements for PVC Piping: ASTM D2564. Include primer according to ASTM F656.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Charlotte Pipe and Foundry Company.
    b. IPEX USA LLC.
    c. Uponor.
    d. Viega LLC.
    e. Lasco Fittings, Inc.
    f. George Fischer Piping Systems
    g. Spears Manufacturing Company.

2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Charlotte Pipe and Foundry Company.
    b. IPEX USA LLC.
    c. NIBCO INC.
    d. Spears Manufacturing Company.
    e. Aquatherm.
    f. Lasco Fittings, Inc.
    g. George Fischer Piping Systems.

2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. A.Y. McDonald Mfg. Co.
    b. Capitol Manufacturing Company.
    c. GF Piping Systems: Georg Fischer LLC.
    d. HART Industrial Unions, LLC.
    e. Jomar Valve.
    f. Matco-Norca.

g. WATTS; A Watts Water Technologies Company.
h. Wilkins.
i. Zurn Industries, LLC.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 150 psig.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. GF Piping Systems: Georg Fischer LLC.
b. WATTS; A Watts Water Technologies Company.
c. Wilkins.
d. Zurn Industries, LLC.
e. CTS Flange.
f. USA Federal Process Corp.

2. Description:

a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 150 psig.
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, LLC.
b. CALPICO, Inc.
c. GF Piping Systems: Georg Fischer LLC.
d. GPT; a division of EnPRO Industries.
e. Ramco Sealing Solutions.
f. Flange Protection and Gasket, Inc.
g. Northtown Co.

2. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
c. Elster Perfection; Honeywell.
d. GPT; a division of EnPRO Industries.
e. Matco-Norca.
f. Precision Plumbing Products.
g. Sioux Chief Manufacturing Company, Inc.
h. Victaulic Company.
i. MIFAB, Inc
j. Camco Manufacturing, Inc.

2. Description:

a. Standard: IAPMO PS 66.
b. Electroplated steel nipple, complying with ASTM F1545.
c. Pressure Rating: 300 psig at 225 deg F.
d. End Connections: Male threaded or grooved.
e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install air vents, consisting of a tee, 3/4-inch ball valve, short threaded nipple with cap or an automatic vent at all system high points.

N. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

P. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated. Route piping and install unions and shutoff valves to allow equipment removal without disturbing piping.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

3.2 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges and flange kits.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.

2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for plastic piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping within 12 inches of each fitting and coupling.

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Pressure Piping: Join ASTM D1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D2855.
3. PVC Non-pressure Piping: Join according to ASTM D2855.

3.5 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

END OF SECTION 232113

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SECTION 238113.13 - PACKAGED TERMINAL AIR-CONDITIONERS, OUTDOOR, WALL-MOUNTED UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes packaged, terminal, outdoor, wall-mounted air conditioners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For packaged, terminal air conditioners.

1. Include plans, elevations, sections, details for wall penetrations, and attachments to other work.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For packaged, terminal air conditioners, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged, terminal air conditioners to include in emergency, operation, and maintenance manuals.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, terminal air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Sealed Refrigeration System: Manufacturer's standard, but not less than five years from date of Substantial Completion, including components and labor.
2. Warranty Period for Nonsealed System Parts: Manufacturer's standard, but not less than five years from date of Substantial Completion, including only components and excluding labor.
3. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products by one of the following:

1. Bard Manufacturing Company.
2. Compu-Aire, Inc.
3. Marvair.

2.2 MANUFACTURED UNITS

A. Description: Factory-assembled and -tested, self-contained, packaged, terminal air conditioner with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant and filled with oil; with hardwired chassis and circuit breaker.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

E. ASHRAE Thermal Comfort: Applicable requirements in ASHRAE 55.

F. ASHRAE ERV Testing: Applicable requirements in ASHRAE 84.

G. AHRI Rating: Applicable requirements in AHRI 1060.

H. UL listed and ETL performance certified.

2.3 CHASSIS

A. Cabinet: 16-gauge zinc coated steel with removable front panel with concealed latches.

1. Mounting: On exterior wall.
2. Discharge Grille: Extruded-aluminum discharge grille.
3. Return Grille: Extruded-aluminum grille.
4. Louvers: Extruded aluminum with enamel finish color.
5. Finish: Baked enamel.
6. Access Door: Hinged door in top of cabinet for access to controls.
7. Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.
8. Insulation: Cooling and heating sections fully insulated with 1-inch -thick fiberglass insulation.
9. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
10. Wall Sleeves: Galvanized steel with polyester finish.

B. Refrigeration System: Direct-expansion indoor coil with capillary restrictor and hermetically sealed scroll compressor with crankcase heater**,** liquid line filter dryer, externally equalized expansion valve, high-pressure switch, fan cycle, control, common alarm**,** vibration isolation, and overload protection.

1. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins.
2. Accumulator.
3. Constant-pressure expansion valve.
4. Reversing valve.
5. Charge: R-410A.

C. Indoor Fan: Backward curved, centrifugal; with variable-speed motor(s) and positive-pressure ventilation damper with concealed manual operator.

D. Filters: 2-inch, pleated**,** disposable MERV 8, serviceable from front of the unit.

E. Condensate Drain: Coated galvanized-steel drain pan.

1. Comply with ASHRAE 62.1 for drain pan construction and connections.

F. Outdoor Fan: High-ambient**,** Forward curved**,** centrifugal, or propeller type with separate motor.

1. Indoor and Outdoor Fan Motors: Two speed; comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Fan Motors: Permanently lubricated split capacitor.
b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.4 HEATING

A. Electric-Resistance Heating Coil: Nickel-chromium-wire, electric-resistance heating elements with contactor and high-temperature-limit switch.

2.5 CONTROLS

A. Control Module: Unit-mounted digital panel with touchpad temperature control and with touchpad for heating, cooling, and fan operation. Include the following features:

1. Low-Ambient Lockout Control: Prevents cooling-cycle operation below 40 degrees F outdoor air temperature if unit is provided with economizer
2. Temperature-Limit Control: Prevents occupant from exceeding preset setup temperature.

B. Dual Unit Control (DUC): Hinged cover with two-stage heat/cool thermostat with individual heat/cool setpoints, adjustable interstage differentials and bimetallic elements. The control shall feature a solid-state timer with 1-2-4-8 day sequence, unit lead selector, Unit 1 and 2 power-on LEDs, Unit 1 or 2 lead unit LEDs, 48-hour program save on loss of power, industry standard connections, and 24-volt power from each unit. The DUC shall provide auto sequencing and displays on status and operating status parameters.

C. Three-Phase Power Rotation Monitor: Three-phase monitoring to protect compressor from reverse rotation and to protect the unit from phase failure. Monitor manually reset.

D. Dehumidification Circuit: Supply-air stream, independent heat exchanger using a separate humidistat, hot gas three-way valve, separate desuperheating condenser circuit, and back drain orifice inserted between the reheat coil and suction line.

2.6 CAPACITIES AND CHARACTERISTICS

A. Refer to Schedule on Drawings.

2.7 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Factory test to comply with AHRI 300, "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment."

B. Unit Performance Ratings: Factory test to comply with AHRI 310/380/CSA C744, "Packaged Terminal Air-Conditioners and Heat Pumps."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.

B. Install wall sleeves in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."

C. Install and anchor wall sleeves to withstand, without damage to equipment and structure, seismic forces required by building code.

3.2 CONNECTIONS

A. Install piping adjacent to machine to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing packaged, terminal air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
3. Unit is level on base and is flashed in exterior wall.
4. Unit casing has no visible damage.
5. Compressor, air-cooled condenser coil, and fans have no visible damage.
6. Labels are clearly visible.
7. Controls are connected and operable.
8. Shipping bolts, blocks, and tie-down straps are removed.
9. Filters are installed and clean.
10. Drain pan and drain line are installed correctly.
11. Electrical wiring installation complies with manufacturer's submittal and installation requirements in electrical Sections.
12. Installation: Perform startup checks according to manufacturer's written instructions, including the following:

    a. Lubricate bearings on fan.
    b. Check fan-wheel rotation for correct direction without vibration and binding.

13. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
14. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. After performance test, change filters.

E. Packaged, terminal air conditioners will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain packaged, terminal air conditioners.

END OF SECTION 238113.13

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Tray cable, Type TC.
3. Connectors and splices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
4. Section 271313 "Communications Copper Backbone Cabling" for twisted pair cabling used for data circuits.
5. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 DEFINITIONS

A. VFC: Variable-frequency controller. Used interchangeably with VFD.

B. VFD: Variable frequency drive. See VFC.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer’s cut sheet for each type of product used on project.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper, ASTM B33 for tinned copper and with ASTM B8 for stranded conductors.

D. Stranding: Refer to CONDUCTOR APPLICATIONS Article in PART 3.

E. Conductor Insulation:
1. Type RHW-2: Comply with UL 44.
2. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
3. Type XHHW-2: Comply with UL 44.

2.2 Type TRAY CABLE, TYPE TC

A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in a nonmetallic jacket.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1277.
3. Comply with ICEA S-73-532/NEMA WC 57 for Type TC cables used for control, thermocouple extension, and instrumentation.
4. Comply with ICEA S-95-658/NEMA WC 70 for Type TC cables used for power distribution.
5. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

D. Ground Conductor: Bare.

E. Conductor Insulation: Type XHHW-2, complying with UL 44.

F. Shield: None.

2.3 TRAY CABLE, TYPE TC-ER FOR VFC APPLICATIONS

A. Type TC-ER: Shielded, stranded, tinned copper cable with three symmetrical ground conductors, XLPE insulation, PVC outer jacket, designed for use as output cable to motor from VFCs.

1. Nexans AmerCable Type 37-108VFD Flexible TC-ER VFD Power Cable or equal.
2. Conduit sizing on Drawings are based on using this manufacturer. Increase conduit size as required to comply with NEC if different manufacturer is submitted.
3. Nexans AmerCable Data:

Circuit Conductor Size (AWG)	Grounding Conductors (x 3) Size (AWG)	Nominal Diameter (inches)	Nexans AmerCable Part Number
12	16	0.509	37-108-516VFD
10	14	0.522	37-108-308VFD
8	14	0.653	37-108-309VFD
6	12	0.737	37-108-310VFD
4	12	0.956	37-108-312VFD
2	10	1.103	37-108-314VFD
1	10	1.221	37-108-315VFD
1/0	10	1.447	37-108-316VFD
2/0	10	1.538	37-108-317VFD
4/0	8	1.883	37-108-319VFD

2.4 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Tin-plated copper.
2. Type:

a. One hole with long barrels for No. 8 AWG to No. 4/0 AWG.
b. Two holes with long barrels for 250 kcmil and larger.
c. Locking spade for No. 10 AWG and smaller.

3. Termination: Compression for No. 8 AWG and larger.

D. Connectors:

1. Solderless pressure type (wirenuts) for No. 10 AWG and smaller.
2. Pre-filled with silicone-based sealant for exterior, wet, or corrosive locations.
3. Split bolt type for No. 8 AWG and larger splices.

E. Motor Terminations: Mechanical compression ring type, secured with bolt, nut and spring washer.

PART 3 - EXECUTION

3.1 CONDUCTOR APPLICATIONS

A. Wires and Cables: Copper; stranded, except for lighting and receptacle wiring which may be solid. Minimum size for power circuits: No. 12 AWG.

B. Nominal 480/277VAC Power Circuits: Single conductors in raceway. Type XHHW-2 for sizes up to 4/0 and Type RHW-2 for size 250 kcmil and larger.

C. Nominal 240/208/120V Power Circuits: Single conductors in raceway. Type XHHW-2 .

D. Cables and Conductors in Cable Trays: Type TC.

E. Direct Burial Outdoor Lighting Circuits: Type RHW-2.

F. Grounding Conductors: Refer to Section 260526 “Grounding and Bonding for Electrical Systems”.

G. Control and Fire Alarm Circuits: Refer to Section 260523 “Control-Voltage Electrical Power Cables”.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. VFC Output Circuits: Type TC-ER with shield.

3.2 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Use of steel fish tapes and/or steel pulling cables in PVC conduit or raceways that terminate into energized enclosures is prohibited.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

H. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. Do not splice service or feeder cables without prior written approval of Engineer.

C. Wiring at Outlets:

1. Install conductor at each outlet, with at least 6 inch of slack.
2. Form solid wire into loop to fit around device terminal screw. Do not overlap wire.

3.4 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIELD QUALITY CONTROL

A. and "Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance, and feeder conductors, and 480V power circuit conductors for compliance with requirements.
2. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Thermographic survey.

    c. Inspect compression-applied connectors for correct cable match and indentation.
    d. Inspect for correct identification.
    e. Inspect cable jacket and condition.
    f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 1000 V(dc) for 600 V rated cable for a one-minute duration. Minimum wire insulation resistance: 250 Megohms.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Control-circuit conductors.
   2. Fire-alarm wire and cable.
   3. Instrumentation cable.
   4. Industrial Ethernet cable.
   5. Termination products.

B. Related Requirements:

   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
   2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer’s cut sheet for each type of product used on project.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inches or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

E. RoHS compliant.

2.2 CONTROL-CIRCUIT CONDUCTORS

A. Individual Conductors: Stranded copper, Type XHHW-2, complying with UL 44 in raceway.

B. Multi-conductor Control Cable: NEC type TC, stranded copper, Type XHHW-2, insulated color coded conductors including ground wire, overall PVC jacket. Rated for cable tray or direct burial use and sunlight resistant. Number of conductors as indicated on Drawings.

C. Minimum Size: No. 14 AWG for 120V circuits, No. 16 AWG for circuits 50V and less.

2.3 FIRE-ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Control-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Low-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

2.4 INSTRUMENTATION CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Belden.
2. Rockbestos-Suprenant Cable Corp.

B. Single or Multiple Paired Cable: NEC Type ITC (Instrumentation Tray Cable), UL Type TC for 4-20mA process instrumentation signals and use under NEC Article 727.

1. One or Multi-pair, twisted, shielded, No. 16 AWG, stranded, tinned-copper conductors.
2. Voltage Rating: 600V.
3. Insulation: XLP.
4. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.
5. Jacket: PVC with manufacturer's identification.
6. Standards: UL 1277 Type TC, UL 1581.
7. Single pair cable maximum overall diameter: 0.297-inches.

C. Triad (three conductor) Cable: NEC Type ITC (Instrumentation Tray Cable), UL Type TC for instrumentation signals and use under NEC Article 727.

1. Three conductor, twisted, shielded, No. 16 AWG, stranded, tinned-copper conductors.
2. Voltage Rating: 600V.
3. Insulation: XLP.
4. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.
5. Jacket: PVC with manufacturer's identification.
6. Standards: UL 1277 Type TC, UL 1581.
7. Triad cable maximum overall diameter: 0.311-inches.

2.5 INDUSTRIAL ETHERNET CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Rockwell Automation 1585-C8HB-S.

B. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz *Ethernet/IP* compliant.

C. Conductors: 100-ohm, 22 AWG solid copper.

D. Shielding/Screening: Overall foil shield.

E. Cable Rating: 600V.

F. Jacket: PVC.

G. Standards: UL, UL PLTC, UL AWM 2570 80C 600V, TIA 568B.

2.6 TERMINATIONS

A. Termination connectors for instrumentation and control conductors:

1. Tin plated copper.
2. Vinyl insulated.
3. Flanged spade / locking fork with upturned leg ends.
4. Crimp / compression installation.

B. Termination connector for industrial Ethernet cable: match conductor count, RJ45 type, intended for shielded cable. Rockwell Automation Bulletin 1585J or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceway selection and installation requirements for conduits as supplemented or modified in this Section.

B. Comply with requirements in Section 260533.23 "Surface Raceways for Electrical Systems" for raceway selection and installation requirements for wireways as supplemented or modified in this Section.

C. Comply with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems" for raceway selection and installation requirements for boxes as supplemented or modified in this Section.

1. Outlet Boxes: No smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
2. Outlet Boxes for Cables: No smaller than 4 inches square by 1-1/2 inches 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
3. Flexible metal conduit isnot allowed.

D. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

E. Install manufactured conduit sweeps and long-radius elbows if possible.

F. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.

2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.
4. Extend conduits 3 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with requirements in Section 260519 “Low-Voltage Electrical Power Conductors and Cables” for installation requirements and as supplemented or modified in this Section.

B. Instrumentation and Ethernet cables may not be spliced and are to be continuous from terminal to terminal.

C. Install instrumentation and Ethernet cabling in separate raceway from control or power wiring.

D. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.

E. Separation from EMI Sources:

1. Separation between open instrumentation cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.

3.4 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 GROUNDING

A. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

B. For instrumentation wiring, ground shield at one end only as recommended by instrument manufacturer and in accordance with Owner’s standard.

3.6 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers comply with UL 969, for label stocks, laminating adhesives, and inks.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.7 FIELD QUALITY CONTROL

A. and "Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding materials and hardware.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on the project.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Insulated Grounding and Bonding Conductor: Copper conductor, 600V with insulation type matching the circuit phase conductors called for in Section 260519 “Low-Voltage Electrical Power Conductors and Cables”, green color.

B. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Referenced Standards: Complying with one or more of the following:

a. Soft or Annealed Copper Wire: ASTM B3.
b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING MATERIALS AND HARDWARE

A. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

B. Ground Rods: Copper clad steel, 3/4-inch by 10-feet, sectionalized as required by Drawings.

C. Grounding Conduit Hubs: Malleable iron type.

D. Water Pipe Ground Clamps: Cast bronze saddle type.

E. Exothermic-welding Kits: CADWELD process or equal.

a. Manufacturer kits to include molds and powder recommended by kit manufacturer for materials being joined and installation conditions.
b. Welds used indoors in occupied buildings or confined space to be low emission type, CADWELD EXOLON or equal.

F. Ground Rod Test Wells: As detailed on the Drawings.

G. Ground Enhancement Material (GEM): Low-resistance, non-corrosive, carbon dust based material that improves grounding effectiveness. Contains cement, which hardens when set to provide a permanent, maintenance-free, low-resistant grounding system that never leaches or washes away. Suitable for installation in trenches or backfilling around ground rods. Resistivity of no more than 20 ohm-cm in cured state. ERICO Part No. GEM25A or equal.

H. Bus Bars: Rectangular bar of annealed copper. As detailed on the Drawings.

PART 3 - EXECUTION

3.1 SELECTION OF GROUNDING AND BONDING CONDUCTORS

A. Conductors: Install solid conductor for 10 AWG and smaller, and stranded conductors for 8 AWG and larger unless otherwise indicated.

B. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.

C. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.

D. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

E. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

F. Underground Grounding Conductors: Install bare tinned-copper conductor, size as indicated on Drawings.

1. Bury at least 30 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

3.2 SELECTION OF CONNECTORS

A. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.3 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
2. Consult Engineer for resolution of conflicting requirements.

C. Special Techniques:

1. Grounding Electrode Conductors:

    a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
    b. Where conductors pass through floor slabs, walls, etc., install in conduit or sleeve.
    c. When conductors need to be installed in conduit for mechanical protection, use non-ferrous conduit to avoid a choke effect for fault currents.

2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

    a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
    b. Make connections with clean, bare metal at points of contact.
    c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
    d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
    e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
    f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

        1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
        2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
        3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.

    g. Grounding and Bonding for Piping:

        1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
        2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
        3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

    h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners.

Installbonding jumper to bond across flexible duct connections to achieve continuity.

i. Grounding for Steel Building Structure: Install as indicated on Drawings.

1) Locate attachment points not subject to mechanical damage, but accessible for inspection.
2) Use exothermic weld process for wire sizes 1/0 AWG and larger. When wire size is smaller than 1/0 AWG, weld a pigtail of 1/0 AWG to structural steel then mechanically connect the two wires.

3. Electrodes:

a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.

1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2) Use exothermic welds for below-grade connections.
3) Drive rods vertically and do not allow them to be deformed or driven at an angle. Where driving is difficult or rock is encountered, use purpose-designed drilling equipment, install rod into drilled hole and backfill around rod using ground enhancement material (GEM) mixed with water to form a slurry in accordance with manufacturer’s instructions.

b. Test Wells: Install as indicated on Drawings. Ring Electrode: Install grounding conductor, electrically connected to each building structure ground rod and to each steel column or other indicated item, extending around perimeter of building, area, or item indicated.

1) Bury ring electrode not less than 24 inch from building's foundation.
2) Lay underground conductors slack, and where exposed to mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe or other magnetic material, electrically connect conductors to both ends of the guard.

c. Concrete-Encased Electrode (Ufer Ground): Fabricate in accordance with NFPA 70.

4. Grounding at Service:

a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.

5. Grounding Separately Derived Systems:

a. Transformers: Bond neutral and ground with a bonding jumper at the equipment in accordance with NEC 250.102. Connect to the grounding electrode system via the electrode grounding conductor in accordance with NEC Table 250.66 or as indicated on the Drawings.

b. Generators and UPS: When indicated on the Drawings as a separately derived system, bond neutral and ground with a bonding jumper at the equipment in accordance with NEC 250.102. Connect to the grounding electrode system via the electrode grounding conductor in accordance with NEC Table 250.66 or a indicated on the Drawings.
c. Generator: Install grounding electrode(s) at generator location. Electrode must be connected to equipment grounding conductor and to frame of generator.

6. Grounding Underground Distribution System Components:

   a. Comply with IEEE C2 grounding requirements.

7. Grounding and Bonding Manholes and Handholes: Install as indicated on Drawings. Bond exposed-metal parts to ground rod or grounding conductor. Grounding and Bonding of Raceways, Cable Trays, Boxes, and Enclosures:

   a. Terminate metallic conduit into pressed steel boxes using double locknuts (same metal type as conduit) and insulated grounding bushings.
   b. Terminate metallic conduit into metallic gasketed enclosures using Meyers grounding type conduit hubs.
   c. Use insulated throat grounding bushings with lay-in type lugs to terminate metallic conduits containing equipment grounding conductors into sheet steel boxes.
   d. Bond metallic electrical system components such as cable trays, supports, brackets, braces, boxes, etc. to the raceway system if they are not rigidly secured to and in contact with the raceway system or are subject to vibration and loosening.
   e. Provide a bonding jumper across hinged metal panels or doors when electrical components in excess of 24 volts are mounted on the moveable panel.
   f. Provide a grounding bushing at the end of metallic conduits that terminate in free air.
   g. Provide 12 AWG insulated green wire bonding jumper for metal outlet boxes that contain receptacles. Connect wire from receptacle ground terminal to box using grounding screw.

8. Equipment Grounding:

   a. Install insulated equipment grounding conductors with feeders and branch circuits.
   b. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
   c. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
   d. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
   e. Metallic Fences: Comply with requirements of IEEE C2.

      1) Grounding Conductor: Bare, tinned copper, not less than 6 AWG.

2) Gates: Must be bonded to grounding conductor with flexible bonding jumper.
3) Barbed Wire: Strands must be bonded to grounding conductor.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
    c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

B. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

C. Collect, assemble, and submit test and inspection reports.

1. Report measured ground resistances that exceed the following values:

    a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 Ω (ohms).
    b. Power and Lighting Equipment or System with Capacity over 500 kVA: 5 Ω (ohms).

3.5 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on the project.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following: channel support systems, conduit support hardware, and accessories.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 DELEGATED DESIGN SUBMITTALS

A. For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer, as defined in Section 014000 “Quality Requirements”, to design hanger and support system.

B. Surface-Burning Characteristics for Nonmetallic Channel Systems and Accessories: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Aluminum Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: 6063-T5 aluminum alloy.
3. Fittings and Accessories Material: 5052-H32 aluminum alloy.

B. Stainless Steel Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Stainless steel, Type 316.

C. Hot-dipped Galvanized Steel Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Hot-dipped galvanized steel.

D. Nonmetallic Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: Ultraviolet resistant FRP.
3. Fittings and Accessories Material: Stainless steel, Type 316 or compatible non-metallic.

E. Accessories: Conduit clamps, straps, hangers, rods, backplates, anchors, nuts, washers, etc. to correspond with channel material as listed in the SELECTION Article. Use of galvanized steel components is only allowed with galvanized steel channel.

F. Threaded Rod: 3/8-inch diameter, minimum.

G. Expansion Anchors: 3/8-inch minimum diameter. Equal to “Kwik Bolt”, manufactured by McCullock Industries; “Wej it” manufactured by Wej it Expansion Products; or “Kwik-Bolt II” manufactured by Hilti Fastening Systems.

PART 3 - EXECUTION

3.1 SELECTION OF CHANNEL

A. Dry, indoor, conditioned, non-process space: Hot dipped galvanized steel and/or aluminum.

B. Outdoor, process areas, or areas indicated on Drawings as “DUST”, “DAMP”, or WET”: Aluminum and/or stainless steel, depending upon load requirements.

C. Areas indicated on Drawings as “CORROSIVE”: Nonmetallic.

3.2 INSTALLATION

A. Comply with the following standards as applicable for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101: Standard for Installing Steel Conduits.
2. NECA NEIS 102: Standard for Installing Aluminum Rigid Metal Conduits.
3. NECA NEIS 105: Standard for Installing Metal Cable Tray Systems.
4. NECA NEIS 111: Standard for Installing Nonmetallic Raceways.

B. Attach support systems only to structural components. Use concrete expansion anchors for attachment to concrete surfaces.

C. Provide a minimum of 1/2-inch clearance between wall and equipment when installing surface mounted panel boxes, junction boxes, conduit, etc.

D. Space conduit supports, other than for underground raceways, at no more than 8 foot intervals, and as required to obtain rigid construction.

E. Remove burrs and grind smooth sharp edges from channel support ends. Fit ends with plastic end caps.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

A. Touchup:

1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Conduits and fittings.

B. Products Installed, but Not Furnished, under This Section:

1. Section 260553 "Identification for Electrical Systems" for conduit identification labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260533.16 “Boxes and Covers for Electrical Systems” for conduit bodies, outlet and device boxes, pull boxes, and junction boxes.
4. Section 260533.23 "Surface Raceways for Electrical Systems” for wireways and auxiliary gutters.
5. Section 260529 “Hangers and Supports for Electrical Systems” for channel support systems and miscellaneous mounting components.
6. Section 260543 “Underground Ducts and Raceways for Electrical Systems” for underground construction requirements.

1.3 DEFINITIONS

A. Conduit: A structure containing one or more duct raceways.

B. Duct Raceway: A single enclosed raceway for conductors or cable.

C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer's cut sheet for each type of product used on project. Note some conduit types listed may not be used on the project. Refer to the Conduit Selection Table in PART 3.

B. Conduit Layouts: For Division 26, 27, and 28 conduits installed underground and concealed within buildings and structures. Show equipment, boxes, handholes, manholes, routing, materials, and sizing. Provide layouts at an appropriate scale for clarity. Submission of separate drawings for power, lighting and control for one area is acceptable. Provide schedule for easy cross check.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 TYPE EMT DUCT RACEWAYS AND ELBOWS

A. Description: Electrical metallic tubing per NEC Article 358.

B. Listing Criteria: UL FJMX - Electrical Metallic Tubing, including UL 797.

C. Material: Hot-dipped galvanized steel (EMT-S).

2.3 TYPE ERMC-A DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Description: Rigid aluminum 6063 alloy conduit, elbows, couplings, and nipples per NEC Article 344.

B. Listing Criteria: UL DYWV - Rigid Nonferrous Metallic Conduit, including UL 6A.

C. Long radius elbows as indicated in Section 260543 "Underground Ducts and Raceways for Electrical Systems".

D. PVC Coated Type: 40 mil PVC on exterior and 2 mil urethane on interior. (ERMC-A-PVC).

2.4 TYPE ERMC-S DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Description: Galvanized rigid steel conduit, elbows, couplings, and nipples, with a hot-dipped galvanized finish inside and out and per NEC Article 344.

B. Listing Criteria:

1. UL DYIX – Rigid Ferrous Metal Conduit, including UL 6.
2. UL DYJC – Rigid Ferrous Metal Conduit with Polyvinyl Chloride Coating, including UL 6.

C. Long radius elbows as indicated in Section 260543 “Underground Ducts and Raceways for Electrical Systems”.

D. PVC Coated Type: 40 mil PVC on exterior and 2 mil urethane on interior. (ERMC-S-PVC).

2.5 TYPE LFMC DUCT RACEWAYS

A. Description: Liquidtight Flexible Metal Conduit, Type UA, per NEC Article 350.

B. Listing Criteria: UL DXHR – Liquid-tight Flexible Metal Conduit, including UL 360.

C. Material: Steel (LFMC-S).

D. Manufacturer: Sealtite®, Type UA, as manufactured by Anaconda, continuously interlocked flexible steel conduit with sunlight and chemical resistant PVC jacket.

2.6 TYPE LFNC-B DUCT RACEWAYS

A. Description: Liquidtight Flexible Nonmetallic Conduit, Type B, suitable for outdoor use and corrosive areas, per NEC Article 356.

B. Listing Criteria: UL DXOQ – Liquid-tight Flexible Nonmetallic Conduit, including UL 1660.

C. Manufacturer: Carflex® as manufactured by Carlon, or equal.

2.7 TYPE PVC DUCT RACEWAYS AND FITTINGS

A. Description: Rigid Polyvinyl Chloride Conduit, sunlight resistant, rated for use with 90 degree C conductors in exposed and direct or concrete encased applications, per NEC Article 352.

B. Listing Criteria: UL DZYR – Rigid Nonmetallic PVC Conduit, including UL 651.

C. Type: Schedule 40 and Schedule 80.

2.8 FITTINGS FOR CONDUIT AND TUBING

A. General: Listed and labeled for type of conduit, location, and use.

1. ERMC-A: Use cast aluminum fittings.
2. ERMC-S: Use cast malleable iron fittings.

B. Listing Criteria as Applicable:

1. UL 514B – Conduit, Tubing, and Cable Fittings.

2. UL 1203 – Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.
3. UL DWTT – Conduit Fittings.
4. UL FKAV – Electrical Metallic Tubing Fittings.
5. UL ILNR – Flexible Metallic Tubing Fittings.
6. UL DXAS – Liquid-tight Flexible Metal Conduit Assemblies.

C. Refer to Section 260533.16 “Boxes and Covers for Electrical Systems” for conduit bodies such as LB’s, T’s, and C’s.

D. Metal Fittings:

1. EMT Fittings: Die cast, rain and concrete tight, compression type. Set screw type not permitted.
2. RMC Fittings: Threaded type. Threadless fittings and split couplings are not permitted.
3. FMC Fittings: Malleable iron, zinc plated, insulated throat.
4. Fittings for PVC Coated Conduit: Minimum 40 mil thick PVC coating, with overlapping sleeves of one pipe diameter in length to protect threaded joints.
5. LFMC Fittings: Three-piece screw in type, malleable iron.
6. Expansion Fittings: Include flexible external bonding jumper.
7. FMT Bushings: Insulated.
8. Grounding and Bonding Hubs, Bushings, and Hardware:

    a. Grounding Hub: Meyers type.
    b. Locknuts: Cast steel or aluminum.
    c. Bushings: Insulated throat with lay-in type lugs.

E. Nonmetallic Fittings:

1. PVC Fittings: Comply with NEMA TC 3 and match conduit material.
2. LFNC Fittings: Dust-tight, liquid-tight, chemical resistant thermoplastic/nylon construction with tapered thread hub and neoprene O-ring gasket. Push-on fittings are prohibited.

F. Specialty Fittings:

1. Explosionproof Sealing Fitting: Crouse-Hinds EYS or equal.
2. Explosionproof Flexible Coupling: Crouse-Hinds ECGJH or equal.
3. Deflection/Expansion Fitting: OZ-Gedney Type DX or equal.
4. Expansion Coupling: Crouse-Hinds Type XJG with bonding jumper or equal.
5. Conduit Sealing Bushings: Refer to Section 260544 “Sleeves and Sleeve Seals for Electrical Raceways and Cabling”.

2.9 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT.

A. Description: Cold galvanizing compound, 95 percent zinc rich paint.

B. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.

2.10 SOLVENT CEMENTS

A. Description: Solvent cement to join Type PVC duct raceways and fittings.

B. Listing Criteria: UL CCN DWTT; including UL 514B.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Refer to Appendix Table 260533.13-1 for conduit application requirements.

B. Minimum Raceway Size: 3/4-inch trade size.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following as applicable:

1. Relevant Article of NFPA 70.
2. NECA NEIS 101 – Standard for Installing Steel Conduits.
3. NECA NEIS 102 – Standard for Installing Aluminum Rigid Metal Conduit.
4. NECA NEIS 111 – Standard for Installing Nonmetallic Raceways.
5. NEMA FB 2.10 – Selection and Installation Guidelines for Fittings for Use with Non-Flexible Metallic Conduit or Tubing.
6. NEMA FB 2.20 – Selection and Installation Guidelines for Fittings for Use with Flexible Electrical Conduit and Cable.
7. NEMA FB 2.40 – Installation Guidelines for Expansion and Expansion/Deflection Fittings.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:

a. Complete duct raceway installation before starting conductor installation.
b. Underground Installations: Refer to additional requirements in Section 260543 “Underground Ducts and Raceways for Electrical Systems”.
c. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 feet above finished floor.
d. Coordinate stub-up locations with approved shop drawings for equipment to position stub-up directly below appropriate section of motor control center, switchboard, or switchgear.
e. Provide a 4 inch thick concrete housekeeping pad at slab and grade penetrations. Provide a 45 degree, 3/4 inch chamfer at exposed edges.

f. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inches of changes in direction.
g. Maximum continuous conduit run: 300 feet. Reduce distance by 75 feet for each 90-degree elbow.
h. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
i. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
j. Support conduit within 12 inches of enclosures to which attached.
k. Drainage: Arrange conduit system to allow liquids such as water, condensation, etc. to drain away from equipment served. If conduit drainage is not possible, plug conduits using conduit seals.
l. Hazardous Areas: Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
m. Moisture Control: Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways using “Duxseal” or seal fitting at the following points:

    1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    2) Where an underground service duct raceway enters a building or structure.
    3) Conduit extending from interior to exterior of building.
    4) Conduit extending into pressurized duct raceway and equipment.
    5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
    6) Where otherwise required by NFPA 70.

n. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
o. Do not install conduits within 2 inches of the bottom side of a metal deck roof.
p. Keep duct raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
q. Cut conduit perpendicular to the length. For conduits trade size 2 and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
r. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inches of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use. Use threaded cap.
s. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
t. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to trade size 1-1/4 and

insulated throat metal bushings on trade size 1-1/2 and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits. Install Meyers grounding type hubs when conduits terminate at NEMA 3R, 4, and 4X gasketed enclosures.

2. Do not install aluminum duct raceways or fittings in contact with concrete or earth.
3. Protect metallic finish conduit installed in contact with concrete or below grade with two coats of bitumastic paint, heat shrink tubing, or approved equivalent. Provide protection from 12 inches below bottom of concrete to not less than 6 inches above surface of concrete.
4. Rigid Metal Conduit (Type ERMC):

    a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
    b. The use of running threads is prohibited. Where such threads are necessary, use a three piece union.

5. PVC Coated Rigid Metal Conduit (Type ERMC-A-PVC and ERMC-S-PVC):

    a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
    b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to PVC-coated ERMC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on PVC-coated ERMC duct raceway.
    c. Coat field-cut threads on PVC-coated duct raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.

6. Flexible Conduit Connections (Types FMC, LFMC, and LFNC):

    a. Provide a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
    b. Include adequate slack to allow for thermal expansion and mechanical vibration.
    c. Orient outdoor flexible connections to provide drip loop to avoid accumulation of water at equipment connection points.

7. Non-Metallic Conduit (Type PVC):

    a. Do not install Type PVC conduit where ambient temperature exceeds 122 degrees F. Conductor ratings must be limited to 75 degrees C except where installed in a trench outside buildings with concrete encasement, where 90 degrees C conductors are permitted.
    b. Comply with manufacturer's published instructions for solvent welding and fittings.

8. Duct Raceways Embedded in Slabs:

a. Comply with spacing requirements as noted on Structural Drawings.
b. Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
c. Arrange duct raceways to ensure that each is surrounded by minimum of 1 inch of concrete without voids.

9. Stub-ups at Slabs: Arrange stub-ups so curved portions of bends are not visible above finished slab.

10. Stub-ups to Above Recessed Ceilings:

a. Provide EMT or ERMC for duct raceways.
b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

11. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:

a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.

12. Duct Fittings: Use only fittings listed for use with each type of tubing or conduit and in accordance with specific fittings listed under PART 2.

a. ERMC-A-PVC and ERMC-S-PVC: Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

13. Expansion-Joint Fittings: Install where necessary to compensate for thermal expansion and contraction and wherever conduits cross building or structure expansion joints.

14. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty.
15. Identification: Install identification tags at conduits in accordance with Section 260553 “Identification for Electrical Systems”.

D. Interfaces with Other Work:

1. Coordinate installation with other trades in advance of installation.
2. Restore walls, floor, and roof to original condition such as watertight, fire rating, smooth and/or painted finish after duct raceway penetration.
3. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.4 APPENDICES

A. Table 260533.13-1: Conduit Selection Guidelines

Table 260533.13-1
Conduit Selection Guidelines

Raceway Type	Location / Application
EMT	Indoor air conditioned spaces in Administration / Office buildings including electrical rooms, mechanical rooms, control rooms, toilets, and offices.
ERMC-A	Indoor and outdoor applications, except where other types are listed. Exposed, non-corrosive areas. Concealed, non-corrosive areas. Under slabs in slab on grade construction / stub-ups. When installed underground or in contact with concrete, paint with two coats of bitumastic paint or use ERMC-A-PVC.
ERMC-A-PVC	Allowed for use in lieu of painting ERMC-A with two coats of bitumastic paint.
ERMC-S	Not used on this project.
ERMC-S-PVC	Not used on this project.
FMC	Flexible connections used in conjunction with EMT.
FMT	Flexible connections to light fixtures in conjunction with EMT.
LFMC	Flexible connections used in conjunction with ERMC types.
LFNC-B	Flexible connections used in designated corrosive areas. Limited to 2-inch trade size.
PVC-40	Concrete encased duct banks. Embedded in concrete slabs or structures. Underground elbows are to be ERMC type.

PVC-80	Direct buried. Areas designated as corrosive. Protection of grounding electrode conductors. Protection of lightning conductors. Underground elbows are to be ERMC type.

END OF SECTION 260533.13

SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Conduit bodies.
2. Metallic outlet boxes, device boxes, rings, and covers.
3. Nonmetallic outlet boxes, device boxes, rings, and covers.
4. Junction boxes and pull boxes.
5. Cover plates for device boxes.
6. Hoods for outlet boxes.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on the project.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Listing Criteria as Applicable:

1. UL 514A – Metallic Outlet Boxes.
2. UL 514B – Conduit, Tubing, and Cable Fittings.
3. UL 514C – Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
4. UL 514D – Cover Plates for Flush-Mounted Wiring Devices.
5. UL BGUZ – Junction and Pull Boxes.
6. UL QCIT – Metallic Outlet Boxes.
7. UL QCMZ – Nonmetallic Outlet Boxes.

2.2 CONDUIT BODIES

A. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point.

B. Listed and labeled for type of conduit, location, and use. Refer to Section 260533.13 “Conduits for Electrical Systems” for conduit types and fittings used on the project.

C. Use mogul type (with rollers) for metal conduit bodies sizes 2-1/2 inch and larger by Appleton Electric.

2.3 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Outlet and Device Box Description: Box having pry out openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover. Outlet boxes do not include provisions to mount devices. Device boxes include provisions to mount a device to the box.

B. Extension Ring Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

C. Pressed Steel Boxes: Hot dipped galvanized with hot-dipped galvanized tile rings. For use when recessed in walls or indoors exposed in non-process ceiling areas.

1. Lighting outlet boxes: 4-11/16 inch square, 2 1/8 inch deep, minimum.
2. Device boxes with electronics device (i.e. smart switch or receptacle, occupancy sensor, dimmer, etc.): Largest size for number of gangs required.

D. Cast Boxes: Type FD (deep) only. Type FS not permitted. Copper free aluminumor malleable iron with zinc finish. PVC coated when used with PVC coated conduits. Gasketed cover when used outdoors. Stainless steel screws for covers.

E. Explosionproof Type Box for Class 1, Division 1 Areas: Copper free aluminum or malleable iron with zinc finish. PVC coated when used with PVC coated conduits. Internal ground screw and O-ring. Pry notches on cover for bar or wrench.

2.4 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Outlet and Device Box Description: Box having pry out openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover. Outlet boxes do not include provisions to mount devices. Device boxes include provisions to mount a device to the box.

B. Only allowed in conjunction with PVC schedule 80 exposed conduit installations.

C. Type FD (deep) box only. Type FS (shallow) box not allowed.

2.5 JUNCTION BOXES AND PULL BOXES

A. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable. Boxes that contain terminals, relays, surge protective devices, or devices mounted on the cover are specified under Section 262716 “Electrical Cabinets and Enclosures”.

B. NEMA 1 and NEMA 12 Junction and Pull Boxes:

1. Material: Sheet steel, minimum 14 gauge, without knockouts.
2. Construction: Flanged box, galvanized with continuous weld seams that are ground smooth.
3. Cover: Gasketed, hinged, fastened with quick connect door clamp.

C. NEMA 4X Junction and Pull Boxes:

1. Material: Type 316 stainless steel, minimum 14 gauge, without knockouts.
2. Construction: Flanged box, continuous weld seams that are ground smooth.
3. Cover: Gasketed, hinged, fastened with quick connect door clamp.

D. NEMA 4X Chemical Area Junction and Pull Boxes: When Drawings classify the area as CORROSIVE, ultraviolet resistant fiberglass reinforced plastic (FRP) with stainless steel hardware and gasketed covers.

E. NEMA 6/6P Junction and Pull Boxes: When Drawings call out for NEMA 6 (temporary submersion at limited depth) or NEMA 6P (prolonged submersion at limited depth), die cast aluminum or nonmetallic, coordinated with conduit material.

F. NEMA 7/4 Junction and Pull Boxes: When Drawings classify the area for Class 1, Division 1, Group D hazardous area, cast aluminum, cover gasket to meet NEMA 4 requirements, stainless steel hinged cover, stainless steel bolts. Crouse-Hinds Type EJB or equal.

2.6 COVER PLATES FOR DEVICES BOXES

A. Single Source: Obtain wall plates from same manufacturer of wiring device. Refer to Section 262726 “Wiring Devices” for requirements.

B. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Flush Mounted Devices in Indoor Administrative Spaces: Includes offices, conference rooms, break rooms, restrooms, and control rooms. Smooth, high impact thermoplastic or nylon. Color to match wiring device.
3. Material for Flush Mounted Devices in Indoor Industrial Spaces: Includes electrical rooms, mechanical rooms, janitor closets, and indoor process areas. Type 302 (18-8) high nickel stainless steel.
4. Material for Surface Mounted Devices: Match box material.

2.7 HOODS FOR OUTLET BOXES

A. Description: Hood to mount to box for to create weatherproof while in use condition.

B. Wet-Location, Weatherproof Cover Plates (Hoods) for Switches and Receptacles: NEMA 250, complying with Type 3R, in-use weather-resistance, die-cast aluminum with lockable cover.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Engineer for resolution of conflicting requirements.

B. Conduit bodies: Match associated conduit type.

C. Outlet boxes recessed in walls or indoors exposed in non-process ceiling areas: Pressed steel.

D. Exposed outlet and device boxes: Cast metal except where PVC-80 is used. Use PVC coated cast metal when conduit is PVC coated. Use non-metallic when PVC-80 is used.

E. Junction and pull boxes: Suitable for the location and conform to the NEMA enclosure ratings and material descriptions included on Drawings. Where no size is indicated, size in accordance with NEC Article 314.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Special Installation Techniques:

1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat

surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.

4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
9. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
10. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
11. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

    a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    b. Provide gaskets for wallplates and covers.

12. Identification: Install labels and nameplates in accordance with Section 260553 “Identification for Electrical Systems”.

3.3 CLEANING

A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.4 PROTECTION

A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

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SECTION 260533.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Surface type raceways including wireways and troughs and auxiliary gutters.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer’s cut sheet for each type of product used on project.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Listing Criteria as Applicable:

1. UL 94 – Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
2. UL 870 – Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
3. UL CCN ZOYX – Wireway, Auxiliary Gutters and Associated Fittings.

2.2 WIREWAYS AND AUXILIARY GUTTERS

A. Metallic:

1. NEMA 1 Type: Painted steel, gasketed, hinged cover, stainless steel hardware. Square Duct as manufactured by Schneider Electric or equal.
2. NEMA 4X Type: Stainless steel, Type 304, gasketed, hinged and clamped cover with drip lip, stainless steel hardware. Hoffman Bulletin F22 by nVent.

B. Nonmetallic:

1. NEMA 3R Type: Fiberglass, gasketed, hinged cover, stainless steel hardware. Hoffman Fiberglass Hinged-Cover Wiring Trough by nVent.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Auxiliary Gutters: Article 366 of NFPA 70.
2. Metal Wireways: Article 376 of NFPA 70.

C. Special Installation Techniques:

1. Install surface raceways or wireways and gutters as indicated on Drawings or when approved by Engineer.

3.2 CLEANING

A. Remove construction dust and debris from surface raceways before installing wires and again when installing covers.

3.3 PROTECTION

A. After installation, protect surface raceways from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.23

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ladder cable tray.
2. Cable tray accessories.
3. Warning signs.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
2. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

a. Vertical and horizontal offsets and transitions.
b. Clearances for access above and to sides of cable trays.
c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer, as defined in Section 014000 “Quality Requirements, to design cable tray supports and seismic bracing.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAY

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles on individual cable tray types for specific values for the following parameters:

1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 LADDER CABLE TRAY

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. B-Line; by Eaton.
2. Cope Cable Tray; by Atkore.
3. MP Husky USA Cable Tray and Cable Bus.

B. Description:

1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
2. Width: 24 inches (600 mm), except where wider widths are required to meet cable tray fill requirements.
3. Minimum Usable Load Depth: 4 inches (100 mm).
4. Straight Section Lengths: 10 feet (3.0 m) 20 feet (6.0 m), except where shorter lengths are required to facilitate tray assembly.
5. Rung Spacing: 9 inches (225 mm) on center.
6. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
7. Minimum Cable-Bearing Surface for Rungs: 7/8 inch width with radius edges.
8. No portion of the rungs can protrude below the bottom plane of side rails.

9. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200 lb. concentrated load, when tested according to NEMA VE 1.
10. Fitting Minimum Radius: 24 inches (600 mm).
11. Class Designation: Comply with NEMA VE 1, Class 12C.
12. Splicing Assemblies: Bolted type using serrated flange locknuts.
13. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

C. Materials and Finishes:

1. Aluminum:

a. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 6061-T6 according to ANSI H35.1/H 35.1M for fabricated parts.
b. Hardware: Chromium-zinc-plated steel, ASTM F1136.
c. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F593 and ASTM F594.

2. Stainless Steel:

a. Materials: Low-carbon, passivated stainless steel, Type 316L, ASTM F593 and ASTM F594.
b. Hardware for Stainless Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F593 and ASTM F594.

2.4 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.5 WARNING SIGNS

A. Lettering: 1-1/2 inches high, black letters on yellow background, with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

B. Comply with Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION OF CABLE TRAY

A. Install metallic cable tray and support systems according to NEMA VE 2.

B. Install fiberglass cable tray and support systems according to NEMA FG 1.

C. Install cable tray as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

D. Install cable tray, so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

E. Remove burrs and sharp edges from cable trays.

F. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.

G. Fasten cable tray supports to building structure.

H. Design fasteners and supports to carry cable tray, cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems."

I. Place supports, so that spans do not exceed maximum spans on schedules, and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of tray rungs.

J. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

K. Support assembly to prevent twisting from eccentric loading.

L. Do not install more than one cable tray splice between supports.

M. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

N. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed recommended dimensions. Space connectors and set gaps according to applicable standard.

O. Make changes in direction and elevation using manufacturer's recommended fittings.

P. Make cable tray connections using manufacturer's recommended fittings.

Q. Install cable trays with enough workspace to permit access for installing cables.

R. Install barriers to separate cables of different systems, such as power, communications, and data processing, or of different insulation levels, such as 600, 5000, and 15 000 V.

S. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

T. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Cable trays with electrical power conductors to be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with single-conductor power conductors to be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72 inch intervals. The grounding conductor to be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding-bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 INSTALLATION OF CABLES

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure to be no more than 72 inches (1800 mm).

E. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect raceways to cable trays according to requirements in NEMA VE 2 for metallic cable trays and NEMA FG 1 for nonmetallic cable trays, as applicable.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items, such as pipes, hangers, or other equipment, in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and to remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 260536

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Manholes, handholes, and duct accessories.

B. Products Installed, but Not Furnished, under This Section:

1. Section 260533.13 “Conduits for Electrical Systems” for conduits.
2. Section 260553 "Identification for Electrical Systems" for underground-line warning tape.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Division 03 for concrete and reinforcing steel.
4. Division 31 for groundwater control, trenching, excavation and backfilling including gravel and sand bedding, and surface restoration.
5. Division 33 for additional requirements associated with manholes and utilities.

1.3 DEFINITIONS

A. Duct: A single raceway or multiple raceways, installed singly or as components of a duct bank.

B. Duct Bank: Two or more ducts installed in parallel, direct buried or with additional casing materials such as concrete.

C. Handhole: An underground chamber containing electrical cables, sized such that personnel are not required to enter in order to access the cables.

D. Manhole: An underground chamber containing electrical cables and equipment, sized to provide access with working space clearances.

E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including spacers and miscellaneous components.
2. Include accessories for manholes and handholes.
3. Include underground-line warning tape.

B. Shop Drawings:

1. Handholes or Manholes:

a. Include plans, elevations, sections, details, and accessories.
b. Include duct entry provisions showing locations and duct sizes.
c. Include frame, cover, entry extensions if applicable, and grounding details.
d. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.

2. Underground Conduit Layouts: In accordance with Section 260533.13 “Conduits for Electrical Systems”.

1.5 INFORMATIONAL SUBMITTALS

A. Buoyancy calculations for manholes. Calculations must be signed and sealed by a qualified professional engineer.

B. Field quality control reports.

PART 2 - PRODUCTS

2.1 CONDUIT AND FITTINGS

A. Comply with Section 260533.13 “Conduits for Electrical Systems” for conduits and fittings.

2.2 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

B. Underground-Line Warning Tape: In accordance with Section 260553 "Identification for Electrical Systems."

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover must form top of enclosure and must have load rating consistent with that of handhole or box.

1. Load Rating: Class H-20.
2. Cover Legend: “ELECTRIC”, unless otherwise indicated.
3. Comply with details shown on Drawings.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Oldcastle Infrastructure.

C. Comply with ASTM C858 “Standard Specification for Underground Precast Concrete Utility Structures” for design and manufacturing process.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.4 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

A. Description: Molded of sand, concrete, and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or combination.

1. Load Rating: Class H-20.
2. Cover Legend: “ELECTRIC”, unless otherwise indicated.
3. Comply with details shown on Drawings.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Oldcastle Polymer; Oldcastle Infrastructure.
2. Quazite; Hubbell Power Systems.

C. Standard: Comply with ANSI / SCTE 77 “Specification for Underground Enclosure Integrity”.

D. Color: Gray.

E. Configuration: Flush burial and open bottom unless otherwise indicated.

2.5 PRECAST MANHOLES

A. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.

1. Load Rating: Class H-20.

2. Cover Legend: “ELECTRIC”, unless otherwise indicated.
3. Comply with details shown on Drawings.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Oldcastle Infrastructure Inc.

C. Comply with ASTM C858 for design and manufacturing process.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Engineer if there is conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Engineer.

C. Clear and grub vegetation to be removed, and protect vegetation to remain in accordance with Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication in accordance with Section 311000 "Site Clearing."

3.2 SELECTION OF UNDERGROUND DUCTS

A. Direct Buried Duct: Type PVC-80 rigid non-metallic conduit, with RMC long radius sweep elbows.

B. Concrete Encased Duct: Type PVC-40 rigid non-metallic conduit, with RMC long radius sweep elbows.

C. Rigid Metal Conduit (RMC) type in accordance with Section 260533.13 “Conduits for Electrical Systems” with two coats of bitumastic paint or PVC coated where:

1. Direct buried conduit enters buildings, structures, and vaults (except manholes and handholes) with not less than a 10-foot length of conduit.
2. Direct buried conduits run below floor slabs in slab-on-grade construction.
3. Stub-ups outdoors or through concrete slabs.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earthwork," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restoration: Restore area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.

C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."

E. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures.

3.4 INSTALLATION OF DUCTS AND DUCT BANKS

A. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
2. Consult Engineer for resolution of conflicting requirements.

B. General Requirements:

1. Comply with installation requirements for conduits in Section 260533.13 “Conduits for Electrical Systems” and as supplemented herein.
2. Ductbank routing and manhole / handhole locations indicated on Drawings are diagrammatically depicted. Coordinate with other utilities, yard piping, yard structures and field conditions to determine required paths and depths at no additional cost to Owner.
3. Where conditions do not allow neat and consistent duct bank cross sections in accordance with Drawings due to existing underground conflicts, provide Engineer with proposed solution for approval that complies with minimum NEC installation cover requirements. For example, where the Drawings indicate direct buried PVC conduits are to be installed at a certain depth below finished grade, a concrete cap or concrete encasement may be permitted to achieve an equivalent protection. Do not deviate from Drawing details without Engineer approval.
4. Reinforce ductbanks as indicated on Drawings. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Separate underground copper signal conduits (instrumentation and telecommunication) from power conduits by a minimum of 12 inches unless noted otherwise. Keep crossing of these conduits to a minimum; cross at 90 degree angles.
6. Plug conduit ends during and after installation to prevent water, mud, and debris from entering conduit.

7. After duct installation is complete and before any cables are pulled, remove obstructions using appropriately sized mandrel for conduits 2 inch and larger. Swab clean interior of all sized conduits. Refer to CLEANING Article.

C. Special Techniques:

1. Where indicated on Drawings, install duct, spacers, and accessories into duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
2. Slope: Pitch duct minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from high point between two manholes to drain in both directions.
3. Curves and Bends: Use long radius elbows, sweeps, and offsets for 2 inch and larger conduits.
4. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
5. Terminations at Manholes: Use end bells for PVC conduit and insulated throat grounding bushings with lay-in type lugs for RMC.
6. Building Wall Penetrations: Make transition from underground duct to RMC at least 10 feet outside building wall, without reducing duct line slope away from building and without forming trap in line. Use fittings manufactured for transition to RMC type installed. Install RMC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
7. Underground-Line Warning Tape: Bury underground line specified in Section 260553 "Identification for Electrical Systems" above concrete-encased duct and direct buried duct banks as shown on detail Drawings. Align tape parallel to and within 3 inches of centerline of duct bank. Provide additional warning tape for each 12 inch increment of duct-bank width over nominal 18 inches. Space additional tapes 12 inches apart, horizontally across width of ducts.
8. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

D. Concrete-Encased Ducts and Duct Bank Special Techniques:

1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earthwork" for pipes 6 inches or less in nominal diameter.
2. Depth: Install so top of duct envelope is as shown on detail Drawing.
3. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
4. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

a. Start at one end and finish at other, allowing for expansion and contraction of duct as its temperature changes during and after pour. Use expansion fittings installed in accordance with manufacturer's published instructions, or use other specific measures to prevent expansion-contraction damage.
b. If more than one pour is necessary, terminate each pour in vertical plane and install 3/4 inch reinforcing-rod dowels extending minimum of 18 inches into concrete on both sides of joint near corners of envelope.

7. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.
8. Concrete Color: Red. Dye color added to concrete during batching; or dye mixed with water and applied to top of ductbank with a sprayer while concrete is wet (prior to curing); or raked into the exposed top layer of concrete.

E. Direct-Buried Duct and Duct Bank Special Techniques:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earthwork" for preparation of trench bottoms for pipes less than 6 inch in nominal diameter.
2. Depth: Install top of duct as shown on detail Drawing.
3. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
4. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to ducts to prevent floating during backfill. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
5. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earthwork" for installation of backfill materials.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Reference Standards:

1. Precast Concrete Handholes: Comply with ASTM C891 unless otherwise indicated.
2. Consult Engineer for resolution of conflicting requirements.

B. Special Techniques:

1. Precast Concrete Handholes and Manholes:

    a. Install units level and plumb and with orientation and depth coordinated with connecting duct to minimize bends and deflections required for proper entrances.
    b. Unless otherwise indicated, support units on level bed of crushed stone or gravel graded from 1 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
    c. Field-cut openings for conduits in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

2. Elevations:

    a. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
    b. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
    c. Install handholes with bottom below frost line, <**Insert depth of frost line below grade at Project site**> below grade.
    d. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
    e. Where indicated, cast handhole cover frame integrally with handhole structure.

3. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
4. Manhole Access: Circular opening in manhole roof; sized to match cover size.

    a. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
    b. Install chimney, constructed of precast concrete collars and rings, and cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight joints and waterproof grouting for frame and chimney.

5. [
6. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 071113 "Bituminous Dampproofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
7. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
8. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
9. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in field. Use minimum of two anchors for each cable stanchion.
10. Ground manholes, handholes, and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Special Techniques:

1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
2. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from 1/2 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
3. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
4. Install handholes and boxes with bottom below frost line, <**Insert depth of frost line below grade at Project site**> below grade.
5. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
6. Field cut openings for duct in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
7. Ground handholes and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Nonconforming Work:

1. Underground ducts, raceways, and structures will be considered defective if they do not pass tests and inspections.
2. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.8 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump, and building interiors affected by Work.

1. Sweep floor, removing dirt and debris.
2. Remove foreign material.

END OF SECTION 260543

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Conduit sealing bushings.
4. Sleeve-seal systems.
5. Sleeve-seal fittings.
6. Grout.
7. Pourable sealants.
8. Foam sealants.

B. Not all components specified in this Section are necessarily utilized on this project.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on project.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Steel Wall Sleeves:

1. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Cast-Iron Wall Sleeves:

1. General Characteristics: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral double waterstop. OZ-Gedney type WSK Thru Wall Floor Seal or equal for new installations with poured concrete.

C. PVC Pipe Sleeves:

1. General Characteristics: ASTM D1785, Schedule 40.

D. PVC Molded Sleeves:

1. General Characteristics: With nailing flange for attaching to wooden forms.

E. PE or PP Molded Sleeves:

1. General Characteristics: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Round, Galvanized-Steel, Sheet Metal Sleeves:

1. General Characteristics: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Rectangular, Galvanized-Steel, Sheet Metal Sleeves:

1. General Characteristics:

a. Material: Galvanized sheet steel.
b. Minimum Metal Thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness is to be 0.052 inch.
2) For sleeve cross-section rectangle perimeter not less than 50 inches or with one or more sides larger than 16 inches, thickness is to be 0.138 inch.

2.3 CONDUIT SEALING BUSHINGS

A. General Characteristics: Malleable iron collar, one piece neoprene sealing ring, stainless steel hardware, designed for field assembly, to prevent passage of fluids and gases as conduits pass through walls and function as a sleeve-seal system. Rated for Class 1, Division 2 locations. OZ-Gedney CSB Series or CSM Series, or equal, depending upon application.

2.4 SLEEVE-SEAL SYSTEMS

A. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

B. Options:

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.5 SLEEVE-SEAL FITTINGS

A. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.6 GROUT

A. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000 psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.7 POURABLE SEALANTS

A. Performance Criteria:

1. : Single-component, neutral-curing elastomeric sealants of grade indicated below.

a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.8 FOAM SEALANTS

A. Performance Criteria:

1. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion cannot damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

    a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
    b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed or seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF CONDUIT SEALING BUSHINGS

A. Install where a sleeve-seal system or seal-fitting installation is required in an NEC Class 1, Division 2 hazardous location.

3.4 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Identification products along with color and legend requirements.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260573 “Power System Studies” for arc flash study labels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Note that not all products listed may be utilized on this project.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following where applicable:

1. Fire-protection and fire-alarm equipment must be finished, painted, or suitably marked safety red.

2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 feet above finished floor.

C. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 degrees F, ambient; 180 degrees F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed for conductors.

1. Color must be factory applied or field applied for sizes larger than 8 AWG.
2. Colors for 208Y/120 V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Neutral: White.

3. Colors for 240/120 V Circuits (Single Phase):

a. Phase A: Black.
b. Phase B: Red.
c. Neutral: White.

4. Colors for 240Δ/120 V Circuits (Three Phase, Four Wire, High Leg, Center Tap):

a. Phase A: Black.
b. Phase B: Orange (high leg).
c. Phase C: Blue.
d. Neutral: White.

5. Colors for 480Y/277 V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.
d. Neutral: Gray.

6. Colors for DC Circuits:

    a. Positive: Red.
    b. Negative: Black.

7. Color for Equipment Grounding Conductors: Green.

B. Color-Coding for Phase- and Voltage-Level Identification, Over 1000 V: Use double colors listed for conductors.

1. Colors for 5 kV Rated Circuits:

    a. Phase A: Black/Red.
    b. Phase B: Red/Red.
    c. Phase C: Blue/Red.

2. Colors for 15 kV Rated Circuits:

    a. Phase A: Brown/Red.
    b. Phase B: Orange/Red.
    c. Phase C: Yellow/Red.

3. Color for Equipment Grounding Conductor (600V rated): Green.

C. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

D. Warning labels and nameplates/signs must include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

E. Equipment Identification and Source Nameplate:

1. Color: Black letters on a white field.
2. Material: See NAMEPLATES Article.
3. Equipment furnished under Divisions 26, 27, 28 and equipment control panels furnished under other Divisions must include equipment identification nameplates. Equipment includes, but is not limited to switchgear, switchboards, motor control centers, panelboards, transformers, disconnect switches, separately mounted motor controllers, transfer switches, control panels, and named enclosures or cabinets. Nameplate to match designation indicated on Drawings.
4. Power source must be identified at all applicable equipment. Nameplate may be separate from identification nameplate or information may be contained on one nameplate. For example, a local disconnect switch for a pump motor could have one nameplate reading “EFFLUENT PUMP NO. 4” for the identification nameplate and a second nameplate reading “FED FROM MCC-2”. Or a two-line nameplate combining the information for both identification and source.

F. Device Identification Labels:

1. Color: Black letters on a white field..
2. Material: Self-adhesive type, machine generated, 1/4 inch high letters.
3. Devices to be labeled with panel and branch circuit number include receptacles, wall switches, lighting fixtures, photocells, emergency lights, exit lights, instruments, etc. For example, a light switch powered from panelboard LP-2 and branch circuit 4 would have the label “LP-2/4” or “LP-2/CKT 4”.

2.3 NAMEPLATES

A. Material:

1. Engraved, engraved plastic (lamicoid).
2. Minimum size: Not less than 1/16 inch thick by 3/4 inch high by 2-1/2 inches wide.
3. Lettering: Upper case, 3/16 inch high minimum.

2.4 LABELS, BANDS, TUBES, AND SLEEVES

A. Self-Adhesive Wraparound Labels: Machine-printed, 3 mil thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive. Printed text is black, permanent, and waterproof.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.

B. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

C. Heat-Shrink Preprinted Tubes (Sleeve Type): Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 degrees F. Comply with UL 224. Printed text is black, permanent, and waterproof.

2.5 TAPES

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inches wide; compounded for outdoor use.

C. Underground-Line Warning Tape:

1. Tape:

a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape must be permanent and may not be damaged by burial operations.

c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".

3. Detectable Tape:

a. Detectable three-layer laminate, consisting of printed pigmented polyolefin film, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
b. Width: 6 inches.
c. Overall Thickness: 5 mil.
d. Foil Core Thickness: 0.35 mil.

2.6 TAGS

A. Metal Tags: Embossed, Type 316 stainless steel, 0.01 inch thick, punched for use with tie fastener. Secure with 0.048 inch diameter stainless steel band fastened with compression wire clamps

B. Nonmetallic Preprinted Tags: Polyester or Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.

2.7 CABLE TIES

A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 degrees F in accordance with ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 degrees F.
4. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Nameplates/Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 SELECTION OF IDENTIFICATION PRODUCTS

A. Power-Circuit Conductor Identification, 1000 V or Less: For conductors at termination points and in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape if conductor is not factory colored to identify phase, neutral, and ground conductors. Use self-adhesive labels to identify circuit.

B. Power-Circuit Conductor Identification, More Than 1000 V: For conductors at termination points and in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape to identify phase conductors. Use nameplate or nonmetallic tag secured with cable ties to indicate phase and indicate circuit designation.

C. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.

D. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive labels with conductor designation.

E. Spare Conductors or Cables: Attach nonmetallic tags or self-adhesive labels to conductors and list source.

F. SCADA Systems, Communication Systems, Fire Alarm Systems or Other Auxiliary Electrical Systems Conductor Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive labels with conductor designation.

G. Conduit Identification: For designated identification as indicated on Drawings provide metal tags.

H. Pull Boxes and Junction Boxes, 24 inches by 24 inches and Larger: For voltage identification provide nameplates using 1 inch high minimum letters, white letters on red background.

I. Equipment Identification: For identification and source information provide nameplate(s) per COLOR AND LEGEND REQUIREMENTS Article.

J. Device Identification: For source and circuit information provide self-adhesive label per COLOR AND LEGEND REQUIREMENTS Article.

3.3 INSTALLATION

A. Install identification product in accordance with manufacturer’s instructions.

B. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Verify identity of item before installing identification products.

E. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

F. Apply identification devices to surfaces that require finish after completing finish work.

G. Apply wire markers so entire designation is clearly visible.

H. Install Arc Flash Labels in accordance with Section 250573 “Power System Studies”.

I. Identify the system voltage (e.g. 208/120 VOLTS, 480 VOLTS, 4160 VOLTS) at the covers of large pull boxes or junction boxes.

J. Install field device (instruments, receptacles, switches, etc.) labels.

K. Install equipment nameplates. Nameplate fastening requirements:

1. NEMA 1 and 12 Enclosures: Screw mounted using stainless steel screws.
2. Other Enclosure Types: Bonded using epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable.

L. Panelboard and Transformer Panel Assembly Identification:

1. Provide equipment identification nameplates as previously described.
2. Label branch circuit phase and neutral wires with associated pole number using self-adhesive labels or type written sleeve type labels.
3. Install typed as built circuit directory listing with unique load identification.

M. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 18 inch overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

N. Install Tags. Fastening Requirements:

1. Secure metal tags using stainless steel ties.
2. Secure nonmetallic tags with UV-stabilized cable ties.

END OF SECTION 260553

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SECTION 260573 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 SUMMARY

A. Section includes a computer-based study for:

1. Short circuit report.
2. Protective device coordination report.
3. Motor starting report.
4. Arc flash report.

B. Study encompasses the power distribution system of the City of Georgetown Dove Springs Wastewater Treatment Plant. Facility is located at 400 Rock Dove Ln, Georgetown, TX.

C. Study includes the electric utility company’s protective devices, emergency generators, service entrance equipment and distribution to motor control center(s). All power distribution to that point whether existing or new is included. Equipment included, but not limited to:

1. Substations and distribution.
2. Switchgear, switchboards, and panelboards.
3. Motor control centers.
4. Variable frequency controllers.
5. Disconnect switches.
6. Transfer switches.
7. 480V control panels.
8. Step-down transformers.

D. The local electric utility is Georgetown Utility Services.

E. Obtain all data necessary to perform the study. Data included, but not limited to:

1. Up to date one-line diagrams.

2. Equipment data.
3. Cable sizes and lengths.
4. Existing protective device settings.
5. Electric utility information: available fault current, protective device equipment information and settings, X/R ratios, transformer impedances and ratings.

1.3 DEFINITIONS

A. Boundary, Arc Flash: When an arc flash hazard exists, an approach limit from an arc source at which the incident energy equals 1.2 cal/cm² (5 J/cm²).

B. Boundary, Limited Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.

C. Boundary, Restricted Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.

E. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

F. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

G. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

H. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

I. Preliminary Short Circuit Report: Report that includes the maximum available utility fault current, proposed equipment, and existing equipment to determine if new equipment may be released for manufacturing and existing equipment is adequate for the calculated short circuit levels.

J. Protective Device: A device that senses when an abnormal condition or current flow exists and then removes the affected portion of the circuit from the system.

K. SCCR: Short-circuit current rating.

L. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

M. Single-Line Diagram: See "One-Line Diagram."

N. Supplier: The person, firm or corporation identified as such to provide the power system study and means the Supplier or its authorized agent. See also Power Systems Analysis Specialist.

O. VFD: Variable frequency drive. Interchangeable with variable frequency controller.

1.4 ACTION SUBMITTALS

A. Supplier qualifications per Quality Assurance paragraph. Submit prior to starting study. Include the following:

1. Brief description of each qualifying study.
2. Name of owner of installation on which study was performed with address, telephone number, and contact person.
3. Date of study.
4. Any other information indicating the firm's experiences and ability to perform the work and business status.

B. Preliminary Power System Study Report. Report must be approved prior to release for manufacture of major electrical equipment including but not limited to switchgear, switchboards, distribution panels, and motor control centers. Fault data from the utility must be included and not assumed or submittal will be rejected.

C. Final Power System Study Report. Report must be approved prior to energization of new major electrical equipment. Revise study as required for changes during construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. If requested, Product Certificates: For power system study software, certifying compliance with IEEE 399, IEEE 1584 and NFPA 70E.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Final power system study updated with any changes made after equipment start-up.

B. Digital computer files with full read-write access of the complete power system model and library.

1.7 QUALITY ASSURANCE

A. Perform Study using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications:

1. Design computer program to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
2. Develop computer program under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
3. Complies with IEEE 399, IEEE 141, IEEE 242, IEEE 519, IEEE 1015, and IEEE 1584 as applicable to the project scope.

E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located and has regularly engaged in this electrical engineering study specialty for minimum of five years and has performed at least three projects of similar complexity to this project within the last three years. Perform all elements of the study under the direct supervision and control of this professional engineer.

F. Power System Study Certification: Report shall be signed and sealed by Power Systems Analysis Specialist.

G. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

A. Acceptable Software:

1. SKM System Analysis, Inc.: Power*Tools.
2. Operation Technology, Inc.: ETAP (Electrical Transient Analyzer Program).
3. EasyPower, Inc.: EasyPower.
4. Or equal.

2.2 POWER SYSTEM STUDY REPORT GENERAL REQUIREMENTS

A. Except for one-line diagrams, standard 8 1/2-inch by 11-inch pages, with total pages numbered.

B. Electronic PDF format copy with electronic bookmarks for each section.

C. Signed and sealed by a professional engineer registered in the state in which the project is located.

D. Organized in the following order:

1. Executive Summary.
2. Short Circuit Analysis.
3. Short Circuit Computer Printout.
4. Protective Device Coordination.
5. Motor Starting.
6. Arc Flash Hazard Analysis.
7. Harmonic Analysis.
8. Utility Data.
9. Modeled One Line Diagrams.

E. Information on one-line diagrams, legible when printed at 11-inch x 17-inch. Show the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA), impedance, and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by the study.

F. Identifiers between the one-line diagram, short circuit study, coordination study, and arc flash study to be the same.

G. Include copies of correspondence with electric utility under utility data section of report. Correspondence to include names and contact information.

2.3 EXECUTIVE SUMMARY

A. Include summary of distribution system, information received from electric utility, major assumptions, adequacy of equipment to safely clear or close on any fault, identify problem areas and recommendations for resolving problem areas.

2.4 SHORT CIRCUIT

A. Comply with IEEE 399 and IEEE 551 (new 3002 series).

B. Include normal utility powered configuration, on-site generation configuration, and alternate modes of operation (i.e. alternate utility configuration, bus ties closed).

C. Include minimum and maximum possible fault conditions. Address three-phase bolted as well as ground fault conditions.

D. Consider the fault contribution of all motors operating during the maximum demand condition of the motors.

E. Calculate short-circuit momentary duties and interrupting duties based on an assumed bolted three-phase short circuit at each high and medium voltage switchgear bus and controller, low voltage switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard and other significant locations throughout the systems. Include the X/R ratios, asymmetry factors, KVA and symmetrical fault-current in the short circuit tabulations. Provide a ground fault current study for the same system areas. Include in tabulations fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault-currents.

F. Include representation of the site power system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, conclusions and recommendations.

G. Identify available fault current at each bus and evaluate system elements including but not limited to equipment, protective devices, and cables.

H. Base current transformers' ratio and burden calculations on a 10 percent maximum ratio error per IEEE C57.13. Identify current transformers that will not allow the protective devices to operate within acceptable IEEE error margins and recommend corrective action.

I. List momentary, interrupting, and/or withstand rating of all key elements of the distribution system along with the maximum available fault current in tabular form and clearly indicate the adequacy of the element with PASS / FAIL designation.

J. Short Circuit Computer Printout:

1. Calculations shall be in sufficient detail for easy review.
2. Back up calculations shall become part of the final report.

2.5 PROTECTIVE DEVICE COORDINATION

A. Comply with IEEE 242 (new 3004 series).

B. Utilize results from the short circuit study and balance the competing objectives of protection and continuity of service for the system specified, considering the basic factors of sensitivity, selectivity and speed. Include all system protective devices in the coordination analysis, not just overcurrent protective devices. This includes, but is not limited to under and over voltage protective relays, frequency relays, differential relays and reverse power relays.

C. Show graphic indication of coordination between protective devices in the form of full color time-current coordination (TCC) plots with each protective device curve in a unique color for easy review.

D. Provide separate TCC plots for each mode of operation. Provide separate TCC plots for "normal" and "stand by" operation. Show maximum fault values in each case. Both power sources shown on one plot is unacceptable.

E. Provide separate TCC for phase over-current and ground fault.

F. Show no more than six devices on one TCC. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots to provide cross-reference. Designate each TCC with a unique identifier and include each TCC identifier and descriptive title in the study's table of contents.

G. Include in each TCC the following as applicable:

1. TCC name and description.
2. One-line diagram.
3. Identifiers on one-line diagram and curves.
4. Significant motor starting characteristics.
5. Appropriate NEC protection points.
6. Appropriate ANSI/IEEE protection points.
7. Magnetizing inrush points of transformers.
8. Transformer damage curves.
9. Complete operating bands for low voltage circuit breaker trip devices and fuses.
10. Relay coil taps, time-dial settings and pickup settings.
11. Significant symmetrical and asymmetrical fault currents.
12. Power cable withstand curves.
13. Generator short circuit decrement and thermal limit curves.

H. Terminate device characteristic curve on TCC at a point reflecting the maximum symmetrical or asymmetrical fault current to which that device is exposed, based on the short circuit study.

I. Select each primary protective device for a delta-to-wye-connected transformer so the characteristic or operating band is within the transformer parameters; where feasible, include a parameter equivalent to 58 percent of the ANSI C37.91 withstand curve to afford protection for secondary line-to-ground faults.

J. Separate low voltage power circuit breakers from each other and the associated primary protective device, by a 16 percent current margin for coordination and protection in the event of line-to-line faults.

K. Separate protective relays by a 0.3-second time margin for the maximum 3 phase fault conditions to assure proper selectivity.

L. Optimize settings for breakers and relays to provide the most effective protection practicable for all modes and power sources.

M. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center and/or power distribution panelboard. Include all adjustable setting ground fault protective devices.

N. Provide tabulations of recommended settings for all protective devices. Where devices are existing, highlight any changes from the existing setting to the proposed recommended setting.

O. Provide all information required to program/set multifunction solid state relays.

2.6 MOTOR STARTING

A. Comply with IEEE 141 (new IEEE 3001 series) for recommended light flicker limits and IEEE 3002.7 for motor starting studies.

B. Provide motor starting study for all large electric drives (100 horsepower and larger). Include all operating modes.

C. Identify any concerns about voltage drop or power inrush limitations due to the starting of motors.

2.7 ARC FLASH HAZARD

A. Comply with IEEE 1584, NFPA 70, and NFPA 70E as applicable.

B. Utilize short circuit and protective device coordination results to provide arc flash hazard analysis. Perform calculations in accordance with IEEE 1584 or NFPA 70E with the method identified within the report.

C. Calculate the incident energy levels at each faulted bus for each mode of operation and for both maximum and minimum fault currents.

D. Include calculations at line side and load side of main breakers, where applicable.

E. Provide tabular report for all modes and conditions and include “worst case” summary. Use the “worst case” to generate the arc flash labels. Include:

1. Fault location.
2. Arcing fault magnitude.
3. Protective device clearing time.
4. Duration of the arc.
5. Arc flash boundary.
6. Working distance.
7. Incident energy.
8. Electrode configuration.

F. Highlight any available incident energy over 40 cal/cm² and provide recommendations to mitigate the hazard.

G. Arc Flash Labels:

1. Machine printed, 4-inches x 4-inches (nominal), thermal transfer, high adhesion polyester.
2. Provide UV resistant laminate for outdoor labels.

H. Arc Flash Label Information:

1. Equipment name.

2. Identifier LINE or LOAD where equipment has potential different energy levels.
3. Arc flash hazard information: arc flash boundary and incident energy in cal/cm².
4. Shock hazard information: limited approach and restricted approach boundaries.
5. Personal Protective Equipment (PPE) requirements.
6. Study Supplier, project number, and date.

I. Provide arc flash label sample with preliminary report.

J. Do not be print the labels until equipment is energized and protective devices set according to the approved final protective device coordination study.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the study.

1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Engineer's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
3. For relocated equipment and that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.

B. Gather and tabulate the required input data to support the power system study.

C. Field data gathering for existing systems shall be under direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.

D. Data included, but are not limited to, the following:

1. Product data for overcurrent protective devices and existing settings.
2. Electrical power utility information. Information required may include:

    a. Available minimum and maximum three-phase fault current and X/R ratio.
    b. Available minimum and maximum single-line-to-ground fault current and X/R ratio.
    c. Service transformer voltage, kVA, and impedance ratings, winding configuration, and grounding method.
    d. Upstream protective device data.

3. Power sources and ties.
4. For switchgear, switchboards, panelboards, and motor control centers, ampacity and SCCR in amperes RMS symmetrical.

5. For transformers, kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
6. For reactors, manufacturer and model designation, voltage rating, and impedance.
7. For circuit breakers, trip units, and fuses, manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
8. For generators, short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For busways, manufacturer and model designation, current rating, impedance, lengths, and conductor material.
10. For motors, horsepower and NEMA MG 1 code letter designation.
11. Conductor sizes, lengths, number, conductor material, shield parameters for medium voltage cable, and conduit material (magnetic or nonmagnetic).
12. For relays, manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
13. For transfer switches, withstand and closing ratings (WCR) with time duration.
14. Derating factors.

3.2 FIELD QUALITY CONTROL

A. Do all testing and adjustment prior to the energization of new equipment.

B. Test existing adjustable protective devices in accordance with NETA MTS.

C. Test new adjustable protective devices in accordance with NETA ATS.

D. Adjust existing and new protective devices according to approved coordination study.

E. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.

F. After successful testing and adjustment, install calibration sticker with Field Adjusting Agency name, employee initials, and date of calibration at each relay or protective device.

G. After energization, minor adjustments to settings may be required to commission the equipment.

H. Submit field report and list any changes made during field adjustment or commissioning for update for record submittal of study.

I. For adjustable breakers, install sticker listing final adjusted settings, i.e. LTPU, LTD, STPU, STD, INST, GFPU, and GFD.

3.3 ARC FLASH LABELING

A. After the field adjustment of relays and protective devices, apply arc flash study labels.

B. Apply arc flash labels on the front covers of the following equipment:

1. Substations and distribution transformers.
2. Medium voltage switches.

3. Switchgear, switchboards, and panelboards.
4. Motor control centers.
5. Variable frequency controllers.
6. Disconnect switches.
7. Transfer switches.
8. 480V control panels.
9. Step-down transformers

C. Apply arc-flash labels at each section for large equipment such as switchgear and motor control centers.

D. Install LINE and LOAD arc-flash labels as applicable.

E. Remove any previous arc flash study labels as applicable and install new labels under the direction of the Power System Analysis Specialist.

END OF SECTION 260573

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SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Source quality-control reports.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.

1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.

C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Comply with NFPA 70.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Transformers Rated 15 kVA and Larger:

1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.

D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70.

B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

1. One leg per phase.
2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
3. Grounded to enclosure.

C. Coils: Continuous windings except for taps.

1. Coil Material: Copper.
2. Internal Coil Connections: Brazed or pressure type.
3. Terminal Connections: Bolted.

D. Taps for Transformers 3 kVA and Smaller: None.

E. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

G. Insulation Class, Smaller Than 30 kVA: 180 degrees C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 degrees C ambient temperature.

H. Insulation Class, 30 kVA and Larger: 220 degrees C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 degrees C ambient temperature.

I. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor, without exceeding the indicated insulation class in a 40 degrees C maximum ambient and a 24-hour average ambient of 30 degrees C.
2. Indicate value of K-factor on transformer nameplate.
3. Unit shall comply with requirements of DOE 2016 efficiency levels when tested according to NEMA TP 2 with a K-factor equal to one.

K. Neutral: Rated 200 percent of full load current for K-factor-rated transformers.

L. Wall Brackets: Manufacturer's standard brackets.

M. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:

1. 9.00 kVA and Less: 40 dBA.
2. 9.01 to 30.00 kVA: 45 dBA.
3. 30.01 to 50.00 kVA: 45 dBA for K-factors of 1, 4, and 9.
4. 50.01 to 150.00 kVA: 50 dBA for K-factors of 1, 4, and 9.

2.4 IDENTIFICATION

A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
2. Ratio tests at rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at rated voltage connections.
4. No load losses, and excitation current and rated voltage at rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation-Resistance Tests:

    a. High-voltage to ground.
    b. Low-voltage to ground.
    c. High-voltage to low-voltage.

9. Temperature tests.

B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Secure transformer to concrete base according to manufacturer's written instructions.

C. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

D. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:

1. Visual and Mechanical Inspection.

    a. Inspect physical and mechanical condition.
    b. Inspect anchorage, alignment, and grounding.
    c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    d. Verify the unit is clean.
    e. Perform specific inspections and mechanical tests recommended by manufacturer.
    f. Verify that as-left tap connections are as specified.
    g. Verify the presence of surge arresters and that their ratings are as specified.

2. Electrical Tests:

    a. Measure resistance at each winding, tap, and bolted connection.
    b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
    c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
    d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

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SECTION 262300 - LOW-VOLTAGE SWITCHGEAR

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metal-enclosed, low-voltage switchgear, with drawout power circuit breakers and metering and control accessories.

1. Switchgear structure.
2. Requirements for indoor switchgear.
3. Requirements for outdoor switchgear.
4. Circuit breakers.
5. Zone-selective interlocking.
6. Surge suppression.
7. Control power supply, 120-V ac.
8. Instrumentation and control.
9. Maintenance tools.
10. Identification.
11. Source quality control.
12. Delegated Design.

B. Related Requirements:

1. Section 266100 “Electrical Power House”.
2. Section 263213.13 “Diesel Emergency Engine Generators”.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for switchgear.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For low-voltage switchgear.

1. System Power One-Line Diagrams: Depict power sources, feeders, distribution components, and major loads. Include as-built data for low-voltage power switchgear and connections as follows:

a. Frame size of each circuit breaker.
b. Trip rating for each circuit breaker.
c. Conduit and wire size for each feeder.

2. Include BOM, master drawing index, plans, elevations, sections, shipping splits, and mounting details.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
5. Indicate short-time and short-circuit current rating of switchgear assembly.
6. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include mimic-bus diagram.

1.4 DELEGATED DESIGN SUBMITTALS

A. For low-voltage switchgear:

1. Comply with Section 260573 "Power System Studies."

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around the low-voltage switchgear where pipe and ducts are prohibited.

B. Qualification Data: For testing agency.

C. Source quality-control reports.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For equipment to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Time-current curves (on full-size logarithmic paper) of the main secondary breaker and largest secondary feeder device.
b. Lists of spare parts and replacement components recommended for storage at Project site.
c. Detailed instructions covering operation under both normal and abnormal conditions.
d. Hard copies of manufacturer's operating specifications, user's guides for software and hardware, and PDF files on a USB storage device of hard-copy Submittal.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every three of each type and rating, but no fewer than three of each for the following:

a. Potential transformers.
b. Control power circuits.

B. System Power Riser Diagram: For each switchgear, post on the wall at each location, using non-fugitive ink on high-quality paper.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. When provisions for temporary power connection are provided as part of the switchgear assembly, provisions shall be included to prevent energization of primary buses or connections by means of backfeed through fuses or control power transformers connected to the primary buses or connections.

B. If outdoor switchgear cannot be installed and energized, temporary power shall be provided for the operation of the space heaters provided so as to prevent condensation of moisture within the housing.

C. Ventilation openings shall be left open to permit proper air circulation.

1.10 FIELD CONDITIONS

A. Ambient Environment Ratings:

1. Ambient Temperature Rating: Not less than minus 22 degrees F and not exceeding 104 degrees F.
2. Humidity Rating: Less than 95 percent (noncondensing).
3. Altitude Rating: Not exceeding 6600 feet.

4. The effect of solar radiation is insignificant.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

2.2 SYSTEM DESCRIPTION

A. Description: Metal-enclosed, low-voltage switchgear with drawout power circuit breakers, with accessories and metering components.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with IEEE C37.20.1.
3. Listed and labeled as complying with UL 1558.
4. Listed and labeled for use as service entrance equipment.

2.3 PERFORMANCE AND DESIGN CRITERIA

A. Delegated Design: Engage a qualified professional engineer, as defined in Sections 013300 “Submittal Procedures” and 014000 “Quality Requirements”, to submit the items listed in the DELEGATED DESIGN SUBMITTALS Article.

B. Capacities and Characteristics:

1. Nominal System Voltage: 480 V, three wire, 60 Hz.
2. Rated Maximum Voltage: 635 V.
3. Rated Power Frequency: 60 Hz.
4. Rated Insulation Level: Power frequency withstand shall be not less than 2.2-kV rms.
5. Rated Continuous Current:

    a. Main-Bus Continuous: As shown on the Drawings.
    b. Vertical Section Bus Riser: Equal to the frame size of the low-voltage power circuit breaker connected to that riser.

6. Rated Short-Circuit Withstand Current: 65,000 A symmetrical.
7. Short-Time and Short-Circuit Current: Match rating of integrated short-circuit current rating.

2.4 SWITCHGEAR STRUCTURE

A. Bus isolation barriers shall be arranged to isolate line bus from load bus at each main and tie circuit breaker. Extend section barriers between main and tie circuit breakers to the rear of the section.

B. Allow the following circuit-breaker functions to be performed when the compartment door is closed:

1. Operate manual charging system.
2. Open and close the circuit breaker.
3. Examine and adjust the trip unit.
4. Read the breaker nameplate.

C. Install instrument compartments when additional space is required for metering and instrumentation. Allow for routing of instrumentation, control and communications wires, and cables.

D. Switchgear Bus:

1. Use bus bars to connect compartments and vertical sections. Cable connections are not permitted.
2. Main Phase Bus: Uniform capacity the entire length of assembly.
3. Ground Bus: Uniform capacity the entire length of assembly, with pressure connector terminations for feeder and branch-circuit ground conductors, minimum size 1/4 by 2 inches.
4. Vertical Section Bus Size: Comply with IEEE C37.20.1, including allowance for spare circuit breakers and spaces for future circuit breakers.
5. Bus Material and Connections:

    a. Phase--Bus Material: Tin-plated copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections.
    b. Use copper for connecting circuit-breaker line to copper bus.
    c. Contact Surfaces of Buses: Silver plated.
    d. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.

6. Neutral Disconnect Link: Bolted, uninsulated, bus, arranged to connect neutral bus to ground bus.
7. Provide for future extensions from either end of main phase, neutral, and ground bus by means of predrilled bolt-holes and connecting links.

E. Circuit-Breaker Compartment:

1. Drawout Features: Circuit-breaker mounting assembly equipped with a racking mechanism to position circuit breaker and hold it rigidly in connected, test, disconnected, and withdrawn positions. Include the following features:

    a. Provide circuit-breaker racking system with positive stops at connected, test, disconnected, and withdrawn positions.

b. Interlocks: Prevent racking of circuit breaker to or from connected position when it is closed, and prevent closure of circuit breaker unless it is in connected, test, or disconnected position.
c. Circuit-Breaker Positioning: Permit the racking of an open circuit breaker to or from connected, test, and disconnected positions only when the compartment door is closed unless live parts are covered by a full dead-front shield. Permit manual withdrawal of an open circuit breaker to a position for removal from the structure. When compartment door is open, status for connection devices for different positions includes the following:

    1) Test Position: Primary disconnects disengaged, and secondary disconnect devices and ground contact engaged.
    2) Disconnected Position: Primary and secondary devices and ground contact disengaged.

d. Primary Disconnect: Mount on the stationary part of the compartment. Disconnect shall consist of a set of contacts extending to the rear through an insulating support barrier, and of corresponding moving finger contacts on the power circuit-breaker studs, which engage in only the connected position. Assembly shall provide multiple silver-to-silver full floating, spring-loaded, high-pressure-point contacts with uniform pressure on each finger. Load studs shall connect to bus extensions that terminate in solderless terminals in the rear cable compartment.
e. Secondary Disconnect: Floating terminals mounted on the stationary part of the compartment that engage mating contacts at the front of breaker.
f. Provide a verification of positive ground contact between the circuit breaker and its compartment when the accessory cover is removed while the circuit breaker is in connected, test, disconnected, and withdrawn positions.
g. Place 2400-A frame and larger circuit breakers at the bottom of switchgear.

2.5 ADDITIONAL REQUIREMENTS FOR INDOOR SWITCHGEAR

A. Enclosure Rating: Indoor NEMA 1A; gasketed.

B. Enclosure Material: Steel.

C. Enclosure Finish: IEEE C37.20.1, manufacturer's standard gray finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.

D. Enclosure Rear Panels: Removable and hinged, to allow access to rear interior of switchgear.

2.6 CIRCUIT BREAKERS

A. Drawout type, unfused, power operated, with electronic trip devices. Comply with IEEE C37.13, IEEE C37.13a, and UL 1066.

B. Ratings: For continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchgear. Comply with IEEE C37.16.

1. Circuit breakers shall have 30-cycle short-time withstand ratings equal to their symmetrical interrupting ratings through 85,000 A, whether or not equipped with instantaneous trip protection.

C. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:

1. Normal Closing Speed: Independent of both control and operator.
2. Slow Closing Speed: Optional with operator for inspection and adjustment.
3. Stored-Energy Mechanism: Electrically charged.

    a. Operating Handle: One for each circuit breaker capable of manual operation.
    b. Electric Close Button: One for each electrically operated circuit breaker.

4. Provide an interlock to discharge the stored energy mechanism before the circuit breaker can be withdrawn from its compartment.
5. Operation counter.

D. Operator Display: Located on the face of the circuit breaker.

1. Electrical operation buttons to open and close the circuit breaker. Provide a clear lockable cover over the buttons.
2. Indicating Lights: To indicate circuit breaker is open or closed, for main and bus tie circuit breakers interlocked either with each other or with external devices. An energized or hot condition shall be indicated by a red light. The de-energized, open, and safe condition shall be indicated by a green light.
3. Indicator to show the position of the circuit-breaker contacts, status of the closing springs, and circuit-breaker position in its compartment.
4. Provide a "charged-not OK to close" indicator when closing springs are charged but circuit breaker is not ready to close.

E. Overcurrent Protective Tripping: Microprocessor-based, programmable, time-current shaping adjustments; complete with current transformers and sensors and the following features:

1. Programmable functions independent of each other in both action and adjustment.

    a. Long-time setting.
    b. Long-time-delay with selectable I2T or I4T curve shaping.
    c. Short-time setting.
    d. Short-time-delay with flat or selectable I2T curve shaping.
    e. Instantaneous trip.

2. Field-adjustable, time-current characteristics.
3. Current Adjustability: Dial settings and rating plugs on trip units, or sensors on circuit breakers, or a combination of these methods.
4. Three bands, minimum, for long-time- and short-time-delay functions; marked "minimum," "intermediate," and "maximum."
5. Pickup Points:

    a. Five minimum, for long-time- and short-time-trip functions. Equip short-time-trip function for switchable I-squared-T operation.

b. Five minimum, for instantaneous-trip functions.

6. Arc flash reduction technology: allow a preset maintenance mode with an accelerated instantaneous override trip to reduce arc flash energy.

F. Ground-Fault Protection:

1. Test Form: Provide each ground-fault relay with information sheets describing system-testing instructions, and with a test form; comply with UL 1558.

G. Undervoltage Trip Devices: Adjustable time-delay and pickup voltage.

H. Metering:

1. Accuracy: 0.5 percent of reading, complying with ANSI C12.20.
2. Values shall be rms average over a period of one second.

a. Current: Each phase,and three-phase average.
b. Voltage: L-L for each phase, L-L three-phase average, L-N each phase, and L-N three-phase average.
c. Active Power (kW): Each phase and three-phase total.
d. Reactive Power (kVAr): Each phase and three-phase total.
e. Apparent Power (kVA): Each phase and three-phase total.
f. Power Factor: Each phase and three-phase total.
g. Active Energy (kWh): Three-phase total.

I. Auxiliary Contacts:

1. Contacts and switches required for normal circuit-breaker operation, sufficient for interlocking and remote indication of circuit-breaker position.
2. Spare auxiliary switches, at least two, unless otherwise indicated. Each switch shall consist of two Type A and two Type B contacts wired through secondary disconnect devices to a terminal block in stationary circuit-breaker compartment.

2.7 ZONE-SELECTIVE INTERLOCKING

A. Trip units for indicated circuit breakers shall include zone-interlocking capability for the short-time delay and ground-fault delay trip functions for system coordination and arc energy reduction. Zone-interlocking system shall restrain the tripping of an upstream circuit breaker and allow the circuit breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the preset time delay. Zone-interlock system shall be factory wired and tested for circuit breakers within the switchgear.

2.8 SURGE SUPPRESSION

A. Surge Suppression: Factory installed as an integral part of low-voltage switchgear, complying with UL 1449 SPD, Type 1, with the following features and accessories:

1. Integral disconnect switch.

2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Indicator light display for protection status.
4. Form-C contacts rated at 5-A 250-V ac, one NO and one NC, for remote monitoring of protection status.
5. Surge counter.

2.9 CONTROL POWER SUPPLY, 120-V AC

A. Control Power Transformer: Supply 120-V control circuits through dry-type control power transformers, include secondary disconnect devices.

1. Place transformers larger than 3 kVA in separate compartments at the bottom of the vertical section, including the related primary and secondary fuses.
2. Two control power transformers in separate compartments with necessary interlocking relays; each transformer connected to line side of associated main circuit breaker.

    a. Secondary windings connected through relay(s) to control bus to affect an automatic transfer scheme.
    b. Secondary windings connected through an internal automatic transfer switch to switchgear control power bus.

3. Control Power Fuses: Primary and secondary fuses provide current-limiting and overload protection.

2.10 INSTRUMENTATION AND CONTROL

A. Instrument Transformers: Comply with IEEE C57.13. Instrument transformers may not be used to power space conditioning equipment associated with outdoor switchgear, of for power to convenience receptacles and lighting.

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA C12.11 Accuracy class of 0.3 with burdens of W, X, and Y.
2. Current Transformers: Burden and Accuracy class suitable for connected relays, meters, and instruments.

B. Power Monitoring: Separately mounted, modular, permanently installed, solid-state, digital I/O multifunction metering instrument for power and energy metering and monitoring, complying with UL 61010-1.

1. Capable of metering four-wire Y, three-wire Y, three-wire delta, and single-phase power systems.
2. Equipped with security lock to protect revenue-related metering from unauthorized and accidental changes.
3. Comply with IEC 60529 degree of protection code of IP65 for the front of meter, and code of IP30 for the body.
4. Overvoltage: Comply with UL 61010-1 overvoltage withstand rating for CAT III.
5. Accuracy:

a. Comply with ANSI C12.20, Class 0.5.
b. Neutral Current Measurement: Not more than 0.65 percent.
c. Power Factor: 1.0 percent.
d. Frequency: 0.1 percent.
e. THD: 1.0 percent.
f. Waveform Sampling: 64 per cycle.

6. Data Link: Ethernet connectivity specified in this article; TCP/IP protocol.
7. Meter Physical Characteristics:

a. Display: Backlit LCD with antiglare and scratch-resistant lens.
b. Display of Metered Values: One screen to show at least three user-selected values displayed at the same time. Selections available to display shall include the following:

1) All meters.
2) Measurements.
3) THD.
4) Energy.
5) Demand.
6) Minimum and maximum values.
7) Power demand.

8. Sampling Rate: Continuously sample and record voltage and current at a rate not less than 64 samples per cycle, simultaneously on all voltage and current channels of the meter.
9. Meters:

a. Instantaneous, rms:

1) Current: Each phase,and three-phase average.
2) Voltage: L-L for each phase, L-L three-phase average, L-N each phase, and L-N three-phase average.
3) Active Power (kW): Each phase and three-phase total.
4) Reactive Power (kVAr): Each phase and three-phase total.
5) Apparent Power (kVA): Each phase and three-phase total.
6) Power Factor: Each phase and three-phase total.

b. Energy:

1) Active Energy (kWh): Three-phase total.

c. Demand, Derived from Instantaneous rms Meters:

1) Current: Present and maximum.
2) Active: Present and maximum.
3) Reactive: Present and maximum.
4) Apparent: Present and maximum/

d. Power Quality Measurements:

1) THD: Current and voltage from measurements simultaneously from the same cycle, as can be calculated from the specified sampling rate.

10. I/O: Two optically isolated digital outputs for KYZ pulsing or control. Output signal characteristics shall be 150 mA at 200 V.

    a. KYZ Pulse: Generate standard KYZ pulses for a user-defined increment of metered active energy as follows:

        1) User-defined pulse output, associated with kWh.
        2) User-defined pulse output, associated with kVArh.

11. Capacities and Characteristics:

    a. Circuit Connections:

        1) Voltage: Measurement autoranging, 60- to 400-V ac L-N. Connect to instrument-grade potential transformers secondary at 120 V. Meter impedance shall be 2 Mohms L-L or greater.
        2) Overload Tolerance: 1500-V ac, rms, continuously.
        3) Current: Connect to instrument-grade current transformer with a metering range of 5 mA to 6 A. Overcurrent tolerance of the instrument shall be 10 A continuous, 50 A for 10 seconds once per hour, and 120 A for one second per hour.
        4) Frequency: 45 to 65 Hz.
        5) Time: Input from a GPS receiver to synchronize the internal clock of the instrument and to time-synchronize this instrument with the network to a deviation of not greater than 1 ms.

2.11 POWER TRANSFER CONFIGURATIONS

A. Factory-installed and -tested controls of circuit breakers to accomplish automatic transfer controls for switchgear having two power sources.

B. Controls designed to meet UL 1008 and be applied on NEC 701, Legally-Required Standby Systems.

C. Relays: Comply with IEEE C37.90, types and settings as indicated; with test blocks and plugs.

D. Control Wiring:

1. Factory installed, complete with bundling, lacing, and protection.
2. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges and for conductors for interconnections between shipping units.
3. Install plugs in control wiring at shipping splits.

E. Two-Breaker Transfer Control:

1. Two-breaker transfer control shall provide for a switchgear assembly with a common load bus and one normally energized low-voltage power source and one low-voltage

legally-required standby generator source, designated "normal" and "standby," connected to the load bus. Circuit breakers connecting the two power sources to the load bus shall be controlled by a microprocessor-based automatic transfer control. Power for the transfer control shall be from the voltage sensing transformers.

2. In automatic mode, the load bus is connected to the normal power source. When the normal source fails, the control shall automatically open the normal power source and close the standby source circuit breaker.
3. Sequence of Operation:

    a. Default operation shall be with the normal source main breaker closed and the standby main breaker open. On detection of an undervoltage to the line side of the normal main breaker and after a field-adjustable time delay, that main breaker shall open and after an additional field-adjustable time delay, the standby breaker shall close restoring power to the facility.
    b. On restoration of voltage to the line side of the normal main breaker and after a field-adjustable time delay, the standby main breaker shall open and after a field-adjustable time delay, the normal main breaker shall close.

4. Field-Adjustable Transfer Parameters:

    a. Delay the transfer from the normal power source to the standby power source and from the standby power source to the normal source. The time delay is to allow the load voltage to decay before reconnecting to another power source. Delay range: zero seconds to 30 minutes.
    b. Delay the initiation of the transfer sequence. The time delay is recommended to override a momentary power outage or voltage fluctuation. Delay range: zero seconds to 120 seconds.
    c. Delay the transfer from the standby power source to the normal power source. Delay range: zero seconds to 30 minutes.
    d. A relay with contact that changes state when the power is available on the normal source and a relay with contact that changes state when the power is available on the standby source.
    e. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to standby power source regardless of condition of normal source. Pilot light indicated override status.

5. Controls and Indicators: Besides the delay setting controls, provide the following:

    a. Interlocks or relay control to prevent transfer when either of the two controlled circuit breakers are tripped due to overcurrent or ground fault.
    b. Three-position selector switch to select the normal source: Source 1, Source 2, or none.
    c. Transfer-control automatic and manual selector.

        1) Interlock shall prevent paralleling of the two power sources in manual mode.

    d. Open-close control switch for manual electrical operation of each controlled circuit breaker.
    e. Selector to place control into programming mode.

f. Circuit-breaker control switch for each of the normal and standby source breakers, providing open and close operation.
g. Push button to initiate manual retransfer to the normal source when the transfer controller is in automatic mode.
h. Meters and display to show the following:

1) Voltage and frequency of both sources.
2) A multiline display showing the following:

a) Set points of timers, and voltage pickup and dropout set points.
b) Date, time, and reason for at least the last 10 transfers. Display may show the information for one transfer at a time using a scrolling control, with the others held in memory.
c) When the control system is in the transferring process, display shall show delay countdown in seconds.

i. LED indicator lights to show the following:

1) Normal source available.
2) Standby source available.
3) Normal source connected.
4) Standby source connected.
5) Load bus energized.

6. Voltage Transformers: Primary and secondary protection and disconnecting means for sensing functions and control power.
7. Voltage Sensing Relays: Microprocessor-based ANSI No. 27/47 voltage detection relays for three-phase undervoltage protection and negative sequence voltage protection.
8. Data Link: Ethernet connectivity; TCP/IP protocol.

2.12 MAINTENANCE TOOLS

A. Description: Furnish tools and miscellaneous items required for circuit-breaker and switchgear test, inspection, maintenance, and operation.

B. Include the following:

1. Portable test set for testing all functions of circuit-breaker, solid-state trip devices without removal from switchgear.
2. Relay and meter test plugs suitable for testing switchgear meters and switchgear class relays.
3. Portable test set for testing all functions of circuit-breaker, solid-state trip devices without removal from switchgear.
4. Racking handle to move circuit breaker manually between connected and disconnected positions.

C. Circuit-Breaker Removal Apparatus: Overhead-circuit-breaker lifting device, track mounted at top front of switchgear and complete with hoist and lifting yokes matching each size of drawout circuit breaker installed.

D. Storage for Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

2.13 IDENTIFICATION

A. Compartment Nameplates: Engraved, laminated-acrylic, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

B. Mimic Bus: Continuous mimic bus, arranged in single-line diagram format, using symbols and lettered designations consistent with approved mimic-bus diagram.

1. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections.
2. Medium: Painted graphics, as selected by Engineer.
3. Color: Contrasting with factory-finish background; as selected by Engineer from manufacturer's full range.

C. Arc-Flash Warning Labels:

1. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.

a. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1) Location designation.
2) Nominal voltage.
3) Flash protection boundary.
4) Hazard risk category.
5) Incident energy.
6) Working distance.
7) Engineering report number, revision number, and issue date.

b. Labels shall be machine printed, with no field-applied markings.

2.14 SOURCE QUALITY CONTROL

A. Testing: Test and inspect low-voltage switchgear according to IEEE C37.20.1. Drawout circuit breakers need not be tested in the assembly if they are tested separately.

1. Dielectric Tests: Perform power-frequency withstand tests to demonstrate the ability of the insulation system to withstand the voltages listed in IEEE C37.20.1. The voltage is to be increased gradually from zero to the required test value within 5 to 10 seconds and shall be held at that value for one minute.

2. Perform mechanical operation tests to ensure proper functioning of operating mechanism, mechanical interlocks, and interchangeability of removable elements that are designed to be interchangeable.
3. Test the effectiveness of grounding of each metal-case instrument transformer frame or case.
4. Verify that control wiring is correct by verifying continuity. Perform electrical operation of component devices to ensure that they function properly and in the intended sequence.
5. Perform the control wiring insulation tests.
6. Verify correct polarity of the connections between instrument transformers and meters and relays.

B. All serial communications devices within the equipment shall be addressed at the factory and tested to verify reliable communications to the equipment's Ethernet gateway.

C. Low-voltage switchgear assembly will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Owner will witness required factory tests. Notify Engineer at least 14 days before date of tests and indicate their approximate duration.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and space conditions for compliance with requirements for secondary unit substations and other conditions affecting performance of the Work.

B. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will have to cross the section barriers to reach load or line lugs.

C. Examine walls, floors, roofs, and concrete bases for suitable conditions where switchgear will be installed.

D. Verify that ground connections are in place and that requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be five ohms at the switchgear location.

E. On delivery of switchgear and prior to unloading, inspect equipment for damage.

1. Verify that tie rods and chains are undamaged and tight, and that blocking and bracing are tight.
2. Verify that there is no evidence of load shifting in transit, and that readings from transportation shock recorders, if equipped, are within manufacturer's written instructions.

3. Examine switchgear for external damage, including dents or scratches in doors and sill, and termination provisions.
4. Compare switchgear and accessories received with the bill of materials to verify that the shipment is complete. Verify that switchgear and accessories comply with manufacturer's written instructions and Shop Drawings. If the shipment is incomplete or does not comply with Project requirements, notify manufacturer in writing immediately.
5. Unload switchgear, observing packing label warnings and handling instructions.
6. Open compartment doors and inspect components for damage or displaced parts, loose or broken connections, cracked or chipped insulators, bent mounting flanges, dirt or foreign material, and water or moisture.

F. Handling:

1. Handle switchgear, according to manufacturer's written instructions; avoid damage to the enclosure, termination compartments, base, frame, tank, and internal components. Do not subject switchgear to impact, jolting, jarring, or rough handling.
2. Protect switchgear compartments against the entrance of dust, rain, and snow.
3. Transport switchgear upright, to avoid internal stresses on equipment mounting assemblies. Do not tilt or tip switchgear.
4. Use spreaders or a lifting beam to obtain a vertical lift and to protect switchgear from straps bearing against the enclosure. Lifting cable pull angles may not be greater than 15 degrees from vertical.
5. Do not damage structure when handling switchgear.

G. Proceed with installation only after examinations are complete and unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchgear on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Grounding Connections at Exterior Locations:

1. Install tinned bare copper conductors not smaller than No. 4/0 AWG, for ground conductors buried not less than 30 inches below grade interconnecting the grounding electrodes.
2. Bond surge arrester and neutrals directly to the switchgear enclosure and then to the grounding electrode system with bare copper conductors, sized as indicated.
3. Keep lead lengths as short as practicable with no kinks or sharp bends.

4. Make joints in grounding conductors and loops by exothermic weld or compression connector.

C. Terminate all grounding and bonding conductors on a common equipment grounding terminal on the switchgear enclosure. Install supplemental terminal bars, lugs, and bonding jumpers as required to accommodate the number of conductors for termination.

D. Complete switchgear grounding and surge-protector connections prior to making any other electrical connections.

3.4 IDENTIFICATION

A. Comply with the installation requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."

B. Install warning signs as required to comply with OSHA 29 CFR 1910.269.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Comply with provisions of NFPA 70B, "Testing and Test Methods" Chapter and of NETA ATS.
2. After installing switchgear and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
4. Visual and Mechanical Inspection:

    a. Verify that fuse and circuit-breaker sizes and types correspond to Drawings and coordination study.
    b. Verify that current and voltage transformer ratios correspond to Drawings.
    c. Inspect bolted electrical connections for high resistance using one of the following two methods:

        1) Use a low-resistance ohmmeter to compare bolted-connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12.

d. Confirm correct operation and sequencing of electrical and mechanical interlock systems.

1) Attempt closure on locked-open devices. Attempt to open locked-closed devices.
2) Make key exchange with devices operated in off-normal positions.

e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
f. Inspect insulators for evidence of physical damage or contaminated surfaces.
g. Verify correct barrier and shutter installation and operation.
h. Exercise active components.
i. Inspect mechanical indicating devices for correct operation.
j. Verify that filters are in place and that vents are clear.
k. Perform visual and mechanical inspection of instrument transformers according to "Instrument Transformer Field Tests" Paragraph.
l. Inspect control power transformers.

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
3) Verify correct functioning of drawout disconnecting and grounding contacts and interlocks.

5. Electrical Tests:

a. Perform dc voltage insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground, for one minute. If the bus temperature is other than plus or minus 20 degrees C, adjust the resulting resistance as provided in NETA ATS, Table 100.11.

1) Insulation-resistance values of bus insulation shall be according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Investigate and correct values of insulation resistance less than manufacturer's written instructions or NETA ATS, Table 100.1.
2) Do not proceed to the dielectric withstand voltage tests until insulation-resistance levels are raised above minimum values.

b. Perform a dielectric withstand voltage test on each bus section, phase-to-ground with phases not under test grounded, according to manufacturer's published data. If manufacturer has no recommendation for this test, it shall be conducted according to NETA ATS, Table 100.2. Apply the test voltage for one minute.

1) If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.

c. Perform insulation-resistance tests on control wiring for ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test

duration shall be one minute. For units with solid-state components or control devices that cannot tolerate the applied voltage, follow the manufacturer's written instruction.

1) Minimum insulation-resistance values of control wiring shall not be less than 2 megohms.

d. Control Power Transformers:

1) Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Insulation-resistance values of winding insulation shall be according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Investigate and correct values of insulation resistance less than manufacturer's written instructions or NETA ATS, Table 100.1.
2) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source. Verify correct potential at all devices.
3) Verify correct secondary voltage by energizing the primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.
4) Verify correct function of control transfer relays located in the switchgear with multiple control power sources.

e. Voltage Transformers:

1) Perform secondary wiring integrity test. Verify correct potential at all devices.
2) Verify secondary voltages by energizing the primary winding with system voltage.

f. Perform current-injection tests on the entire current circuit in each section of switchgear.

1) Perform current tests by secondary injection with magnitudes such that a minimum 1.0-A current flows in the secondary circuit. Verify correct magnitude of current at each device in the circuit.
2) Perform current tests by primary injection with magnitudes such that a minimum 1.0-A current flows in the secondary circuit. Verify correct magnitude of current at each device in the circuit.

g. Perform system function tests according to "System Function Tests" Article.
h. Verify operation of space heaters.
i. Perform phasing checks on double-ended or dual-source switchgear to ensure correct bus phasing from each source.

C. Circuit-Breaker Field Tests:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.

b. Inspect anchorage, alignment, and grounding.
c. Verify that all maintenance devices are available for servicing and operating the breaker.
d. Verify the unit is clean.
e. Verify that the arc chutes are intact.
f. Inspect moving and stationary contacts for condition and alignment.
g. Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.
h. Perform mechanical operator and contact alignment tests on both the breaker and its operating mechanism according to manufacturer's published data.
i. Verify cell fit and element alignment.
j. Verify racking mechanism operation.
k. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
l. Perform adjustments for final protective-device settings according to coordination study provided by Owner.
m. Record as-found and as-left operation counter readings.

2. Electrical Tests:

a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to ground with switch closed, and across each open pole. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.1. Insulation-resistance values shall be according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Values of insulation resistance less than Table 100.1 or manufacturer's written instructions shall be investigated.
b. Measure contact resistance across each power contact of the circuit breaker. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in manufacturer's published data. In the absence of manufacturer's published data, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Determine long-time pickup and delay by primary current injection. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors. If manufacturer's curves are unavailable, trip times shall not exceed the value shown in NETA ATS, Table 100.7.
d. Determine short-time pickup and delay by primary current injection. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.
e. Determine ground-fault pickup and delay by primary current injection. Ground-fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.
f. Determine instantaneous pickup value by primary current injection. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.8.
g. Test functions of the trip unit by means of secondary injection. Pickup values and trip characteristic shall be as specified and within manufacturer's published tolerances.

h. Perform minimum pickup voltage tests on shunt trip and close coils according to manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall comply with manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.20.
i. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
j. Verify correct operation of any auxiliary features, such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free operation, antipump function, and trip-unit battery condition. Reset trip logs and indicators. Auxiliary features shall operate according to manufacturer's published data.
k. Verify operation of charging mechanism. Charging mechanism shall operate according to manufacturer's published data.

D. Instrument Transformer Field Tests:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data complies with the Contract Documents.
b. Inspect physical and mechanical condition.
c. Verify correct connection of transformers with system requirements.
d. Verify that adequate clearances exist between primary and secondary circuit wiring.
e. Verify that the unit is clean.
f. Inspect bolted electrical connections for high resistance using one of the following two methods:

1) Use a low-resistance ohmmeter to compare bolted-connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12.

g. Verify that required grounding and shorting connections provide contact.
h. Verify correct operation of transformer withdrawal mechanism and grounding operation.
i. Verify correct primary and secondary fuse sizes for voltage transformers.
j. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

2. Electrical Tests of Current Transformers:

a. Perform insulation-resistance test of each current transformer and its secondary wiring for ground at 1000-V dc for one minute. For units with solid-state components that cannot tolerate the applied voltage, follow manufacturer's written instructions. Investigate and correct values of insulation resistance less than manufacturer's written instructions or NETA ATS, Table 100.5.

b. Perform a polarity test of each current transformer according to IEEE C57.13.1. Polarity results shall agree with transformer markings.
c. Perform a ratio-verification test using the voltage or current method according to IEEE C57.13.1. Ratio errors shall be according to IEEE C57.13.
d. Perform an excitation test on transformers used for relaying applications according to IEEE C57.13.1. Excitation results shall match the curve supplied by manufacturer or be according to IEEE C57.13.1.
e. Measure current circuit burdens at transformer terminals according to IEEE C57.13.1. Measured burdens shall be compared to, and shall match, instrument transformer ratings.
f. Perform insulation-resistance tests on the primary winding with the secondary grounded. Test voltages shall be according to NETA ATS, Table 100.5.
g. Perform dielectric withstand tests on the primary winding with the secondary grounded. Test voltages shall be according to NETA ATS, Table 100.9.
h. Perform power-factor or dissipation-factor tests according to test equipment manufacturer's published data.
i. Verify that current transformer secondary circuits are grounded and have only one grounding point according to IEEE C57.13.3. That grounding point should be located as specified by Engineer in Project Drawings.

3. Electrical Tests of Voltage Transformers:

a. Perform insulation-resistance tests, winding-to-winding and winding-to-ground. Test voltages shall be applied for one minute according to NETA ATS Table 100.5. For units with solid-state components that cannot tolerate the applied voltage, follow manufacturer's written instructions. Investigate and correct values of insulation resistance less than manufacturer's written instructions or NETA ATS, Table 100.5.
b. Perform a polarity test on each transformer to verify the polarity marks or H1-X1 relationship as applicable. Polarity results shall agree with transformer markings.
c. Perform a turns-ratio test on all tap positions. Ratio errors shall be according to IEEE C57.13.
d. Measure voltage circuit burdens at transformer terminals. Measured burdens shall be compared to, and shall match, instrument transformer ratings.
e. Perform a dielectric withstand test on the primary windings with the secondary windings connected to ground. Dielectric voltage shall be according to NETA ATS, Table 100.9. Test voltage shall be applied for one minute. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the primary windings are considered to have passed the test.
f. Perform power-factor or dissipation-factor tests according to test equipment manufacturer's published data. Power-factor or dissipation-factor values shall be according to manufacturer's published data. In the absence of manufacturer's published data, use test equipment manufacturer's published data.
g. Verify that voltage transformer secondary circuits are grounded and have only one grounding point according to IEEE C57.13.3. Test results shall indicate that the circuits are grounded at only one point.

E. Ground-Resistance Test:

1. Visual and Mechanical Inspection:

a. Verify that ground system complies with the Contract Documents and with NFPA 70, Article 250, "Grounding and Bonding."
b. Inspect physical and mechanical condition. Grounding system electrical and mechanical connections shall be free of corrosion.
c. Inspect bolted electrical connections for high resistance using one of the following two methods:

1) Use a low-resistance ohmmeter to compare bolted-connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12.

d. Inspect anchorage.

2. Electrical Tests:

a. Perform fall-of-potential or alternative test according to IEEE 81 on the main grounding electrode or system. Resistance between the main grounding electrode and ground shall be no more than 5 ohms.
b. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and derived neutral points. Investigate point-to-point resistance values that exceed 0.5 ohms. Compare equipment nameplate data with the Contract Documents.
c. Inspect physical and mechanical condition.
d. Inspect bolted electrical connections for high resistance using one of the following two methods:

1) Use a low-resistance ohmmeter to compare bolted-connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12.

F. Metering Devices Field Tests:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect bolted electrical connections for high resistance using one of the following two methods:

1) Use a low-resistance ohmmeter to compare bolted-connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12.

c. Inspect cover gasket, cover glass, condition of spiral spring, disk clearance, contacts, and case shorting contacts, as applicable.
d. Verify that the unit is clean.
e. Verify freedom of movement, end play, and alignment of rotating disk(s).

2. Electrical Tests:

a. Verify accuracy of meters at all cardinal points. Meter accuracy shall be according to manufacturer's published data.
b. Calibrate meters according to manufacturer's published data. Calibration results shall be within manufacturer's published tolerances.
c. Verify all instrument multipliers. Instrument multipliers shall be according to system design specifications.
d. Verify that current transformer and voltage transformer secondary circuits are intact. Test results shall confirm the integrity of the secondary circuits of current and voltage transformers.

G. Microprocessor-Based Protective Relay Field Tests:

1. Visual and Mechanical Inspection:

a. Record model number, style number, serial number, firmware revision, software revision, and rated control voltage.
b. Verify operation of LEDs, display, and targets.
c. Record passwords for each access level.
d. Clean the front panel and remove foreign material from the case.
e. Check tightness of connections.
f. Verify that the frame is grounded according to manufacturer's written instructions.
g. Download settings from the relay. Print a copy of the settings for the report and compare the settings to those specified in the coordination study.

2. Electrical Tests:

a. Perform insulation-resistance tests from each circuit to the grounded frame according to manufacturer's published data.
b. Apply voltage or current to analog inputs, and verify correct registration of the relay meter functions.
c. Check functional operation of each element used in the protection scheme as follows:

1) ANSI No. 2/62, Timing Relay:

a) Determine time delay.
b) Verify operation of instantaneous contacts.

2) ANSI No. 24, Volts/Hertz Relay:

a) Determine pickup frequency at rated voltage.
b) Determine pickup frequency at a second voltage level.
c) Determine time delay.

3) ANSI No. 25, Sync Check Relay:

a) Determine closing zone at rated voltage.
b) Determine maximum voltage differential that permits closing at zero degrees.
c) Determine set points of live line, live bus, dead line, and dead bus.
d) Determine time delay.
e) Verify control functions of dead bus/live line, dead line/live bus, and dead bus/dead line.

4) ANSI No. 27, Undervoltage Relay:

a) Determine dropout voltage.
b) Determine time delay.
c) Determine time delay at a second point on the timing curve for inverse time relays.

5) ANSI No. 32, Directional Power Relay:

a) Determine minimum pickup at maximum torque angle.
b) Determine closing zone.
c) Determine maximum torque angle.
d) Determine time delay.
e) Verify time delay at a second point on the timing curve for inverse time relays.

6) ANSI No. 46, Current Balance Relay:

a) Determine pickup of each unit.
b) Determine percent slope.
c) Determine time delay.

7) ANSI No. 46N, Negative Sequence Current Relay:

a) Determine negative sequence alarm level.
b) Determine negative sequence minimum trip level.
c) Determine maximum time delay.
d) Verify two points on the I-two-squared-T curve.

8) ANSI No. 47, Phase Sequence or Phase Balance Voltage Relay:

a) Determine positive sequence voltage to close the NO contact.

b) Determine positive sequence voltage to open the NC contact (undervoltage trip).
c) Verify negative sequence trip.
d) Determine time delay to close the NO contact with sudden application of 120 percent of pickup.
e) Determine time delay to close the NC contact on removal of voltage when previously set to rated system voltage.

9) ANSI No. 50, Instantaneous Overcurrent Relay:

a) Determine pickup.
b) Determine dropout.
c) Determine time delay.

10) ANSI No. 51, Time Overcurrent:

a) Determine minimum pickup.
b) Determine time delay at two points on the time current curve.

11) ANSI No. 64, Ground Detector Relay:

a) Determine maximum impedance to ground causing relay pickup.

12) ANSI No. 67, Directional Overcurrent Relay:

a) Determine directional unit minimum pickup at maximum torque angle.
b) Determine closing zone.
c) Determine maximum torque angle.
d) Plot operating characteristics.
e) Determine overcurrent unit pickup.
f) Determine overcurrent unit time delay at two points on the time current curve.

13) ANSI No. 87, Differential Relay:

a) Determine operating unit pickup.
b) Determine the operation of each restraint unit.
c) Determine slope.
d) Determine harmonic restraint.
e) Determine instantaneous pickup.
f) Plot operating characteristics for each restraint.

d. Control Verification:

1) Functional Tests:

a) Check operation of all active digital inputs.
b) Check output contacts or SCRs, preferably by operating the controlled device, such as circuit breaker, auxiliary relay, or alarm.
c) Check internal logic functions used in protection scheme.

d) On completion of testing, reset minimum/maximum recorders, communications statistics, fault counters, sequence-of-events recorder, and event records.

2) In-Service Monitoring: After the equipment is initially energized, measure magnitude and phase angle of inputs and verify expected values.

H. Ground-Fault Protection Field Tests: Evaluate the interconnected system according to switchgear manufacturer's written instructions.

1. Determine the proper location of the sensors around the bus of the circuit to be protected. This determination may be done visually, with knowledge of which bus is involved.
2. Verify the grounding points of the system to determine that ground paths do not exist that would bypass the sensors. Use high-voltage testers and resistance bridges.
3. Test the installed system for correct response by application of full-scale current into the equipment to duplicate a ground-fault condition, or by equivalent means such as by simulated fault current generated by the following:

a. A coil around the sensors.
b. A separate test winding in the sensors.

4. Record the test results on the test form provided with the instructions provided by manufacturer.

I. Switchgear components will be considered defective if they do not pass tests and inspections.

J. Remove and replace defective units and retest.

K. Prepare test and inspection reports. Record as-left set points of adjustable devices.

3.6 SYSTEM FUNCTION TESTS

A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality-control tests have been completed and all components have passed specified tests.

1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
3. Verify the correct operation of sensing devices, alarms, and indicating devices.

B. Switchgear will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 FOLLOW-UP SERVICE

A. Voltage Monitoring and Adjusting: After Substantial Completion, but not more than six months after Final Acceptance, and if requested by Owner, perform the following voltage monitoring:

1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the outgoing section of each piece of switchgear. Use voltmeters with calibration traceable to NIST standards and with a chart speed of not less than 1 inch per hour. Voltage unbalance greater than 1 percent between phases, or deviation of phase voltage from the nominal value by more than plus or minus 5 percent during the test period, is unacceptable.
2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:

    a. Adjust switchgear taps.
    b. Prepare written request for voltage adjustment by electric utility.

3. Retests: Repeat monitoring, after corrective action has been performed, until specified results are obtained.
4. Report:

    a. Prepare a written report covering monitoring performed and corrective action taken.

B. Infrared Inspection: Perform the survey during periods of maximum possible loading. Remove covers prior to inspection.

1. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of the electrical power connections of switchgear.
2. Instrument: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 degree C at 30 degrees C.
3. Record of Infrared Inspection: Prepare a certified report that identifies the testing technician and equipment used and that lists the results as follows:

    a. Description of equipment to be tested.
    b. Discrepancies.
    c. Temperature difference between the area of concern and the reference area.
    d. Probable cause of temperature difference.
    e. Areas inspected. Identify inaccessible and unobservable areas and equipment.
    f. Identify load conditions at time of inspection.
    g. Provide photographs and thermograms of the deficient area.

4. Act on inspection results according to recommendations in NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.
5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.8 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION 262300

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Power panelboards.
2. Lighting and appliance branch circuit panelboards.
3. Circuit breakers.
4. Accessories and special construction.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 264313 “Surge Protection for Low-Voltage Electrical Power Circuits” for performance requirements of factory installed SPDs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on project. Note this Section may include products not required for the project.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.

5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include Internet link for electronic access to downloadable PDF of coordination curves.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. Include the following:

1. Manufacturer’s written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

B. Warranty documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to equipment manufacturer restrictions listed in Section 260010 “Supplemental Requirements for Electrical”, panelboards from the following manufacturers are approved:

1. Eaton.
2. GE by ABB.
3. Siemens.
4. Square D by Schneider Electric.

B. Source Limitations:

1. Obtain new panelboards from single source from single manufacturer.
2. Obtain retrofit disconnecting and overcurrent protective devices from existing panelboard manufacturer or subsequent responsible manufacturer, to maintain overall UL listing of panelboard.

2.2 GENERAL REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.

B. Comply with the following standards as applicable:

1. NEMA PB 1, Panelboards.
2. UL 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
3. UL 50E, Enclosures for Electrical Equipment, Environmental Considerations.
4. UL 67, Standard for Panelboards, CCN QEUY.
5. UL 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
6. UL 1449, Surge Protective Devices.

C. Ratings:

1. Ratings are indicated on the Drawings.
2. Series rated panelboards are prohibited. Circuit breakers must be fully rated for the short circuit rating listed for the panelboard.

D. Construction:

1. NEMA1 enclosure, unless noted otherwise on Drawings. See ACCESSORIES AND SPECIAL CONSTRUCTION Article for enclosures other than NEMA 1.
2. Copper equipment grounding bar, separate and distinct from neutral bar.
3. Conductor Lugs:

    a. Mechanical type.
    b. Size suitable for indicated conductor sizes.
    c. Neutral (when present) and ground lug quantity equal to each pole in panelboard.

4. Where Drawings indicate space for future circuit breaker, equip panelboard with bus bars, blank covers, and mounting hardware so only the future breaker need be provided.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearance between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

2.3 POWER PANELBOARDS

A. Manufacturer’s power distribution panelboard using molded-case bolt-on circuit breakers, where available. Drawing designation using “PP” or “DP”.

B. Doors: Hinged cover or door-in-door trim when available. Secure door with flush keyed lock and catch, except doors over 36 inches in height to use a vault-type latch with tumbler lock and 3-point catch. All locks keyed alike.

C. Bus: Tin-plated copper.

2.4 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

A. Manufacturer's lighting and appliance panelboard using molded-case bolt-on circuit breakers.

B. Doors: Door-in-door construction with concealed hinges; secured with flush keyed lock and catch, except doors over 48 inches in height to use a vault-type latch with tumbler lock and 3-point catch. All locks keyed alike.

C. Bus: Tin-plated copper.

2.5 CIRCUIT BREAKERS

A. Molded case, manufactured by panelboard manufacturer.

B. Plug-in or bolt-on as listed in associated panelboard Article.

C. Configuration, frame size, trip, and special features such as GFCI (Class A trip, 4-6 mA) or GFI (Class B trip, 30 mA) as shown on Drawings.

D. Provide breaker lugs to accommodate wire sizes shown on Drawings.

E. Multi-pole breakers to have common trip. Do not convert single pole breakers to multi-pole using handle ties, use multi-pole breaker.

F. Thermal-Magnetic Circuit Breakers:

1. Inverse time-current element for low-level overloads.
2. Instantaneous magnetic trip element for short circuits.
3. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

G. Electronic Trip Circuit Breakers:

1. RMS sensing.
2. Field-replaceable rating plug or electronic trip.
3. Adjustable trip functions as indicated on Drawings.

2.6 ACCESSORIES AND SPECIAL CONSTRUCTION

A. Accessories such as breaker lockout devices or key interlocks are indicated on the Drawings.

B. Integral Surge Protective Device:

1. By panelboard manufacturer, factory installed.
2. Type 2.
3. SCCR: Equal to SCCR of panelboard where installed.
4. Performance: Comply with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits".

C. Electronic Grade:

1. Integral SPD.
2. Neutrals: 200 percent rated.

D. NEMA 3R or 12 Enclosure:

1. Material: galvanized steel.

E. NEMA 4X Enclosure:

1. Material: 316 stainless steel.
2. When available, 3-point latch door.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent requirements are specified in Contract Documents or manufacturer's published instructions, comply with the following:

1. ANSI/NEMA PB 1.1 – General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
2. NECA NEIS 407 – Standard for Installing and Maintaining Panelboards.

C. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

D. Equipment Mounting:

1. Attach panelboard to the vertical finished or structural surface behind panelboard.
2. Mount back box plumb and level, and surface or flush mount as indicated on Drawings.

3. Mount surface-mounted panelboards to supports to allow a minimum of 1/2 inch air space between the box and the mounting surface.
4. Mount flush-mounted panelboards with front cover uniformly flush with wall finish and mating with back box.
5. Mount top of trim 72 inches above finished floor unless otherwise indicated.

E. Install circuit breakers not already factory installed. Rearrange circuit breakers to correspond to panel schedules shown on Drawings.

F. Tighten bolted connections and wiring connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

G. Install filler plates in unused spaces.

H. Plug abandoned or unused entry holes.

I. Do not leave cut off wires at breakers, neutral bar terminal, or ground bar terminal.

J. Identify panelboards in accordance with Section 260553 "Identification for Electrical Systems".

1. Identify equipment by name designation and fed from source nameplates.
2. Identify pole numbers.
3. Color code wiring.
4. Identify branch circuit phase and neutral wires by circuit number.
5. Provide as built typed panelboard directory.

K. Adjust circuit breakers with adjustable trips in accordance with the final approved submittal of Section 260573 "Power System Studies".

L. Install Arc Flash Labels in accordance with Section 260573 "Power System Studies".

3.3 FIELD QUALITY CONTROL

A. Perform checkout and testing activities recommended by and in accordance with manufacturer's instructions, NECA 407, and as specified herein. Correct deficiencies, make adjustments, and retest until requirements are met.

B. Visual and Mechanical Inspection:

1. Compare equipment nameplate data with Drawings and Specifications.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, and grounding.
4. Verify unit is clean.
5. Verify breakers operate smoothly.

C. Electrical Tests:

1. Perform insulation resistance test on buswork in accordance with manufacturer's instructions.
2. Verify correct voltage and phasing at each panelboard.
3. Verify load currents are balanced across the three phases.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of panelboard connections for new or modified panelboards.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform follow-up infrared scan of panelboards, at 11 months after Substantial Completion.
3. Prepare a certified report identifying panelboard checked and describing results of scanning. Include a notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

3.4 CLEANING

A. Remove rubbish and debris from inside and around equipment. Vacuum clean interior.

END OF SECTION 262416

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SECTION 262419 - MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes MCCs for use with ac circuits rated 600 V and less, with combination controllers and having the following factory-installed components for Dove Springs WWTP:

1. Active harmonic filter and power correction unit.
2. Variable frequency drives.
3. Solid-state reduced voltage starters.
4. Auxiliary devices.
5. Panelboards.
6. Transformers.

B. Related Requirements

1. Section 260573 "Power System Studies" for arc-flash analysis and arc-flash label requirements.
2. Section 266100 "Electrical Power House" for pre-fabricated electrical walk-in enclosure requirements.
3. Section 262923 "Variable-Frequency Motor Controllers" for variable frequency drive requirements.
4. Section 263533 "Power Correction Equipment" for active harmonic filter and power factor correction unit requirements.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. AHF: Active harmonic filter.

C. MCC: Motor-control center.

D. MCCB: Molded-case circuit breaker.

E. MCP: Motor-circuit protector.

F. OCPD: Overcurrent protective device.

G. PCU: Power correction unit. Used interchangeably with AHF.

H. PID: Control action; proportional plus integral plus derivative.

I. PT: Potential transformer.

J. SPD: Surge protective device.

K. SCR: Silicon-controlled rectifier.

L. VFD: Variable-frequency drive.

M. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for MCCs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for each cell of the MCC.
3. Provide AHF sizing calculations to confirm required harmonic mitigation and power factor correction performance for the AHF's proposed.
4. AHF assembly rated input KVA and output KVA, topology, converter/inverter type, percent efficiency, operating characteristics, and electrical characteristics.

B. Shop Drawings: For each MCC, manufacturer's approval drawings as defined in UL 845. In addition to requirements specified in UL 845, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.

1. Show tabulations of installed devices, equipment features, and ratings. Include the following:

    a. Each installed unit's type and details.
    b. Factory-installed devices.
    c. Enclosure types and details.
    d. Nameplate legends.
    e. Short-circuit current (withstand) rating of complete MCC, and for bus structure and each unit.
    f. Features, characteristics, ratings, and factory settings of each installed controller and feeder device, and installed devices.
    g. Specified optional features and accessories.

2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring for each installed controller.
3. Nameplate legends.
4. Vertical and horizontal bus capacities.
5. Features, characteristics, ratings, and factory settings of each installed unit.

1.5 INFORMATIONAL SUBMITTALS

A. Production Drawings: For each MCC, as defined in UL 845.

B. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around MCCs where pipe and ducts are prohibited. Show MCC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

C. Qualification Data: For testing agency.

D. Product Certificates: For each MCC.

E. Source quality-control reports.

F. Field quality-control reports.

G. Load-Current and Overload Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

I. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For MCCs, all installed devices, and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
2. Manufacturer's Record Drawings: As defined in UL 845. In addition to requirements specified in UL 845, include field modifications and field-assigned wiring identification incorporated during construction by manufacturer, Contractor, or both.
3. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
4. Manufacturer's written instructions for setting field-adjustable overload relays.
5. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage, solid-state controllers.
6. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
7. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain MCCs and controllers of a single type from single source from single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, and marked for intended use.

D. UL Compliance: MCCs shall comply with UL 845 and shall be listed and labeled by a qualified testing agency.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handle MCCs according to the following:

1. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."
2. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."

B. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside MCCs; install temporary electric heating, with at least 250 W per vertical section.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace MCC and SPD that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

2.2 SYSTEM DESCRIPTION

A. NEMA Compliance: Fabricate and label MCCs to comply with NEMA ICS 18.

B. Ambient Environment Ratings:

1. Ambient Temperature Rating: Not less than 0 degrees F and not exceeding 104 degrees F, with an average value not exceeding 95 degrees F over a 24-hour period.
2. Ambient Storage Temperature Rating: Not less than minus 4 degrees F and not exceeding 140 degrees F
3. Humidity Rating: Less than 95 percent (noncondensing).
4. Altitude Rating: Not exceeding 6600 feet, or 3300 feet if MCC includes solid-state devices.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 PERFORMANCE REQUIREMENTS

2.4 MOTOR CONTROL CENTER ENCLOSURES

A. Indoor Enclosures: Freestanding steel cabinets unless otherwise indicated. NEMA 250, Type 1A gasketed unless otherwise indicated to comply with environmental conditions at installed location.

B. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

C. Outdoor Enclosures: Type 3R, non-walk-in aisle.

1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
2. Enclosure: Downward, rearward sloping roof; bolt-on rear covers for each section, with provisions for padlocking.

2.5 ASSEMBLY

A. Structure:

1. Comply with UL requirements for service entrance equipment.
2. Units up to and including Size 3 shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
3. Units in Type B and Type C MCCs shall have pull-apart terminal strips for external control connections.

B. Compartments: Modular; individual lift-off doors with concealed hinges and quick-captive screw fasteners.

1. Interlock compartment door to require that the disconnecting means is "off" before door can be opened or closed, except by operating a concealed release device.
2. Compartment construction shall allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC.
3. The same-size compartments shall be interchangeable to allow rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.

C. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same-size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.

D. Wiring Spaces:

1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place.
2. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.

E. Provisions for Future:

1. Compartments marked "future" shall be bused, wired and equipped with guide rails or equivalent, and ready for insertion of drawout units.

F. Compartments marked "spare" shall include provisions for connection to the vertical bus.Integrated Short-Circuit Rating:

1. Short-Circuit Current Rating for Each Unit: Fully rated; 65 kA.
2. Short-Circuit Current Rating of MCC: Fully rated with its main overcurrent device; 65 kA.

G. Control Power:

1. 120-V ac; obtained from CPT integral with controller; with primary and secondary fuses. The CPT shall be of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

    a. CPT Spare Capacity: 100 VA.

H. Factory-Installed Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

1. Wiring Class: NEMA ICS 18, Class II, Type B, for starters larger than Size 3, and Type B-D, for starters Size 3 and smaller.
2. Control and Load Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

I. Bus:

1. Main Horizontal and Equipment Ground Buses: Uniform capacity for entire length of MCC's main and vertical sections. Provide for future extensions.
2. Vertical Phase and Equipment Ground Buses: Uniform capacity for entire usable height of vertical sections, except for sections incorporating single units.
3. Phase-Bus Material: Tin-plated copper of 98 percent minimum conductivity, with mechanical connectors for outgoing conductors.
4. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for ground conductors, minimum size 1/4-by-2 inches. Equip with mechanical connectors for outgoing conductors.
5. Neutral Disconnect Link: Bolted, uninsulated, 1/4-by-2-inch copper bus, arranged to connect neutral bus to ground bus.
6. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Insulation temperature rating shall not be less than 105 deg C.

2.6 MAIN DISCONNECT AND OVERCURRENT PROTECTIVE DEVICE(S)

A. MCCB (to 2500 A): Fixed mounted, manually operated air-circuit breaker. Comply with UL 489.

1. MCCB shall have quick-make, quick-break, over-center switching mechanism that is mechanically trip-free, its position shall be shown by the position of the handle, and manual push-to-trip push button.
2. Solid-state monitoring and tripping system to show system status monitoring, adjustable time-current protection, and shunt trip.

    a. Interchangeable current sensors and timing circuits for adjustable time-current protection settings and status signals.
    b. Trip-setting dials or interchangeable plugs to establish the continuous trip of the circuit breaker. Plugs shall not be interchangeable between frames, and the breaker may not be closed without the plug.
    c. Time-current adjustments to achieve protective-device coordination as follows:

1) Adjustable long-time delay.
2) Adjustable short-time setting and delay to shape the time-current curve.
3) Adjustable instantaneous setting.
4) Individually adjustable ground-fault setting and time delay.

d. Built-in connector to test the long-time delay, instantaneous, and ground-fault functions of the breaker. Provide one test set for testing the installed circuit breakers 225-A frame and higher.
e. Built-in digital ammeter display, showing load current and tripping cause.

3. Switch operator power shall be from control power specified in "Assembly" Article.

B. Surge Suppression: Factory installed as an integral part of the incoming feeder, complying with UL 1449, SPD Type 2.

2.7 AUTOMATIC POWER TRANSFER

A. Factory-installed and -tested controls of circuit breakers to accomplish automatic transfer controls for motor control center having two power sources.

B. Controls designed to meet UL 1008 and be applied on NEC 701, Legally-Required Standby Systems.

C. Two-Breaker Transfer Control:

1. Transfer control, using electrically operated MCCBs, for an MCC supplied from one normally energized low-voltage power source and one low-voltage legally-required standby generator sources, designated "normal" and "standby." The circuit breakers connecting the two power sources to the load bus shall be controlled by a microprocessor-based automatic transfer control. Power for the transfer control shall be from the voltage-sensing transformers.
2. MCCBs (to 2500 A): Fixed mounted, manually operated air-circuit breaker. Comply with UL 489.

a. MCCB shall have quick-make, quick-break, over-center switching mechanism that is mechanically trip-free, its position shall be indicated by the position of the handle, and manual push-to-trip push button.
b. Solid-state monitoring and tripping system to show system status monitoring, adjustable time-current protection, and shunt trip.

1) Interchangeable current sensors and timing circuits for adjustable time-current protection settings and status signals.
2) Trip-setting dials or interchangeable plugs to establish the continuous trip of the circuit breaker. Plugs shall not be interchangeable between frames, and the breaker may not be closed without the plug. With neutral ground-fault sensor.
3) Time-current adjustments to achieve protective-device coordination as follows:

a) Adjustable long-time delay.

b) Adjustable short-time setting and delay to shape the time-current curve.
c) Adjustable instantaneous setting.
d) Individually adjustable ground-fault setting and time delay.

4) Built-in connector to test the long-time delay, instantaneous, and ground-fault functions of the breaker.
5) Built-in digital ammeter display, showing load current and tripping cause.

3. In the automatic mode, the load bus is connected to the normal power source. When the normal source fails, the control shall automatically open the normal power source and close the standby source circuit breaker.
4. Sequence of Operation:

a. The default operation shall be with the normal source main breaker closed and standby main breaker open. On detection of an undervoltage to the line side of the normal main breaker and after a field-adjustable time delay, the main breaker shall open and, after an additional field-adjustable time delay, the standby breaker shall close and restore power to the facility.
b. On restoration of voltage to the line side of the normal main breaker and after a field-adjustable time delay, the standby main breaker shall open and, after a field-adjustable time delay, the normal main breaker shall close.

5. Field-Adjustable Transfer Parameters:

a. Delay the transfer from the normal power source to the standby power source and from the standby power source to the normal source. The time delay is to allow the load voltage to decay before reconnecting to another power source. Delay range is zero seconds to 30 minutes.
b. Delay the initiation of the transfer sequence. The time delay is recommended to override a momentary power outage or voltage fluctuation. Delay range is zero to 120 seconds.
c. Delay the transfer from the standby power source to the normal power source. Delay range is zero seconds to 30 minutes.
d. A relay with contact that changes state when the power is available on the normal source, and a relay with contact that changes state when the power is available on the standby source.
e. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to standby power source regardless of condition of normal source. Pilot light indicated override status.

6. Controls and Indicators: In addition to the delay setting controls, include the following:

a. Interlocks or relay control to prevent transfer when either of the two controlled circuit breakers trip due to overcurrent or ground-fault.
b. Three-position selector switch to select the normal source: Source 1, Source 2, or none.
c. Transfer-control automatic and manual selector.

1) Interlock shall prevent paralleling of the two power sources in manual mode.

d. Open-close control switch for manual electrical operation of each controlled circuit breaker.
e. Selector to place control into programming mode.
f. Circuit breaker control switch for each of the normal and standby source breakers, providing open and close operation.
g. Push button to initiate manual retransfer to the normal source when the transfer controller is in the automatic mode.
h. Meters and display to show the following:

1) Voltage and frequency of both sources.
2) A multiline display showing the following:

a) Set points of timers, and voltage pickup and dropout set points.
b) Date, time, and reason for minimum of the last 10 transfers. The display may show the information for one transfer at a time using a scrolling control, with the others held in memory.
c) When the control system is in the transferring process, the display shall show delay countdown in seconds.

i. LED indicators to show the following:

1) Normal source available.
2) Standby source available.
3) Normal source connected.
4) Standby source connected.
5) Load bus energized.

7. Voltage Transformers: Primary and secondary protection and disconnecting means for sensing functions and control power.
8. Voltage Sensing Relays: Microprocessor-based, IEEE device number 27/47 voltage detection relays for three-phase undervoltage protection and negative sequence voltage protection.
9. Data Link: Ethernet connectivity; TCP/IP protocol.

2.8 MAGNETIC CONTROLLERS

A. Controller Units: Combination controllers.

B. Disconnects:

1. MCP:

a. UL 489, with interrupting capacity complying with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
b. Lockable Handle: For three padlocks and interlocks with cover in closed position.

2. MCCB:

a. UL 489, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
c. Lockable Handle: For three padlocks and interlocks with cover in closed position.

C. Controllers: Comply with UL 508.

1. Full-Voltage Magnetic Controllers: Electrically held, full voltage, NEMA ICS 2, general purpose, Class A.

a. Classification: Nonreversing.

D. Overload Relays:

1. Solid-State Overload Relays:

a. Switch or dial selectable for motor-running overload protection.
b. Sensors in each phase.
c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
d. UL 1053 Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

2. NC isolated overload alarm contact.
3. External overload reset push button.

2.9 REDUCED-VOLTAGE SOLID-STATE CONTROLLERS

A. Controller Units: An integrated unit with disconnects, power SCRs, heat sink, microprocessor logic board, door-mounted digital display and keypad, bypass contactor, and overload relays. Comply with UL 508.

1. Suitable for use with NEMA MG 1 Design B, polyphase induction motors.

B. Disconnects:

1. MCP:

a. UL 489, with interrupting capacity complying with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
b. Lockable Handle: For three padlocks and interlocks with cover in closed position.
c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
d. NC alarm contact that operates only when MCP has tripped.
e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

C. Configuration: Standard duty; nonreversible.

D. Starting Mode: Voltage ramping Current limit; field selectable.

E. Stopping Mode: Coast to stop; field selectable.

F. Bypass Contactor: Shall operate automatically to bypass the SCRs when the motor has reached rated speed and full voltage is applied to motor. Solid-state controller protective features shall remain active when the bypass relay is in the bypass mode.

1. Bypass Contactor: Manufacturer's standard product.
2. Bypass Contactor Coils: Pressure-encapsulated type; manufacturer's standard operating voltage, matching control power or line voltage, depending on contactor size and line-voltage rating.

G. Acceleration Control: Adjustable, using voltage or current ramp, and adjustable starting torque control with up to 400 percent current limitation for 20 seconds.

H. SCR Bridge: At least two SCRs per phase, for stable and smooth acceleration with external feedback from the motor or driven equipment.

I. Keypad: Front accessible; for programming the controller parameters, functions, and features; shall be manufacturer's standard and include not less than the following functions:

1. Adjusting motor full-load amperes, as a percentage of the controller's rating.
2. Adjusting current limitation on starting, as a percentage of the motor full-load current rating.
3. Adjusting linear acceleration and deceleration ramps, in seconds.
4. Setting initial torque, as a percentage of the nominal motor torque.
5. Adjusting torque limit, as a percentage of the nominal motor torque.
6. Adjusting maximum start time, in seconds.
7. Adjusting voltage boost, as a percentage of the nominal supply voltage.
8. Selecting stopping mode and adjusting parameters.
9. Selecting motor thermal-overload protection class between 5 and 30.
10. Activating and deactivating protection modes.
11. Selecting or activating communications modes.

J. Digital Display: Front accessible; for showing motor, controller, and fault status; shall be manufacturer's standard and include not less than the following:

1. Controller Condition: Ready, starting, running, stopping.
2. Motor Condition: Amperes, voltage, power factor, power, and thermal state.
3. Fault Conditions: Controller thermal fault, motor overload alarm and trip, motor underload, overcurrent, shorted SCRs, line or phase loss, phase reversal, and line frequency over or under normal.

K. Controller Diagnostics and Protection:

1. Microprocessor-based thermal protection system for monitoring SCR and motor thermal characteristics, and providing controller overtemperature and motor overload alarm and trip; settings selectable via the keypad.

2. Protection from line-side reverse phasing; line-side and motor-side phase loss; motor jam, stall, and underload conditions; and line frequency excursions to over- or under-normal. Accomplish protection by the following:

    a. Input isolation contactor that opens when the controller diagnostics detect a faulted solid-state component, or when the motor is stopped.
    b. Shunt trip that opens the disconnecting means when the controller diagnostics detect a faulted solid-state component.

L. Remote Output Features:

1. All outputs prewired to terminal blocks.
2.
3. Form C status contacts that change state when controller is running.
4. Form C alarm contacts that change state when a fault condition occurs.

M. Overload Relays:

1. Solid-State Overload Relays:

    a. Switch or dial selectable for motor-running overload protection.
    b. Sensors in each phase.
    c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    d. UL 1053, Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

N. Optional Features:

1. Output Signal Interface: A minimum of two programmable analog output signal(s) for field-selectable assignment of motor operating characteristics; 4- to 20-mA dc, which can be configured for any of the following:

    a. Output current (load)
    b. Power (kW)
    c. Power Consumption (kWh)
    d. Power factor, .

2. Two additional field-assignable Form C contacts for alarm outputs.
3. Full-voltage/BYPASS selector switch. Power contacts shall be totally enclosed, double break, made of silver-cadmium oxide, and assembled to allow inspection and replacement without disturbing line or load wiring.

2.10 CONTROLLER-MOUNTED AUXILIARY DEVICES

A. Control-Circuit and Pilot Devices: Factory installed in controller enclosure cover unless otherwise indicated. Comply with NEMA ICS 5.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oil-tight type.

a. Push Buttons: Unguarded types; momentary contact unless otherwise indicated.
b. Pilot Lights: LED types; push to test.
c. Selector Switches: Rotary type.

B. Elapsed-Time Meters: Heavy duty with digital readout in hours; non-resettable.

C. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus 2 percent accuracy, with selector switches having an off position.

D. Auxiliary Dry Contacts: Reversible NC/NO.

E. Control Relays:

1. Time Delay: Auxiliary and adjustable solid-state time-delay relays.
2. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections and adjustable undervoltage, overvoltage, and time-delay settings.

2.11 MEASUREMENT AND CONTROL DEVICES

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. PTs: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. CPTs: Dry type, mounted in separate compartments for units larger than 3 kVA.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Listed or recognized by a nationally recognized testing laboratory.
2. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
3. Switch-selectable digital display of the following values with the indicated maximum accuracy tolerances:

a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
d. Three-Phase Real Power (Megawatts): Plus or minus 2 percent.
e. Three-Phase Reactive Power (Megavars): Plus or minus 2 percent.
f. Power Factor: Plus or minus 2 percent.
g. Frequency: Plus or minus 0.5 percent.
h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.

4. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.
5. Data Link: Ethernet connectivity; TCP/IP protocol.

C. Control Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

D. Motor Protection Relays:

1. Programmable motor protection relays: Solid state, panel mounted, Eaton MP-3000; General Electric Multilin , or equal, furnished complete with potential and current transformers, zero sequence ground fault transformer and RTD input module.
2. Provide the following protective functions:

    a. Motor thermal overload, with thermal lockout to prevent trip reset after an overload trip.
    b. Ground fault protection.
    c. Phase current heating model to calculate motor thermal capacity during starting and running states.
    d. Independent running protection during acceleration.
    e. Phase and residual overcurrent elements.
    f. Unbalance/single phase.
    g. Load-loss (undercurrent).
    h. Rapid trip/mechanical jam.
    i. Motor locked/stall protection.

3. Over-temperature protection: provide configurable thermistor or RTD inputs, including alarm and trip settings, and associated TRIP or ALARM outputs. The following functionality shall be provided:

    a. PTC or NTC Thermistor input.
    b. Assign RTD input as "Off", "Stator" or "Bearing" type.
    c. Four different RTD types: 100 Ohm Platinum, 120 Ohm Nickel, 100 Ohm Nickel, or 10 Ohm Copper.
    d. RTD sensor fail alarm.

4. Provide monitoring and metering functions:

    a. Current: RMS Values of per Phase, Percent of Motor Load, Current Unbalance, Ground.
    b. Temperature of each RTD and/or thermistor input.
    c. Provide data in the form of trending or data logger, sampling and recording up to eight actual values at an interval defined by the user. Several parameters shall be trended and graphed at sampling periods ranging from 1 second up to 1 hour. The parameters which can be trended by the Setup software shall be: Phase Currents A, B, and C, Motor Load, Current Unbalance, Ground Current, and Thermal Capacity Used.
    d. The relay shall include one transducer output with a settable DC output range of 0 to 20 mA, 4 to 20 mA or 0 to 1 mA, which may be assigned to motor load, average phase current, thermal capacity, and any of the three optional RTDs.
    e. Latest trip report containing cause, phase, ground, current unbalance, and RTD temperatures.

f. An immediate Overload Alarm feature shall be provided as an early alert during overload conditions.
g. The relays shall retain in non-volatile memory, a trip record of the last 5 causes of trip.
h. The relay shall monitor total motor running time (including start conditions) and the maximum average current present during the last successful start.
i. The relay shall have starter failure detection feature which shall produce an alarm in the event that the motor relay does not detect a starter/breaker open condition after a trip is initiated.
j. The relay shall have the capability to display up to 5 user programmable messages to scan sequentially when the motor relay is left unattended. The user shall be able to select from any setpoint or actual value message to be added to the default message queue. Under normal conditions, if no front panel activity is detected within a settable time, the screen shall sequentially display messages.

5. User Interfaces: Include the following:

a. A large 40-character LCD display, and navigation keys.
b. Indicator LEDs on the front panel which shall provide a quick visual indication of status.
c. Serial communication: two wire RS485 link operating at 1200 – 19200 bps. Open protocol, ModBus RTU for read/write commands shall be included in the relay instruction manual.
d. Five switch inputs shall be provided for setpoint access, emergency restart, external reset, and two user programmable option switches.
e. The relay shall accept AC/DC control power.
f. The relay shall be capable of being set by Windows-based, easy to use, setup graphical terminal interface.

6. To make the data acquisition more efficient, the motor relay shall provide a User Definable Memory Map, which shall allow a remote computer to read up to 120 nonconsecutive data registers by using one Modbus packet. The User Definable Memory Map shall be programmed to join any memory map address to one in the block of consecutive User Map locations, so that they can be accessed by means of these consecutive locations. The User Definable area shall have two sections:

a. A register index area containing 120 actual values or setpoints registers.
b. A Register area containing the data located at the addresses in the Register Index.
c. A simulation feature shall be included to allow testing without the need for external current inputs.

2.12 FEEDER TAP UNITS

A. MCCBs (to 1200 A): Fixed mounted, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger. Comply with UL 489, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

1. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

3. With built-in digital ammeter and a digital display, showing tripping cause.
4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.13 PANELBOARDS

A. Comply with NEMA PB 1.

B. Branch OCPDs for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in or Bolt-on circuit breakers.

C. Branch OCPDs for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

D. Accessory Control Power Voltage: Integrally mounted, self-powered,.

2.14 TRANSFORMERS

A. Factory-assembled and -tested, air-cooled, two-winding, low-voltage dry-type transformers; with primary circuit breaker. Comply with NEMA ST 20.

B. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

C. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 degrees C rise above 40 degrees C ambient temperature.

D. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

2.15 SOURCE QUALITY CONTROL

A. MCC Testing: Test and inspect MCCs according to requirements in NEMA ICS 18.

B. MCCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive MCCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. NEMA Industrial Control and Systems Standards: Comply with parts of NEMA ICS 2.3 for installation and startup of MCCs.

B. Floor Mounting: Install MCCs on 4-inch nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in control circuits if not factory installed.

E. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

G. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification of MCC, MCC components, and control wiring.

1. Identify field-installed conductors, interconnecting wiring, and components.
2. Install required warning signs.
3. Label MCC and each cubicle with engraved nameplate.
4. Label each enclosure-mounted control and pilot device.

5. Mark up a set of manufacturer's connection wiring diagrams with field-assigned wiring identifications and return to manufacturer for inclusion in Record Drawings.

B. Operating Instructions: Frame printed operating instructions for MCCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of MCCs.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches within enclosed controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 CONNECTIONS

A. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multipole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multipole enclosed controller 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Submit calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
6. Mark up a set of manufacturer's drawings with all field modifications incorporated during construction and return to manufacturer for inclusion in Record Drawings.

D. MCCs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to NETA Acceptance Testing Specification and manufacturer's written instructions.

3.8 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload relay pickup and trip ranges.

B. Adjust overload relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.

D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage, solid-state controllers.

E. Program microprocessors in VFCs for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage, solid-state controllers.

END OF SECTION 262419

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SECTION 262505 – 480V CONTROL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes industrial control panels with the following features:
   1. Enclosure.
   2. Main circuit breaker.
   3. Motor controllers.
   4. Control and monitoring devices.
   5. Accessories.
   6. Identification.

B. Related Requirements:

   1. Division 26 for electrical work
   2. Section 262923 – Variable-Frequency Drives for variable-frequency drive requirements.
   3. Division 27 for communications wiring
   4. Division 40 for process automation requirements

1.3 DEFINITIONS

A. CPT: Control power transformer

B. GFCI: Ground-fault circuit interrupter

C. MCCB: Molded-case circuit breaker

D. MCP: Motor circuit protector

E. NEC: National Electrical Code

F. RVSS: Reduced voltage soft start

G. RVAT: Reduced voltage autotransformer start

H. SCCR: Short-circuit current rating

I. SPD: Surge protective device

J. UL: Underwriter’s Laboratories

K. VFC: Variable frequency motor controller. See VFD

L. VFD: Variable frequency drive. Used interchangeably with the term VFC.

1.4 ACTION SUBMITTALS

A. Product Data: For each control panel.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each control panel.

1. Include dimensioned plans, elevations, sections, and details.
2. Bill of materials with part numbers, cross-referenced to plans.
3. Nameplate schedule.
4. Conduit entrance locations and mounting details.
5. Power and control schematics.
6. Certification for compliance with UL 508A.
7. Identification per NEC 409.110.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, from manufacturer.

B. Startup reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include the following if applicable:

1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
2. Manufacturer's written instructions for setting field-adjustable overload relays.
3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
5. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
6. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Control fuses: Equal to 10 percent of total quantity installed for each size and type, but no fewer than two of each size and type.
2. Power fuses: Equal to 10 percent of total quantity installed for each size and type, but no fewer than three of each size and type.
3. Corrosion Inhibitor: Equal to 100 percent of total number of control panels. (One spare per panel.)

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store control panels indoors in clean, dry space with uniform temperature to prevent condensation. Protect control panels from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.10 FIELD CONDITIONS

A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace control panels that fail in materials or workmanship within specified warranty period.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for control panels clearances between control panels and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. Comply with NEMA ICS 6: Industrial Control and Systems: Enclosures.

E. Comply with UL 1203 for control panels located in hazardous (classified) locations.

F. Comply with NFPA 70.

G. Comply with UL 508A.

H. Complete and fully functional control to manually or automatically operate the control system as specified herein and in other applicable sections of these specifications. Include manufacturer’s recommended safety devices to protect operators. All control devices, unless specified otherwise, mounted in the Control Panel.

I. The control panel shall operate on a power supply of 480 volts, 3-phase, 60 hertz unless otherwise noted.

J. Control panel consists of a main circuit breaker, motor circuit protector (MCP) and motor controller for each motor, and a 120-volt control power transformer (fused on primary and secondary) along with other devices specified. Mount all control components in one common enclosure.

K. Operation of motors will be manually or automatically. Stager control of multiple motors to prevent simultaneous motor starting.

L. All electronic control equipment (i.e. controllers, isolators, signal boosters, transmitters, PLC's, etc.) shall be as specified in Division 40.

M. Control panels containing PLC’s shall contain UPS or battery ride-through for the PLC in accordance with Division 40 specifications.

N. SCCR: Control panels with main breakers of 125 amps or less shall have SCCR of 35kA, unless specifically noted elsewhere.

2.2 ENCLOSURES

A. Indoor Enclosures: Surface-mounted, steel cabinets unless otherwise indicated. NEMA 250, Type 1A gasketed unless otherwise indicated to comply with environmental conditions at installed location.

B. Enclosures: Surface-mounted, dead-front cabinets rated for environmental conditions at installed location. Unless noted elsewhere, NEMA rating shall be NEMA 4X, Type 316 stainless steel, minimum 14 gauge.

C. Construction: The door shall be mounted via continuous stainless steel hinged and provided with a pad-lockable vault type 3-point latch. The enclosure shall be equipped with a door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Door(s) shall be interlocked with main circuit breaker and provided with pad-locking provision.

D. All motor branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

E. Operating handle for main circuit breaker: flange mounted.

F. Outdoor enclosures shall be provided with sun shields. Install sun shields on fronts, sides, and tops of enclosures subject to direct and extended sun exposure.

G. Provide additional temperature control if required to meet UL temperature rating of internal components. If forced air ventilation is required, the enclosure shall be pressurized. Air filters shall be of commercially available types and sizes.

H. All operating control and instruments shall be securely mounted on the exterior door. All controls and instruments shall be clearly labeled to indicate function. All exterior mounted equipment shall be NEMA 4X.

I. Print storage pockets shall be provided on the inside of each panel. Pocket shall be of sufficient size as required to hold all prints necessary to service the equipment.

2.3 COMPONENTS

A. Main Breaker: Thermal-magnetic air circuit breaker, Schneider Electric/Square D PowerPact Type BG (125 amp frame, 35kAIC) or equal.

B. MCP: Molded case motor circuit protector with adjustable magnetic trip only, Schneider Electric/Square D “Mag-Gard” or equal.

C. Motor Controller:

1. Full Voltage Motor Starting: Open frame, across-the-line, NEMA-rated magnetic motor starter, Schneider Electric/Square D Class 8536 or equal. Solid state overloads with Class 10/20 selectable tripping. Submersible motors shall use Class 10 trip curve.
2. Reduced voltage motor starting: VFD.

D. Overload relays shall be self-powered solid-state type and provide the following features: tamper guard over trip adjustment setting, ambient insensitive, harmonic immunity, phase loss and phase unbalance protection, manual reset, and push-to-test.

E. Overload reset buttons shall be mounted on dead front door.

F. Normally open and normally closed auxiliary motor overload contacts wired to terminal blocks shall be provided for each motor starter within the control panel.

G. SPD: The control panel shall be provided with a surge protective device (SPD) rated for 100kA per mode for the incoming power. SPD shall be mounted within the control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker.

H. Control Power Transformer: 480-120V CPT, fused on primary and secondary sides, capacity as required.

2.4 CONTROL DEVICES AND ACCESSORIES

A. Control Operators and Indictors:

1. Heavy duty type, full size (30.5mm), NEMA 4X or 7 as required.
2. Each motor shall include Hand-Off-Auto selector switches to permit override of automatic control and manual actuation of shutdown.

B. Indicating Lights:

1. LED, full size (30.5mm), full voltage and push-to-test type.
2. Indicators shall be provided for individual motor run and an indicator for each failure condition.

C. Elapsed Time Meters (ETM):

1. Six (6) digit, non-reset elapsed time meter to indicate the total running time of each motor in "hours" and "tenth of hours". Series T50 as manufactured by the ENM Company or equal.
2. Provide an ETM for each motor.

D. Failure Alarm Horn and Beacon Light:

1. Alarm horn: weatherproof rated with gasket (Federal Signal Corporation, Cat. #350 or equal) for NEMA 4X applications.
2. Alarm beacon: Red lens and solid-state flasher (Ingam Products Inc. LRX-40 or equal) for NEMA 4X applications.
3. All lift station pump control panels shall include alarm horn and light for summary alarm condition.
4. Silence and reset pushbuttons shall also be furnished. A common failure reset pushbutton shall be provided to reset the alarm conditions (reset shall occur only if fault condition has been cleared).

E. Relays:

1. Control relays shall be 10 amp rated contacts (minimum), 11 pin with mounting base, 3PDT (minimum), with LED indicators to show relay status, relays shall be manufactured by Potter Brumfield or equal.

2. Timing relays shall be solid state, with pin (octal) and bases, relays shall be T-series as manufactured by Diversified Electronics Inc. or equal.
3. Intrinsically safe relays shall be solid state type with 5 amp output contacts, suitable for use on 120 volt, 60 hertz power supply and shall be Factory Mutual approved for devices in Class 1, Division 1 hazardous atmospheres. Intrinsically safe relays shall be Gems Solid State Safe-Pak as manufactured by Gems Sensors, Division of Transamerica Delaval, Inc. or equal.

F. A duplex GFCI utility receptacle (circuit breaker protected) providing 120 volts, 60 Hertz, single phase current shall be mounted on the side of the enclosure.

G. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by Divisions 40, 26 and as shown on the Drawings.

H. Alternators shall be provided to sequence lead/lag motors, alternators shall be 008-120-13SP or 009-120-23AP as manufactured by Sta-con, or equal.

I. A phase monitor shall be provided for the control panel, monitors shall be model SUA-440-ASA as manufactured by Diversified Electronics Inc., or equal.

J. Corrosion Inhibitor Emitter: Inclusion of an industrial corrosion inhibitor emitter, selected by the manufacturer, to protect internal components of control panel from corrosion for up to one year.

K. Space heaters, with NC auxiliary contacts, to mitigate condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

2.5 WIRING

A. Power and control wire shall be 600 Volt class, Type MTW insulated stranded copper and shall be of the sizes required for the current to be carried, but not smaller than No. 14 AWG. All wiring shall be enclosed in PVC wire trough with slotted side openings and removable cover.

B. Wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600 Volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.

C. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks.

D. Terminal blocks shall be 600 Volt heavy duty rated, tubular clamp type. Terminal strips shall be Allen Bradley catalog #1492-CA-1 or equal.

E. A copper ground bar with sufficient terminals for all field and panel ground connections shall be provided.

F. All signal wiring entering and exiting the control panel shall be provided with surge protection. Surge protection shall be as specified in Division 40.

G. An 8-inch (minimum) clear space within the enclosure shall be provided horizontally along the entire top and bottom of the control panel. A 4-inch (minimum) clear space within the enclosure

shall be provided vertically along the entire sides of the control panel. No devices, terminals, etc. shall be installed within this space, the space shall be provided for field conduit and wiring access only.

2.6 IDENTIFICATION

A. All control panel wiring shall be numbered at both ends with type written heat shrinkable wire markers.

B. The control diagrams and overload tables shall be laminated to the inside of the door except where door space is limited the laminated documents shall be in the print storage pocket.

C. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process (inner door nameplates shall be fastened with stainless steel screws). Nameplates shall be laminated plastic, engraved black letters with a white background.

D. All control panels shall be provided with two nameplates located on the exterior door. The first nameplate shall identify the control panel name. The second nameplate shall identify the power source.

E. Where applicable provide a nameplate which reads as follows "CAUTION - THIS PANEL CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE." Letters shall be black on a high visibility yellow background.

F. Each terminal at terminal blocks shall be individually labeled.

G. Incoming phase conductor terminals shall be clearly identified. All wiring within the control panel shall be color coded or coded using electrical tape in sizes where colored insulation is not available. The following coding shall be used.

System	**Wire**	**Color**
Incoming line voltage	Phase conductors	Black
	Ground	Green
	Neutral (as required)	Gray
Internal control voltage	AC	Red
Internal control voltage	DC	Blue
External source	All	Yellow

2.7 FACTORY TESTS

A. Inspect and test control panel for correct operation. Test each circuit for continuity, short circuits, and ground faults.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Inspect anchorage, alignment, grounding, and clearances.

C. Compare equipment nameplate data for compliance with Drawings and Specifications.

D. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

E. Motor Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

F. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 STARTUP SERVICE

A. Complete startup checks according to manufacturer’s written instructions.

B. Verify motor running protection is appropriate for actual motors installed.

C. Test control panel with all field wiring connected. Set adjustable set points and time delays for proper operation of equipment. Adjust as required.

D. Perform infrared inspection of panel interior during periods of maximum possible loading. Remove all necessary covers prior to the inspection. Comply with the recommendations of NFPA 70B, "Testing and Test Methods" Chapter, "Infrared Inspection" Article.

E. Prepare test and inspection reports.

F. Install a set of legible “as built” control panel drawings (11x17 or 8.5 x 11), in the storage pocket.

3.3 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION 2625050

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes receptacles, toggle switches, cover plates, and cord and plug sets.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on project. Note this Section may include products not required for the project.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with the following standards and UL Category Control Number (CCN) listing criteria as applicable:

1. UL 20, Standard for General-Use Snap Switches, CCN WMUZ.
2. UL 498, Standard for Attachment Plugs and Receptacles, CCN RTRT.
3. UL 894, Standard for Safety Switches for Use in Hazardous (Classified) Locations.
4. UL 943, Standard for Ground-Fault Circuit-Interrupters (Class A), CCN KCXS.
5. UL 1010, Standard for Safety Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
6. ANSI/NEMA WD 6 for dimensional requirements for receptacles and plugs rated up to 60A and 600V.
7. NEMA WD 1 for colors.
8. Federal Specifications:

    a. FS W-S-896 for switches.
    b. FS W-C-596 for receptacles.

C. Device Color:

1. White: Devices located in administrative office areas, conference rooms, break rooms, restrooms, and control rooms.
2. Gray: Devices located in electrical rooms, mechanical rooms, process areas, and outdoors.

D. Wall Plate Color: For non-metallic covers, match device color.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 INDUSTRIAL SPECIFICATION GRADE RECEPTACLES, 125V, 20A

A. Duplex Receptacles, 125V, 20A

1. Manufacturers or equal:

    a. Arrow-Hart (Eaton), 5362 Series.
    b. Hubbell, 5362 Series.
    c. Leviton, 5362 Series.

2. Description: Heavy duty, industrial, specification grade, two-pole, three-wire, and self-grounding, NEMA 5-20R.

B. Duplex Weather-Resistant Receptacles, 120V, 20A. Drawing Designation: WP.
1. Hubbell, HBL5362WR Series or equal.
2. Description: Heavy duty, industrial, specification grade, weather-resistant, two-pole, three-wire, and self-grounding, NEMA 5-20R.

C. Duplex GFCI Receptacles, 125V, 20A. Drawing Designations GFCI.

1. Manufacturers or equal:

a. Hubbell GF5362SG Series.
b. Arrow-Hart (Eaton) TWRSGF20 Series.
c. Leviton GFTR2-3L Series.

2. Description: Extra heavy duty, industrial, specification grade, tamper-resistant, weather resistant, ground-fault circuit-interrupter receptacle, two-pole, three-wire, and self-grounding, NEMA 5-20R. Integral GFCI with “Test” and “Reset” buttons. Three LED indicators: power solid green, GF/trip solid red, ending of life flashing red.

2.3 HAZARDOUS (CLASSIFIED) LOCATION DEVICES

A. Hazardous (Classified) Locations Receptacles and Switches. Drawing Designation: XP.

1. Enclosure Rating: NEC Hazardous Area Class I, Divisions 1 and 2, Groups C and D (NEMA 7) and wet locations.
2. Receptacle Description: Explosion-proof factory sealed, pin and sleeve receptacle, 20A, for use at 125 or 250V, two wire, 3 pole. Complete with cast box and matching plug. Appleton Contender CPS152 Series with matching cover and CPP plug or equivalent by Crouse-Hinds. With optional GFCI if noted on Drawing.
3. Switch Description: Explosion-proof factory sealed, control station switch, 20A, for use at 120/277V, single pole. Complete with cast box. Appleton Contender EDS Series or equivalent by Crouse-Hinds.

2.4 INDUSTRIAL SPECIFICATION GRADE TOGGLE SWITCHES, 120/277V, 20A

A. Manufacturers as listed below or equal.

1. Arrow-Hart (Eaton), 1220 Series.
2. Hubbell, HBL1220 Series.
3. Leviton, 1220 Series.

B. Description: Extra heavy duty, industrial, specification grade, switch, 120/277V, 20A, toggle action, flush mounting, quiet type. Single pole, double pole, three-way, or four-way, as indicated on Drawings.

2.5 WALL PLATES

A. Match gang configuration as indicated on Drawings.

B. Obtain wall plates from same manufacturer as wiring device.

C. Plate-Securing Screws: Metal with head color to match plate finish.

D. Material for administrative offices, conference rooms, break rooms, restrooms, and control rooms: Smooth, high impact thermoplastic or nylon.

E. Material for flush mounted devices in electrical rooms, mechanical rooms, and indoor process areas: Type 302 (18-8) high nickel stainless steel.

F. Material for surface mounted device plates: Same material as box.

G. WP Receptacle Cover Plates: In-use weather-resistant, heavy duty die-cast aluminum with lockable cover.

H. WP Switch Cover Plates: Weatherproof switch cover, listed to UL514D, non-metallic UV-resistant, operable without opening cover, lockable. Arrow-Hart (Eaton) S2983 or equal.

2.6 CORD AND PLUG SETS

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices in accordance with NFPA 70, manufacturer's instructions, and listing for each device.

B. Install switch and receptacle outlets flush with finished wall for new wall construction and where existing wall is stud and sheetrock construction.

C. Drawings show the general location of devices unless dimensioned. Adjust and coordinate location to avoid piping or other obstructions.

D. Use of one GFCI receptacle to protect downstream conventional receptacles is prohibited.

E. Device Mounting Heights (as measured to the center of the device box):

1. Switches and occupancy sensors: 48 inches AFF, located on strike side of door.
2. Wall receptacles, unless otherwise noted on Drawings:

    a. Process areas and shops: 36 inches AFF.
    b. Administration office areas: 18 inches AFF.
    c. Corridors and hallways: 18 inches AFF.
    d. Electrical and mechanical rooms: 18 inches AFF.
    e. Restrooms: 18 inches AFF.
    f. Above counters: 8 inches above countertop or at backsplash level.
    g. Exterior walls: 24 inches AFG.

3. Where walls are unplastered brick or masonry, adjust mounting height above so one horizontal edge of device box lines up with a horizontal joint in the masonry.

F. Device Boxes:

1. Install correct size and type box for the device(s) and location, allowing for adequate space for conductors, connectors, clamps, devices, and barriers, where required.
2. Install boxes level, plumb, and secure. Do not install boxes back-to-back in walls.

G. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install wiring devices after all wall preparation, including painting, is complete.

H. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. Provide adequate length of free conductors at boxes for devices without pigtails. Pigtailing existing conductors is permitted, provided the box is large enough.

I. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Make equipment grounding conductor connections and splices so removal or disconnection of any wiring devices does not interrupt continuity of the branch circuit equipment grounding conductor.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw. Do not overlap conductors.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. Tighten unused terminal screws on the device.
8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

J. Orientation and Arrangement:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

2. Group adjacent switches under single, multi-gang wall plates.

K. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

3.2 IDENTIFICATION

A. Label receptacles and switches with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

B. Label receptacles that are non-GFCI type but GFCI protected, such as from a GFCI circuit breaker, with a label “GFCI Protected”.

3.3 FIELD QUALITY CONTROL

A. Verify correct operation of GFCI receptacles using GFCI tester.

B. Verify correct voltage and phasing at receptacles.
1. Use receptacle circuit tester for NEMA 5-20R receptacles. Use voltmeter for other receptacles.
2. Use phase sequence meter for three phase receptacles.

C. Correct deficiencies found and reverify.

D. Prepare field quality report certifying verification of correct installation.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Molded-case switches.
5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.

2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 degrees F and not exceeding 104 degrees F.
2. Altitude: Not exceeding 6600 feet.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by UL or a NRTL if approved by the Owner and/or Engineer, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.

4. 200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. NEMA Type 7/9, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, UL 1203, NEMA 7BCD, 9EFG, rated for Class I, Division 2 locations, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Auxiliary Contact Kit for disconnects with upstream VFD: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. .

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for 167 degrees F rated wire.

G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be gray baked enamel paint or Owner approved color and paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1), gray baked enamel paint or Owner approved color and paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12), a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X 316 stainless steel if approved by Owner and Engineer), or copper-free cast aluminum alloy (NEMA 250 Types 7, 9).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover externally operable with the operating mechanism being an integral part of the cover (NEMA 250 Types 7, 9). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X 316 stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, As indicated on the Drawings.
3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 with cover attached by Type 316 stainless steel bolts.

3.3 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.

j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare an Initial and
5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 263213.13 - DIESEL EMERGENCY ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes packaged diesel engine generators for emergency use with the following features:

1. Diesel engine.
2. Diesel fuel-oil system.
3. Control and monitoring.
4. Generator overcurrent and fault protection.
5. Generator, exciter, and voltage regulator.
6. Outdoor engine generator enclosure.
7. Vibration isolation devices.
8. Finishes.

B. Related Requirements:
1. Section 262300 "Low-Voltage Switchgear" for controls, including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.3 DEFINITIONS

A. EPS: Emergency power supply.

B. EPSS: Emergency power supply system.

C. Operational Bandwidth: The total variation, from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.

4. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include airflow requirements for cooling and combustion air in cubic feet per minute at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F. Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.
8. Sound test data, based on a free field requirement.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.
7. Include design loading calculations to support the recommended size of the engine generator based upon actual facility loads and specified maximum allowable voltage drop. Provide detailed sizing analysis. Clearly identify assumptions made for the loads being started/operated by the generator. When conducting the generator sizing analysis, set the maximum voltage drop of the generator to a maximum of 20 percent. The generator manufacturer and Contractor shall be responsible for obtaining all information to run the generator sizing analysis. Notify Engineer of any changes to the generator size. Submit the sizing analysis with the generator's initial submittal.

C. Submit a copy of this specification confirming compliance with each paragraph. For deviations, provide detailed commentary to explain the deviation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Source Quality-Control Reports: Including, but not limited to, the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.

4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

C. Field quality-control reports.

D. Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For engine generators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
b. Operating instructions laminated and mounted adjacent to generator location.
c. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
4. Tools: Each tool listed by part number in operations and maintenance manual.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Caterpillar Inc.
2. Cummins Power Generation.
3. Kohler Power Systems.

B. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. B11 Compliance: Comply with B11.19.

B. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.
3. Comply with NFPA 99.
4. Comply with NFPA 110 requirements for Level 2 EPSS.

C. UL Compliance: Comply with UL 2200.

D. Engine Exhaust Emissions: Comply with EPA Tier 2 requirements and applicable state and local government requirements.

E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator, including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 104 deg F.
2. Altitude: Sea level to 1000 feet.

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. EPSS Class: Engine generator shall be classified as a Class 24 according to NFPA 110.

D. Power Output Ratings: Not less than as shown on the Drawings.

E. Power Factor: 0.8, lagging.

F. Frequency: 60 Hz

G. Voltage: 480 V ac.

H. Phase: Three-phase, three four-wire wye.

I. Induction Method: Turbocharged.

J. Governor: Adjustable isochronous, with speed sensing.

K. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.

L. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

M. Engine Generator Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage, from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency, from no load to full load.

5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content, measured line to neutral, shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

    a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 60, system requirements.

2.4 DIESEL ENGINE

A. Fuel: ASTM D 975 diesel fuel oil, Grade 2-D S15.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: Engine or skid mounted.

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and with UL 499.

E. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant, from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant-system pressure for engine used. Equip with gage glass and petcock.

4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.

    a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

F. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 23 feet from exhaust discharge after installation is complete shall be 75 dBA or less.

G. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

H. Starting System: 24 V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle, with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
f. Enclosure and Mounting: NEMA 250, Type 1 wall-mounted cabinet.

2.5 DIESEL FUEL-OIL SYSTEM

A. Comply with NFPA 30.

B. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.

C. Fuel Filtering: Remove water and contaminants larger than 1 micron.

D. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

E. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:

1. Tank level indicator.
2. Fuel-Tank Capacity: Fuel for 24 hour(s) continuous operation at 100 percent rated power output.
3. Leak detection in interstitial space.
4. Vandal-resistant fill cap.
5. Tank rails and lifting eye rated for the full dry weight of the tank, genset, and enclosure.
6. Electrical stub up(s).
7. Subbase tank shall include a welded steel containment basin, sized at a minimum of 110 percent of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.
8. Normal and emergency vents.
9. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.6 CONTROL AND MONITORING

A. Automatic-Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

B. Manual-Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts engine generator. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

C. Provide minimum run time control set for 30 minutes, with override only by operation of a remote emergency-stop switch.

D. Comply with UL 508A.

E. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator-disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel shall be powered from the engine generator battery. Panel features shall include the following:

1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6.

F. Control and Monitoring Panel:

1. Digital controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
2. Instruments: Located on the control and monitoring panel and viewable during operation.

a. Engine lubricating-oil pressure gage.
b. Engine-coolant temperature gage.
c. DC voltmeter (alternator battery charging).
d. Running-time meter.
e. AC voltmeter, for each phase.
f. AC ammeter, for each phase.
g. AC frequency meter.
h. AC kW output, total and for each phase (indicate power flow direction).
i. AC kVA output, total and for each phase (indicate power flow direction).
j. AC kVAR output, total and for each phase.
k. AC power factor, total and for each phase (indicate leading or lagging condition).
l. Generator duty level (actual kW loading divided by kW nameplate).
m. Generator-voltage-adjusting rheostat.

3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication as required by NFPA 110 for Level 2 system, including the following:

a. Cranking control equipment.
b. Run-Off-Auto switch.
c. Control switch not in automatic position alarm.
d. Overcrank alarm.
e. Overcrank shutdown device.
f. Low water temperature alarm.
g. High engine temperature pre-alarm.
h. High engine temperature.
i. High engine temperature shutdown device.

j. Overspeed alarm.
k. Overspeed shutdown device.
l. Low-fuel main tank.

1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for the duration required for the indicated EPSS class.

m. Coolant low-level alarm.
n. Coolant low-level shutdown device.
o. Coolant high-temperature prealarm.
p. Coolant high-temperature alarm.
q. Coolant low-temperature alarm.
r. Coolant high-temperature shutdown device.
s. EPS load indicator.
t. Battery high-voltage alarm.
u. Low-cranking voltage alarm.
v. Battery-charger malfunction alarm.
w. Battery low-voltage alarm.
x. Lamp test.
y. Contacts for local and remote common alarm.
z. Generator overcurrent-protective-device not-closed alarm.

G. Connection to Datalink:

1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication as follows:
   a. Ready.
   b. Running.

   c. Fault.

   d. Fuel Low Level
2. Provide connections for datalink transmission of indications to remote data terminals via Ethernet TCP/IP.

H. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.

I. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.

1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other engine generator protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other engine generator malfunction alarms. Contacts shall be available for load shed functions.
2. Under single- or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.

1. Indicate ground fault with other engine generator alarm indications.
2. Trip generator protective device on ground fault.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H (105 degree C).

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide six-lead alternator.

E. Range: Provide limited range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Dripproof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.

1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
2. Maintain voltage within 20 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.
4. Maintain frequency within 15 percent and stabilize at rated frequency within five seconds.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Subtransient Reactance: 12 percent, maximum.

2.9 OUTDOOR ENGINE GENERATOR ENCLOSURE

A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 75 dBA measured at any location 23 ft from the engine generator in a free field environment.

C. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads as follow:
1. Wind Rating:
   a. Ultimate Wind Speed, V_{ult}: 120 mph
   b. Nominal Wind Speed, V_{nom}: 93 mph

D. Mounting Base: Suitable for mounting on sub-base fuel tank.

E. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to keep door open at 180 degrees during maintenance. Rain lips over all doors.

F. Hardware: Stainless steel latches, hinges, and hardware.

G. Space Heater: Thermostatically controlled and sized to prevent condensation.

H. Provide a factory mounted and wired Transformer Load Center to serve the generator set and enclosure.
1. Product Description: NEMA ST 20, transformer distribution unit with integral primary, secondary and branch circuit breakers.
2. KVA Rating: 15 kVA.

3. Primary Voltage: 480V, 3 phase, 3 wire.
4. Secondary Voltage: 208Y/120V, 3 phase, 4 wire.
5. Coil material: Copper.
6. Encapsulation: Transformer core and coils completely resin encapsulated.
7. Molded Case Circuit Breakers: UL 489, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for poles, Class A ground fault interrupter circuit breaker where indicated. Do not use tandem circuit breakers.
8. Enclosure: NEMA ST 20, Type 1. Suitable for the environment in which the transformer is installed. Furnish lifting eyes or brackets.

I. Convenience Outlets: Two factory-wired 20A, 125 VAC, GFCI-protected duplex receptacles.

J. Lighting with switch: Provide factory-wired, weather-resistant LED lighting with 30-fc average maintained. Arrange to illuminate controls and accessible interior.

K. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

L. Insulation Flammability Classification: UL 94 HF1.

M. Muffler Location: Within enclosure.

N. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.
1. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

O. Interior Lights with Switch: Factory-wired, vapor-proof luminaires within housing; arranged to illuminate controls and accessible interior.

P.

2.10 VIBRATION ISOLATION DEVICES

A. Vibration Isolation: Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation..

B. IBC Compliance: Isolators complying with IBC requirements shall be specified in the equipment documentation, as well as the installation requirements for the unit.

C. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Test generator, exciter, and voltage regulator as a unit.
3. Full-load run.
4. Maximum power.
5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
10. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than seven working days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

3.3 INSTALLATION

A. Comply with NECA 1 and NECA 404.

B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.

C. Equipment Mounting:

1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
3. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch on 4-inch- high concrete base. Secure enclosure to anchor bolts installed in concrete bases. Concrete base construction is specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

E. Exhaust System: Install Schedule 40 black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.
1. Install flexible connectors and steel piping materials.
2. Insulate muffler/silencer and exhaust system components.
3. Install isolating thimbles where exhaust piping penetrates combustible surfaces with a minimum of 9 inches of clearance from combustibles.

F. Drain Piping: Install condensate drain piping to muffler drain outlet with a shutoff valve, stainless-steel flexible connector, and Schedule 40 black steel pipe with welded joints.

G. Fuel Piping:
1. Copper and galvanized steel shall not be used in the fuel-oil piping system.

H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow space for service and maintenance.

C. Connect cooling-system water piping to engine generator and [with flexible connectors.

D. Connect engine exhaust pipe to engine with flexible connector.

E. Connect fuel piping to engines with a gate valve and union and flexible connector.

F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.

H. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.5 IDENTIFICATION

A. Identify system components according to Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Tests and Inspections:

1. Perform tests recommended by manufacturer and in "Visual and Mechanical Inspection" and "Electrical and Mechanical Tests" subparagraphs below, as specified in the NETA ATS. Certify compliance with test parameters.

    a. Visual and Mechanical Inspection:

        1) Compare equipment nameplate data with Drawings and the Specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment, and grounding.
        4) Verify that the unit is clean.

    b. Electrical and Mechanical Tests:

        1) Perform insulation-resistance tests according to IEEE 43.

            a) Machines Larger Than 200 hp: Test duration shall be 10 minutes. Calculate polarization index.
            b) Machines 200 hp or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.

        2) Test protective relay devices.
        3) Verify phase rotation, phasing, and synchronized operation as required by the application.
        4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
        5) Perform vibration test for each main bearing cap.

6) Conduct performance test according to NFPA 110.
7) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise-Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet from edge of the generator enclosure, and compare measured levels with required values.

D. Coordinate tests with tests for transfer switches, and run them concurrently.

E. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

F. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

I. Remove and replace malfunctioning units and retest, reinspect as specified above.

J. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.

K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component, indicating satisfactory completion of tests.

3.7 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.13

SECTION 263533 - POWER FACTOR CORRECTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes all work, materials and equipment required to construct and install low voltage active harmonic filter unit (AHF) as shown on the Drawings.

B. AHF functions:
   1. Monitor the load current under review utilizing current transformers (CT's) mounted on the supply AC lines.
   2. Analyze the content of the supply current for harmonics from the 2nd to the 51st harmonic and determine the reactive current content representing displacement power factor and current balancing.
      a. Inject cancellation for every harmonic order from 2nd to 51th order. AHF with designs to inject less than all harmonic orders are unacceptable.
   3. Field selectable to operate as a harmonic filter or provide power factor correction or supply current balancing or any combination of the three modes.
   4. Provide current balancing of AC supply for harmonic and reactive currents regardless of actual load distribution per phase.
   5. Have up to 30 seconds of logic ride thru in the event of power loss.
   6. Compatible with SPD, EMC filters, SCR (thyristor) snubber circuits, and switched mode power supplies (SMPS).

C. Related Requirements:
   1. Section 260573 "Power System Studies."
   2. Section 262419 "Motor Control Centers."

1.3 DEFINITIONS

A. AHF: Active harmonic filter unit.

B. EMC: Electromagnetic Compatibility.

C. HMI: Human Machine Interface.

D. IGBT: Insulated gate bipolar transistor.

E. LV: Low voltage.

F. PCU: Power correction unit. Used interchangeably with the term AHF.

G. SPD: Surge protective device.

H. VFD: Variable frequency drive.

1.4 ACTION SUBMITTALS

A. Product Data: Submit required product data specific to each product and accessory proposed. In addition, include the following information:
   1. AHF sizing calculations shall be provided to confirm required harmonic mitigation and power factor correction performance for the AHFs proposed.
   2. AHF assembly rated input KVA and output KVA, topology, converter/inverter type, percent efficiency, operating characteristics, and electrical characteristics
   3. Maximum Btu heat release data and ambient cooling requirements
   4. Certification of UL conformity
   5. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For automatic power factor correction units.

   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Wire Termination Diagrams and Schedules: Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer- and field-installed wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Harmonic Analysis Report: Project-specific calculations and statement of compliance with IEEE 519, latest revision.

B. Qualification Data: For testing agency.

C. Seismic Qualification Data: Certificates, for power capacitor banks, accessories, and components, from manufacturer.

   1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Test Reports: Factory production test reports.

E. Field quality-control reports.

F. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For equipment to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Lists of spare parts and replacement components recommended for storage at Project site.
b. Detailed instructions covering operation under both normal and abnormal conditions.
c. Hard copies of manufacturer's operating specifications, user's guides for software and hardware, and PDF files on a USB storage device of hard-copy submittal.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide the minimum spare parts recommended by the manufacturer.

2. Fuses: One for every three of each type and rating, but no fewer than three of each.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

B. Manufacturer Qualifications:
1. Firm engaged in the manufacture of this same type of equipment and whose products have been in satisfactory use in similar service for a minimum of ten years.
2. ISO 9001 certification and an applicable quality assurance program implementing suitable procedures and controls to monitor all aspects of production and testing.
3. 24-hour, 7-days-a-week service, repair and technical support.

C. Installer Qualifications:
1. Firm having a minimum of five years of successful installation experience with projects utilizing AHFs similar in size and scope to what is required.

D. Work Qualifications:
1. All work performed, and all materials used in accordance with the National Electrical Code, and with applicable local regulations and ordinances.
2. Equipment, assemblies and materials listed and labeled by Underwriter’s Laboratories or by a testing agency acceptable to authorities having jurisdiction and marked for intended use

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace active harmonic filter(s) that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Harmonic Correction Unit (HCU2) by Eaton.
2. Accusine PCS+ by Schneider Electric.
3. HGA – HarmonicGuard Active by TCI.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1. AHF shall be defined as a power electronic device consisting of insulated gate bipolar transistors (IGBT) that switch into the AC lines to modulate its output to mitigate detrimental harmonic current and to correct the displaced reactive current (leading or lagging) and balance the current for the power source.

2. The converter design shall be a three-level design to optimize performance and minimize heat loss.

B. Comply with NFPA 70.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Power factor correction equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

B. Provide the following performance per the basis of design sizing calculation method for non-linear loads each with a minimum impedance of 3%:
1. THD(v) to be not more than 5% as contributed by the loads at the location of each AHF. Use a THD(v) set point to optimize performance of the AHF and maintain the 5% THD(v) set point.
2. Displacement power factor (PF) 0.97 or better at the location of each AHF. Power factor must not go leading due to AHF performance. In addition:

a. AHF to have a set point entry to maintain objective.
b. AHF to have optimized displacement correction such that overcorrection or crossover of the PF will not occur.

3. AHF to provide negative sequence current correction to source current imbalance not more than 2% phase-to-phase after correction.

C. Service Conditions:

1. Operating Ambient Temperature Range:
   a. Operating Temperature: Minus 40 to plus 104 deg F.
   b. Maximum Altitude: 3300 feet.
   c. Humidity: Zero to 95 percent, noncondensing.
   d. Audible noise: 80 dBA at one meter from enclosure.
   e. Printed circuit board assembly protection: all PCBs to have conformal coating.
2. AHF sizing and ratings:
   a. Capable of operating with an input voltage of 380 volts AC to 480 volts AC, +10%, -15% at each nominal voltage.
   b. Capable of operating at an AC supply frequency of 50 Hz or 60 Hz, +/- 3 Hz.
   c. Phase rotation insensitive to detect phase rotation and align output accordingly.
   d. Heat losses not to exceed more than 3 percent of the unit kVAR rating.
   e. AHF amperage output amperage ratings shall be one of the following:
      1) A minimum of 60, 120, 200, or 300 amperes from 380 to 480 VAC.
   f. Up to 10 units of any size combination paralleled to inject current according to the information received from one set of supply current transformers (CTs). Each unit field selectable for operation as master or slave. If one unit is offline for maintenance or faulted, the remaining units shall automatically adjust the total output to make up for the offline unit(s).

2.4 ACTIVE HARMONIC FILTER UNIT

A. UL listed according to UL 508.

B. Enclosure: The AHF shall be incorporated into the motor control center assemblies.

C. Features:
1. AHF shall be designed with a current limiting function to protect the IGBT's.
   a. When the current limit level is attained on any harmonic order, a message shall be displayed indicating the output capacity is operating at maximum.
   b. Operation shall continue indefinitely at this reduced level without trip or degradation of AHF.
2. AHF shall have automatic restart capability upon power loss return and fault resets.
   a. Fault trip limit shall occur after 5 restarts within a 5 minute period.
   b. Automatic restart shall occur for the following faults and may include other faults: AC line overvoltage, AC line power loss, and AC line phase imbalance, over temperature, under temperature, and DC bus overvoltage.
3. Upon occurrence the fault trip limit, AHF shall stop output current production and lock out restart until the fault is manually cleared.
4. AHF shall incorporate an over temperature output roll back that shall reduce the total output current to reduce power component heating in order to maintain maximum current correction at the elevated temperatures within the electrical system.

a. AHF shall monitor the incoming air temperature and invoke a hard trip of the unit at 124°F.
b. Cooling Architecture: Separate cooling arrangement shall be made for the heat sinks. The clean and dry air intake for PCB's should not mix with the air for the heat sinks. The heat sinks shall be mounted in a separate plenum.

5. Operator Interface:
   a. Door mounted human machine interface (HMI) with touch screen control rated NEMA 4-12 (IP65), dust tight and liquid resistant.
   b. Run/stop control from every screen.
   c. Oscilloscope feature to display:
      1) Three sets of data may at a time.
      2) Up to twenty predefined parameters can be chosen for each curve.
6. Performance trend curves displayed for:
   a. load total RMS current
   b. load RMS harmonic current per phase
   c. AHF harmonic current output per phase
   d. AC mains voltage per phase
   e. THDi
   f. TDD
   g. load RMS reactive current
   h. AHF RMS reactive current output
7. Bar graphs shall be provided for display of the mains and load harmonic current amplitudes per harmonic order.
8. Selected internal curves provided for diagnostic and performance checks.

2.5 HUMAN MACHINE INTERFACE

A. HMI to display:
   1. Operating and setup parameters and event/fault messages in plain English, no cryptic codes or symbols are permitted on the display. Display includes:
   2. Mains voltage and CT current.
   3. Parameter adjustment (password protected).
   4. Event log with time and date stamp. Event log via the stop function or power-off. A minimum of 100 events to be stored.

B. External communications via an RJ45 connectors to include:
   1. Modbus TCP/IP remote run/stop and display of operating parameters, set up parameters and diagnostic functions.
   2. Safety feature to lock out all other forms of control during service and commissioning.
   3. Display a flashing warning screen in the event of a fault.
   4. Download of pertinent parameters to a USB memory device to permit remote diagnostic evaluations and to save unit set up parameters.

C. HMI to include, but not be limited to, an on-board commissioning guide with automatic detection the following features:
   1. Check for proper AC line phase rotation. No specific phase rotation required.
   2. Test for CT phase rotation and polarity. Lockout of operation if rotation cannot be achieved
   3. AHF shall automatically calibrate the CT for optimum harmonic cancellation performance.

4. Perform at full capacity for a period of 15 minutes to validate components.
5. In the event, any of the above cannot be reconciled, lock out AHF function until commissioning agent corrects, verifies, and clears each test
6.

2.6 CURRENT TRANSFORMER

A.

B. Split core type current transformers (CT) installed as defined herein and as shown on the Electrical Drawings. CT properties:
   1. A minimum of two current transformers per AHF location are required and mounted on phases A & B of the mains. If phase to neutral loads are connected on a 4-wire system, three CT's are required.
   2. Primary current ratings of the CT according to full load current rating of the circuit on which installed.
   3. Current transformer ratio as shown on the Drawings. Secondary rating: 5 amperes.
   4. Current transformers rated for 50 to 400 hertz.
   5. 1% or better (metering class) accuracy.
   6.

2.7 WARNING LABELS

A. Electrical Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inchthermal transfer label of high-adhesion polyester for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.

   1. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

      a. Location designation.
      b. Nominal voltage.
      c. Flash protection boundary.
      d. Hazard risk category.
      e. Incident energy.
      f. Working distance.
      g. Engineering report number, revision number, and issue date.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment exterior and interior prior to installation. Report damage and do not install any equipment that is structurally, moisture, or mildew damaged.

B. Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

C. Indicate acceptance of the areas and conditions as approved by the Installer.

D. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.

E. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.
1. .

3.2 INSTALLATION

A. For installation as part of motor-control center, comply with the installation requirements of that Section.

B. Install arc-flash labels as required by NFPA 70.

C. Identify components according to Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Test and adjust controls and safeties.

D. Replace damaged or malfunctioning controls and equipment.

E. Certify in writing prior to scheduling functional demonstration testing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations and is ready for operation.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain AHF.

END OF SECTION 263533

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes lightning protection system for ordinary structures.

B. Section includes lightning protection system for the following:

1. Operations Building.
2. Storage Building.
3. E-house.
4. Belt Press Filter Building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
2. Include raceway locations needed for the installation of conductors.
3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
4. Include roof attachment details, coordinated with roof installation.
5. Calculations required by NFPA 780 for bonding of metal bodies.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lightning protection cabling attachments to roofing systems and accessories.
2. Lightning protection strike termination device attachment to roofing systems, coordinated with the roofing system manufacturer.

3. Lightning protection system components penetrating roofing and moisture protection systems and system components, coordinated with the roofing system manufacturer.

B. Qualification Data: For Installer.

C. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For lightning protection system to include in maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations. Comply with requirements of Section 017839 "Project Record Documents."
b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.

B. Completion Certificate:

1. UL Master Label Certificate.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: [**UL-listed installer, category OWAY**] [**or**] [**LPI Master Installer**].

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.2 PERFORMANCE REQUIREMENTS

A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for [**Class I**] [**Class II**] buildings.

B. UL Lightning Protection Standard: Comply with UL 96A requirements for [**Class I**] [**Class II**] buildings.

C. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

2.3 MATERIALS

A. Air Terminals:

1. [**Copper**] [**Stainless steel**] [**or**] [**Aluminum**] unless otherwise indicated.
2. [**3/8-inch**] [**1/2-inch**] [**5/8-inch**] diameter by [**10 inches**] [**12 inches**] [**15 inches**] [**18 inches**] [**24 inches**] <**Insert length of air terminal**> long.
3. [**Pointed**] [**Rounded**] tip.
4. [**Integral base support**] [**Threaded base support**].

B. Air Terminal Bracing:

1. [**Aluminum**] [**Copper**] [**Stainless steel**] [**Galvanized steel**].
2. [**1/4-inch**] <**Insert size**> diameter rod.

C. Class 1 Main Conductors:

1. [**Stranded Copper: 57,400 circular mils in diameter**].
2. [**Aluminum: 98,600 circular mils in diameter**].

D. Class II Main Conductors:

1. [**Stranded Copper: 115,000 circular mils in diameter**].
2. [**Aluminum: 192,000 circular mils in diameter**].

E. Secondary Conductors:

1. [**Stranded Copper: 26,240 circular mils in diameter**].
2. [**Aluminum: 41,400 circular mils in diameter**].

F. Ground Loop Conductor: [**Stranded copper**] [**Tinned copper**]**.**

G. Ground Rods:

1. Material: [**Solid copper**] [**Copper-clad steel**] [**Stainless steel**].
2. Diameter: [**5/8 inch**] [**3/4 inch**].
3. Rods shall be not less than 120 inches long.
4. [**Sectional type, with integral threads**].

H. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to [**UL 96A**] [**NFPA 780**].

B. Install conductors with direct paths from air terminals to ground connections. Avoid bends greater than 90 degrees and 8 inches in radius and narrow loops.

C. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for [**concealed installations in UL 96A**] [**concealed systems in NFPA 780**].

1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
2. Install conduit where necessary to comply with conductor concealment requirements.
3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.

D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

3.2 CONNECTIONS

A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.

B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: [**bolted connectors**] [**exothermic weld**] [**high compression**] [**crimp**].

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: [**Owner will engage**] [**Engage**] a qualified special inspector to perform the following special inspections:

1. Perform inspections as required to obtain a UL Master Label for system.
2. Perform inspections to obtain an LPI certification.

B. Prepare test and inspection reports and certificates.

END OF SECTION 264113

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SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following types of LED luminaires:

1. Downlight.
2. Linear industrial.

B. Related Requirements:

1. Section 266100 "Electrical Power House.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

    a. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Structural members to which luminaires will be attached.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire.

E. Product Test Reports: For each type of luminaire, for tests performed by a qualified testing agency.

F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 41 to 104 degrees F.

1. Relative Humidity: Zero to 100 percent.

B. Altitude: Sea level to 1000 feet.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles.

1. Label shall include the following lamp characteristics:

C. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

E. Refer to Light Fixture Schedule on the Drawing for other requirements.

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A240/A240 M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Engineer, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

D. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

E. Suspended Luminaires:

1. Ceiling Mount:

a. Pendant mount with 5/32-inch-diameter adjustable aircraft cable supports.
b. Hook mount.

2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 265213 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.
4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.

a. Testing Agency Certified Data: For indicated luminaires and signs, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires and signs shall be certified by manufacturer.
b. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule:

1. For emergency lighting units. Use same designations indicated on Drawings.
2. For exit signs. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Structural members to which equipment will be attached.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of luminaire.

D. Product Test Reports: For each luminaire for tests performed by a qualified testing agency.

E. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.
2. Warranty Period for Self-Powered Exit Sign Batteries: Two years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Comply with UL 1598 for fluorescent luminaires.

F. Lamp Base: Comply with ANSI C81.61.

G. Bulb Shape: Complying with ANSI C79.1.

H. Refer to Light Fixture Schedule on the Drawing for other requirements.

2.2 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.3 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.

4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service:

1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.
2. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.

a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265213

SECTION 265619 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.
4. Delegated Design.

B. Related Requirements:

1. Section 266100 “Electrical Power House.”

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.

5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

    a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 DELEGATED DESIGN SUBMITTALS

A. For luminaire supports:

1. Include design calculations for luminaire supports.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Structural members to which luminaires will be attached.
3. Building features.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.

D. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.

E. Source quality-control reports.

F. Sample warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 100of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 20of each type and rating installed. Furnish at least one of each type.

1.9 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Delegated Design: Engage a qualified professional engineer, as defined in Sections 013300 “Submittal Procedures” and 014000 “Quality Requirements”, to submit the items listed in the DELEGATED DESIGN SUBMITTALS Article.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. Lamp base complying with ANSI C81.61.

F. Bulb shape complying with ANSI C79.1.

G. Refer to Light Fixture Schedule on the Drawing for other requirements.

H. Source Limitations: Obtain luminaires from single source from a single manufacturer.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

E. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

F. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage and coating.
c. CCT and CRI for all luminaires.

2.4 FINISHES

A. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

    a. IES LM-5.
    b. IES LM-50.
    c. IES LM-52.
    d. IES LM-64.
    e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION 265619

SECTION 266100 - ELECTRICAL POWER HOUSE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pre-fabricated electrical walk-in enclosure, referred to as the enclosure or Power House within this specification for Coordinated E-House I, Coordinated E-House II, and Coordinated E-House III.
2. Enclosure accessories.
3. Delegated Design.

B. Related Requirements:

1. Section 033000 “Cast-in-Place Concrete” for concrete foundation and pad.
2. Section 262300 “Low-Voltage Switchgear”
3. Section 262419 "Motor Control Centers”
4. Section 262923 "Variable-Frequency Drives”
5. Section 406717 "Industrial Enclosures”
6. Section 462113 “Multi-Rake Bar Screens”
7. Section 462363 "Grit Classifying and Washing Equipment”
8. Division 26 for electrical materials and equipment.

1.3 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.4 ACTION SUBMITTALS

A. Include with submittal copy of this specification confirming compliance with each paragraph.

B. Product Data: For each type of product.

1. Include product data sheets and catalog numbers for HVAC equipment, receptacles, lighting, and other accessories.

C. Shop Drawings:

1. Include plans, elevations, sections, mounting details, installation and anchoring requirements, fasteners, and other details..
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Grounding system plan.
5. Building electrical plan, showing conduit, cable tray, wire tray, subfloor wireway, and any other means of wiring transit. Including conduit entrance locations.

D. Calculations:

1. Heating and Cooling: For sizing of HVAC units.
2. Lighting: For illuminance levels.
3. Anchor and Mounting Bolt Design: Calculations and details.

1.5 DELEGATED DESIGN SUBMITTALS

A. Delegated-Design Submittal: For anchorage details of enclosure.

B. Qualifications Statement: Submit qualifications for licensed professional.

1.6 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Installation instructions.

C. Field quality-control reports.

D. Manufacturer’s warranties.

E. Building inspection certificate.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC systems.

1.8 QUALITY ASSURANCE

A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the State of Texas.

B. Manufacturer of assembly must be ISO 9001 certified or have a quality management system in place comparable to the requirements of ISO 9001.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Ship power house, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

B. Protect finishes and components against damage, weather elements, and condensed water vapor. Do not remove protection until work area is substantially free of construction dust and debris.

C. Manufacturer shall supervise offloading at the site in the presence of the Contractor.

1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer and Installer agree to repair or replace components that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Factory fabricated, all-weather walk-in enclosure with environmental control, specifically designed to house electrical equipment along with other equipment as indicated on the Drawings and noted herein. Provide all equipment and accessories unless otherwise noted.

B. Coordinated E-House I Requirements: Coordinate with other Section suppliers for final equipment dimensions. Provide the following equipment:

1. Switchgear SWGR-2
2. Motor Control Center MCC-1
3. Motor Control Center MCC-2
4. PLC-SGB Enclosure
5. Grit Basin Master Control Panel MCP-2110-1

C. Coordinated E-House II Requirements: Coordinate with other Section suppliers for final equipment dimensions. Provide the following equipment:

1. Motor Control Center MCC-3
2. Variable Frequency Drive VFD-WWP-01
3. Variable Frequency Drive VFD-WWP-02
4. Bar Screen Master Control Panel MCP-2000-1

D. Coordinated E-House III Requirements: Coordinate with other Section suppliers for final equipment dimensions. Provide the following equipment:

1. Motor Control Center MCC-4
2. Space for future 36”Wx24”D enclosure.

E. Intended to be delivered to the project site as a complete assembly.

F. Intended to be off-loaded and installed at the project site with a crane making a single point lift using suitable rigging. Provide with appropriate lifting lugs and jacking plates.

G. Coordinate with actual dimensions of equipment to be installed in enclosure.

2.2 MANUFACTURERS

A. Manufacturer Qualifications: Same manufacturer as the motor control centers and switchgear. Manufacturer takes complete responsibility for equipment or enclosures purchased from third parties.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements", to submit the items listed in the DELEGATED DESIGN SUBMITTALS Article.

B. General Design Standards:

1. ASCE 7-10: Minimum Design Loads for Buildings and Other Structures.

C. Wind Design:

1. Ultimate Design Wind Speed V_{ult} (3 second gust): 120 mph.
2. Nominal Design Wind Speed, V_{asd}: 93 mph.
3. Risk Category: III.
4. Wind Exposure Category: C.
5. Internal Pressure Coefficient: +/- 0.18.

D. Roof Design:

1. Insulation / Heat Transfer: R-38, minimum.
2. Snow Load: 8 psf.
3. Slope roof and provide drip edges.

E. Wall Assembly Insulation / Heat Transfer: R-20, minimum.

F. Floor Insulation: R-6, minimum. Polyurethane spray foam insulation.

G. The building shall be designed to include loads induced by the HVAC, mechanical, process equipment, piping sprinklers, exhaust system, and other such devices shown on the plans and as specified. Additional girts or purlins shall be designed and placed in convenient locations for

attachment of all devices or equipment. Contractor shall provide building manufacturer with the equipment loads and other information that is needed for the building design.

2.4 GENERAL REQUIREMENTS

A. Enclosure may be concrete or metal, as long as the intent and performance requirements are met.

B. Enclosure Rating: NEMA 4 with sloping roof, drip edges, appropriate gasketing and animal guards, and an asphalt base undercoating on the exterior bottom.

C. When structural elements are metal, they shall be structural quality pre-galvanized sheet steel, with all members continuously welded at all joints.

D. Doors:

1. Two-man doors, minimum dimension 3 feet x 7 feet, one at end each of the structure.
2. Insulated, double walled aluminum, fastened with full length Type 316 stainless steel hinge.
3. Panic-type door hardware.
4. Automatic door closer.
5. Lockable.
6. Drip shield above doors.
7. Door jams with adjustable gasketing around door frame for proper seal.
8. Door thresholds with flexible gaskets from weather protection.
9. Door Hardware: Type 316 stainless steel.

E. For equipment requiring rear access, provide access doors with 3-point latching system and stainless-steel padlockable handles. Provide drip shields and gasketing per previous paragraph.

F. Provide minimum clear floor area of 4 feet x 4 feet in front of each personnel door.

G. Provide two Type 316 stainless steel ground pads located at opposite corners of enclosure skid with provisions for NEMA hole pattern lug.

H. Provide removable steel cover plates over conduit entrance areas.

I. Landings and Stairs:

1. Provide to meet building code when enclosure is set on 4-inch high concrete pad.

J. Exterior Enclosure Color: To be selected from manufacturer’s standards during shop drawing approval.

K. Interior Enclosure Color: To be selected from manufacturer’s standards during shop drawing approval.

2.5 MARKING AND IDENTIFICATION

A. Control wiring: Identify at each end with type-written heat shrinkable wire markers.

B. Load Centers and Panelboards: Type written directory.

C. “Danger High Voltage / Keep Out” Signs: On each door.

2.6 ELECTRICAL

A. Electrical components, devices, and accessories to be listed and labeled as defined in NFPA 70, by a qualified testing agency, and in accordance with the intended location and application.

B. Interior Lights:

1. Type: LED industrial 4-foot fixtures with protectives lenses, 120VAC.
2. Illumination requirement: 50-foot candles measured 2.5 feet above floor.
3. Emergency battery backup fixture: Minimum of two, at each entry door.
4. Control: Toggle switches (3-way) located inside and next to each entry door.

C. Exterior Lights:

1. Type: LED with emergency battery backup, 120VAC.
2. Control: Photocell.

D. Interior Receptacles:

1. Type: NEMA 5-20R, duplex, 20A, 120VAC, GFCI, specification grade.
2. Location: At each entry door and as indicated on Drawings.

E. Exterior Receptacles:

1. Type: NEMA 5-20R, duplex, 20A, 120VAC, WR, GFCI, specification grade, with weatherproof while in-use protective cover.
2. Location: As indicated on Drawings.

F. Equipment: Provide appropriately sized transformer, and panelboard to provide all auxiliary power to enclosure. Incoming auxiliary power will be powered from 480VAC motor control center located within enclosure. Include in auxiliary power circuits:

1. Lights.
2. Receptacles. Each receptacle to be on its own circuit.
3. HVAC.
4. PLC cabinet, 120VAC.

G. Circuitry:

1. Refer to Section 260519 – Low-Voltage Electrical Power Conductors and Cables for cable requirements.
2. Refer to Section 260529 – Hangers and Supports for Electrical Systems.
3. Refer to Section 260533 – Raceways and Boxes for Electrical Systems.

4. Refer to Section 260536 – Cable Trays for Electrical Systems.
5. Run circuitry in enclosed raceways or surface mounted rigid aluminum conduit. Use XHHW-2 copper wire for enclosure accessory circuits.

H. Grounding:

1. Include a ground wire with all circuits.
2. Use No. 12 AWG solid wire for all receptacle circuits.
3. Provide #4/0 green insulated copper ground wire from ground bar(s) to exterior ground pads.

2.7 HVAC

A. Refer to HVAC schedule sheet H-2 and specification section 238113.13 FL for HVAC system requirements.

2.8 ADDITIONAL ACCESSORIES

A. Provide portable hand-carried fire extinguishers as indicated on the Drawings.

B. Provide rubber floor mats directly in front of all electrical equipment for entire length of the equipment.

1. Meet voltage ratings of equipment.

2.9 SURFACE PREPARATION AND SHOP COATINGS

A. Clean all non-current carrying metal parts of enclosure of weld spatter and other foreign material and provide hot iron phosphate chemical treatment.

B. Utilize manufacturer’s standard procedures and processes.

C. Paint entire outdoor exterior assembly with same color (i.e., either all ANSI 61 or all ANSI 49).

2.10 SOURCE QUALITY CONTROL

A. All accessory system components shall be completely factory assembled, wired, and tested prior to shipment.

B. Test and inspect assembled equipment, by a qualified testing agency, for building code compliance. Affix certification label.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosure on concrete pad, level to manufacturer's tolerances.

B. Use Type 316 stainless steel hardware if exposed to outdoor conditions.

C. Anchor enclosure per manufacturer's instructions.

D. Remove temporary lifting angles, lugs, and shipping braces. Cover holes.

E. Touch up damaged paint finishes.

F. Make wiring interconnections as required.

G. Caulk seams, cracks, and openings to exterior.

3.2 ADJUSTING

A. Adjust doors and hardware to operate smoothly, easily, properly, and without binding. Confirm that locks engage accurately and securely without forcing or binding.

B. Adjust interior and exterior lighting controls.

C. Lubricate hardware and other moving parts.

1. After completing installation, inspect exposed finishes and repair damaged finishes.

END OF SECTION 266100

SECTION 271323 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. 9/125 micrometer single-mode, indoor-outdoor optical fiber cable (OS1).
2. Optical fiber cable connecting hardware, patch panels, and cross-connects.
3. Cabling identification products.

B. Related Requirements:

1. Section 262726 "Wiring Devices."
2. Section 260529 "Hangers and Supports for Electrical Systems”

1.3 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Catalog data on fiber-optic cable, termination devices, patch panels, breakout enclosures, splice kits, pigtails, and fan-outs where applicable. Product data sheets shall include the manufacturer's name and catalog number for each item, the manufacturer's descriptive literature, catalog cuts, and any power supply requirements.
2. Certification of compliance in writing stating the fiber optic cable, anticipated layout, and components are compatible, acceptable for use, and in compliance with these specifications.
3. Detailed bill of materials for fiber-optic cable, terminations, patch panels, breakout enclosures, splice kits, connectors, pigtails, and fan-outs.
4. Drawings indicating the locations of all patch panels, termination points, or breakout enclosures.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Optical fiber cable testing plan.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Product Certificates: For each type of product.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: One of each type.
2. Plugs: Ten of each type.
3. Jacks: Ten of each type.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings by an Technician.
2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

D. Grounding: Comply with TIA-607-B.

2.2 9/125 MICROMETER SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS1)

A. Description: Single mode, 9/125-micrometer, 12 fibers, single loose tube, optical fiber cable.

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Corning Optical Communications; Corning Incorporated.

C. Standards:

1. Comply with TIA-492CAAA for detailed specifications.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with ICEA S-104-696 for mechanical properties.

D. Jacket:

1. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.

2. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

E. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
2. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.
3. Plenum Rated, Nonconductive: Type OFNP, or Type OFNR in metallic conduit.
4. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum communications raceway; or Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.
5. Riser Rated, Nonconductive: complying with UL 1666.
6. Riser Rated, Nonconductive: Type OFNP or Type OFNR in listed riser or plenum communications raceway.
7. Riser Rated, Nonconductive: Type OFNP, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
8. Plenum Rated, Armored (Conductive): Type OFCP, complying with NFPA 262.
9. Plenum Rated, Armored (Conductive): Type OFCP or Type OFNP in listed plenum communications raceway.
10. Plenum Rated, Armored (Conductive): Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
11. Riser Rated, Armored (Conductive): Type OFCR; complying with UL 1666.
12. Riser Rated, Armored (Conductive): Type OFCP, Type OFNP, or Type OFCR or Type OFNP in listed riser or plenum communications raceway.
13. Riser Rated, Armored (Conductive): Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit.

2.3 OPTICAL FIBER CABLE HARDWARE

A. Approved Manufacturers:

1. Corning Splice Module CCH-CS12-6C-P00RE.
2. Corning Connector Housing CCH-04U.
3. Belden CDT Networking Division/NORDX.

B. Standards:

1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Patch Panel to be 2U Rackmount Fiber Cabinet.
2. Cabinet is constructed of high-quality 16-gauge cold-rolled steel and finished with a black electrostatically applied powder coat.

3. Provide adapters that work with multi-mode fibers, and they are constructed with high retention phosphor bronze alignment sleeves.

D. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

E. Connector Type: Type LC complying with TIA-604-10-B, connectors.

F. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.

G. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to a patch panel or faceplate.

2.4 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.5 SOURCE QUALITY CONTROL

A. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.

B. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301.

B. General Requirements for Optical Fiber Cabling Installation:

1. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
2. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
3. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
4. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified by the manufacturer. Use lacing bars and distribution spools.
5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
7. In the communications equipment room, provide a 10-foot- long service loop on each end of cable.
8. Pulling Cable: Comply with manufacturer recommendations. Monitor cable pull tensions.
9. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Group connecting hardware for cables into separate logical fields.

3.4 IDENTIFICATION

A. The individual fibers shall be color coded for identification. The optical fiber color coding shall be in accordance with EIA/TIA-598, “Color Coding of Fiber Optic Cables.” The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color coded buffered fibers shall not adhere to one another. When fibers are grouped into individual units, each unit shall be numbered in the unit jacket for identification. The number shall be repeated at regular intervals.

B. The outer cable jacket shall be marked with the manufacturer's name or UL file number, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet. The markings shall be in contrasting color to the cable jacket.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
b. Link End-to-End Attenuation Tests:

1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 271323

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.

B. Related Requirements:

1. Section 260529 "Hangers and Supports for Electrical Systems”
2. Section 262726 "Wiring Devices."

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. FTP: Shielded twisted pair.

C. F/FTP: Overall foil screened cable with foil screened twisted pair.

D. F/UTP: Overall foil screened cable with unscreened twisted pair.

E. IDC: Insulation displacement connector.

F. LAN: Local area network.

G. Jack: Also commonly called an "outlet," it is the fixed, female connector.

H. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

I. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

J. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

K. S/FTP: Overall braid screened cable with foil screened twisted pair.

L. S/UTP: Overall braid screened cable with unscreened twisted pairs.

M. UTP: Unscreened (unshielded) twisted pair.

1.4 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft. and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration Drawings and printouts.
4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:

    a. Telecommunications rooms plans and elevations.
    b. Telecommunications pathways.
    c. Telecommunications system access points.
    d. Telecommunications grounding system.
    e. Telecommunications conductor drop locations.
    f. Typical telecommunications details.
    g. Mechanical, electrical, and plumbing systems.

C. Twisted pair cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, installation supervisor, and field inspector.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Connecting Blocks: One of each type.
2. Faceplates: One of each type.
3. Jacks: Ten of each type.
4. Multiuser Telecommunications Outlet Assemblies: One of each type.
5. Patch-Panel Units: One of each type.
6. Plugs: Ten of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, cabling administration Drawings, and field testing program development by a Technician.
2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified as a Technician to supervise on-site testing.

B. Testing Agency Qualifications: Testing agency must have personnel certified on staff.

1. Testing Agency's Field Supervisor: Currently certified as a Technician.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Electrical Contractor.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Non-plenum: Type CMP or Type CMR in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

C. Conductors: 100-ohm, 23 AWG solid copper.

D. Shielding/Screening: Shielded twisted pairs (FTP).

E. Cable Rating: Riser.

F. Jacket: Blue thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

C. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.

D. Patch Cords: Factory-made, four-pair cables with 36-inch lengths as required for the application and service; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.
3. Jacket rated for 600V or higher when used in proximity in panels with 480V.

E. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568-C.2.
3. Marked to indicate transmission performance.

F. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 CABLE MANAGEMENT SYSTEM

A. Description: Computer-based cable management system, with integrated database capabilities.

B. Document physical characteristics by recording the network, TIA details, and connections between equipment and cable.

C. Information shall be presented in database view, schematic plans, or technical drawings.

1. AutoCAD drawing software shall be used as drawing and schematic plans software.

D. System shall interface with the following testing and recording devices:

1. Direct upload tests from circuit testing instrument into the personal computer.
2. Direct download circuit labeling into labeling printer.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 SOURCE QUALITY CONTROL

A. Factory test cables on reels according to TIA-568-C.1.

B. Factory test twisted pair cables according to TIA-568-C.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters. Conceal raceway and cables, except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems." Section 260528 "Pathways for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

A. Comply with Section 270528 "Pathways for Communications Systems."

B. Comply with Section 270529 "Hangers and Supports for Communications Systems."

C. Comply with Section 270536 "Cable Trays for Communications Systems."

D. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Consolidation points may be used only for making a direct connection to equipment outlets:

    a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    b. Locate consolidation points for twisted-pair cables at least 49 feet from communications equipment room.

6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified by the manufacturer. Use lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
11. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
12. Pulling Cable: Comply with manufacturer recommendations. Monitor cable pull tensions.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

A. Comply with TIA-569-D, Annex A, "Firestopping."

B. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

A. Install grounding according to the NEC.

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

B. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

C. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Verify cable length does not exceed the manufacturer’s recommendations or 295ft, whichever is smaller.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 271513

SECTION 284621.12 - ADDRESSABLE FIRE-ALARM SYSTEMS - PERFORMANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Addressable Fire-alarm System performance requirements

B. Related Requirements:
1. Division 23 for duct mounted smoke detectors and fan shutdown controls.
2. Division 21 for fire suppression systems, including water flow and valve supervisory switches.
3. Section 260533 “Raceways and Boxes for Electrical Systems”, for electrical boxes, fittings, and raceway systems.
4. Section 260543 “Underground Ducts and Raceways for Electrical Systems” for underground electrical work.
5. For electrical wire and cable not specified herein:

a. Section 260519 “Low-Voltage Electrical Power Conductors and Cables” for power conductors.
b. Section 260523 “Control-Voltage Electrical Power Cables” for control circuit conductors.

1.3 DEFINITIONS

A. AHJ: Authority Having Jurisdiction.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal Computer.

F. VESDA: Very Early Smoke-Detection Apparatus.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system: Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and include the following:

1. Plans, elevations, sections, details, and attachments to other work.
2. Details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations.
3. Conductor sizes, termination locations and requirements.

    a. Distinguish between factory and field wiring.

4. Input/output point address for each panel.
5. Detail assembly and support requirements.
6. Voltage drop calculations for notification-appliance circuits.
7. Battery-size calculations.
8. Input/output matrix.
9. Statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
10. Performance parameters and installation details for each detector.
11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
13. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
    e. Locate detectors according to manufacturer's written recommendations.
    f. Show air-sampling detector pipe routing.

14. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
15. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Engineer.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.

b. NICET-certified, fire-alarm technician; Level IV minimum.
c. Licensed or certified by authorities having jurisdiction.

1.5 DELEGATED-DESIGN SUBMITTAL

A. For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer testing agency factory-authorized service representative.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire alarm system systems, subsystems, or equipment to include in emergency, operation, and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Provide the Owner with wiring diagrams including terminal to terminal designations, complete equipment specifications and complete sequence of operation.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

D. The equipment furnished under this Section shall be provided by a fire alarm system manufacturer who has been providing this type of equipment for the past 5 years.

1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer and Installer agree to repair or replace components of fire alarm system that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design and install the addressable fire alarm system and prepare detailed installation drawings and material specifications for the indicated locations: Belt Filter Press Building to be signed and sealed by a professional engineer registered in the state where the project is located.

B. All components shall be from one equipment manufacturer when possible.

C. All equipment shall be AHJ approved.

2.2 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components:
1. Components compatible with, and operate as an extension of, existing system.
2. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 SYSTEMS OPERATIONAL DESCRIPTION

A. Initiate fire-alarm signal by one or more of the following devices and systems:
1. Manual stations.
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.
5. Duct smoke detectors.
6. Air-sampling smoke-detection system (VESDA).
7. Carbon monoxide detectors.
8. Combustible gas detectors.
9. Automatic sprinkler system water flow.
10. Pre-action system.
11. Fire-extinguishing system operation.
12. Fire standpipe system.
13. Dry system pressure flow switch.

B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances, including voice evacuation notices.
2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels,.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
9. Activate stairwell and elevator-shaft pressurization systems.
10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
11. Activate pre-action system.
12. Activate emergency lighting control.
13. Activate emergency shutoffs for gas and fuel supplies.
14. Record events in the system memory.
15. Record events by the system printer.
16. Indicate device in alarm on the graphic annunciator.

C. Provide supervisory signal initiation by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Alert and Action signals of air-sampling detector system.
4. Independent fire-detection and -suppression systems.
5. User disabling of zones or individual devices.
6. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.
11. Hose cabinet door open.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels,.
3. Record the event on system printer.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on graphic annunciator.

2.4 FIRE ALARM CONTROL UNITS

A. General Requirements:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

    a. Control Panel: Surface-mounted with key lock door.
    b. Double-supervised so that a trouble signal shall sound in the event of loss or either operating or supervising power.
    c. Contain an internal audible signal with audible acknowledge switch, system reset switch, lamp test switch, audible silence switch and auxiliary master box disconnect switch.
    d. System software and programs held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    e. Include a real-time clock for time annotation of events on the event recorder and printer.
    f. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    g. Alarm initiating circuits: Comply with NEC requirements for limited energy applications and function up to 100 ohms resistance in the alarm initiating device and its associating wiring.
    h. The FACP listed for connection to a central station signaling system service.
    i. Provide nonvolatile memory for system database, logic, and operating system and event history.

j. The system to require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
k. Grounding assembly consisting of ground rod, clamps and all other required hardware shall be provided for master box protection.

2. Addressable Initiation Device Circuits: The FACP should:

a. Indicate which communication zones have been silenced
b. Provide selective silencing of alarm notification appliance by building communication zone.

3. FACP for Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands[and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters].

C. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class A.
2. Pathway Survivability: Level 0.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Serial Interfaces:

a. One dedicated RS 485 port for central-station and remote station operation using point ID DACT.
b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One USB port for PC configuration.
d. One RS 232 port for VESDA HLI connection.
e. One RS 232 port for voice evacuation interface.

D. Notification-Appliance Circuit:

1. Audible appliances sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas:

a. Use an alarm signal having a 520-Hz square wave with an intensity 15 dB above the average ambient sound level; 5 dB above the maximum sound level; or at least 75 dBA, whichever is greater, measured at the pillow.

3. Visual alarm appliances: flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

E. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls to be connected to fire-alarm system.

F. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

G. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.

1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.

    a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
    b. Programmable tone and message sequence selection.
    c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

    a. Capable of withstanding its own short circuit current for a minimum of one minute.
    b. Battery Lids: Flame retardant plastic ABS type and heat sealed to this wall ABS container.
    c. Battery posts shall incorporate brass inserts for maximum conductivity.
    d. In event of accidental cell case cracking, battery shall be capable of maintaining the electrical circuit
    e. Provide automatic battery charging equipment to supervise battery condition and maintain full capacity at all times.

2. Standby battery source capable of providing the connected system operating and supervisory current for 60 hours followed by 10 minutes of alarm operation at the end of this period.
3. System shall automatically transfer to the standby battery upon loss of normal 120-V ac input power, or upon detection of brownout, short circuit, over voltage, or a trouble condition in the power supply. System shall re-transfer back to the power supply upon normalization of this source.

J. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 PREACTION SYSTEM

A. Initiate Pre-signal Alarm: This function shall cause an audible and visual alarm and indication to be provided at the FACP. Activation of an initiation device connected as part of a pre-action system shall be annunciated at the FACP only, without activation of the general evacuation alarm.

2.6 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.7 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
    a. Multiple levels of detection sensitivity for each sensor.

b. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address:

a. Accessible from fire-alarm control unit.
b. Able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.8 CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

1. Mounting: Adapter plate for outlet box mounting.
2. Testable by introducing test carbon monoxide into the sensing cell.
3. Detector shall provide alarm contacts and trouble contacts.
4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Comply with UL 2075.
6. Locate, mount, and wire according to manufacturer's written instructions.

7. Provide means for addressable connection to fire-alarm system.
8. Test button simulates an alarm condition.
9. .

2.9 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

C. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

D. Horns:

1. Electric-vibrating-polarized type, 24-V dc;
2. provision for housing the operating mechanism behind a grille.
3. Comply with UL 464.
4. sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

E. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
1. Rated Light Output:
   a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

F. Voice/Tone Notification Appliances:
1. Comply with UL 1480.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Mounting: surface mounted and bidirectional.
5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

G. Exit Marking Audible Notification Appliance:

1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
2. Provide exit marking audible notification appliances at the entrance to all building exits.
3. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.

2.10 FIREFIGHTERS' TWO-WAY TELEPHONE COMMUNICATION SERVICE

A. Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control unit, the fire command center, and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:

1. Common-talk type for firefighter use only.
2. Selective-talk type for use by firefighters and fire wardens.
3. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously. An indicator lamp shall flash if a phone is disconnected from the talk circuits.
4. Addressable firefighters' phone modules to monitor and control a loop of firefighter phones. Module shall be capable of differentiating between normal, off-hook, and trouble conditions.
5. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is taken off the hook, it causes an audible signal to sound and a high-intensity lamp to flash at the fire-alarm control unit.
6. Selector panel controls to provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
7. Display: Graphic to indicate location of caller.
8. Remote Telephone Cabinet: Flush- or surface-mounted cabinet as indicated, factory-standard red finish, with handset.

    a. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Emergency Phone."
    b. With "break-glass" type door access lock.

9. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved "Fire Emergency Phone."
10. Handsets: 1 push-to-talk-type sets with noise-canceling microphone stored in a cabinet adjacent to fire-alarm control unit.

2.11 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Surface cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.12 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance:

1. An alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line(s) and dial a preset number for a remote central station.
2. When contact is made with central station(s), signals to be transmitted.
3. If service on either line is interrupted for longer than 45 seconds:

    a. Initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line
    b. Automatically report telephone service restoration to the central station.
    c. If service is lost on both telephone lines, initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.

3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.14 NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway using Modbus for connection to building automation system.

2.15 SYSTEM PRINTER

A. Printer: listed and labeled as an integral part of fire-alarm system.

2.16 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by device manufacturer.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex Ain NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.

H. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, connect so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

I. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

J. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

L. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.
   1. Exposed pathways located less than 96 inches above the floor shall be installed in RAC.

B. Pathways: installed in RAC.

C. Exposed RAC: painted red enamel.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

   1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
   2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
   3. Smoke dampers in air ducts of designated HVAC duct systems.
   4. Magnetically held-open doors.
   5. Electronically locked doors and access gates.
   6. Alarm-initiating connection to elevator recall system and components.

7. Alarm-initiating connection to activate emergency lighting control.
8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
9. Supervisory connections at valve supervisory switches.
10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
11. Supervisory connections at elevator shunt-trip breaker.
12. Data communication circuits for connection to building management system.
13. Data communication circuits for connection to mass notification system.
14. Supervisory connections at fire-extinguisher locations.
15. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
16. Supervisory connections at fire-pump engine control panel.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 WIRE AND CABLE

A. Wiring for the fire alarm system initiating and indicating circuits as recommended by the fire alarm system vendor. As minimum, wiring shall meet or exceed the following requirements:

1. Solid Copper Conductors
2. Individually insulated (PVC or Teflon) conductors assembled in multi-conductor cable(s).
3. Overall PVC or Teflon red color jacket.
4. Twisted non-shielded or twisted shielded as required.
5. Shield, when required, shall be 100 percent coverage, metallic foil or copper braid.
6. Drain wire, when required, shall be solid tinned copper.
7. Cables: Pass the UL 70,000 BTU Flame Test (comparable to IEEE 383 Flame Test), listed with the AHJ, 105 degrees C rated.

3.7 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.8 FIELD QUALITY CONTROL

A. Field tests witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.10 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 284621.12

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SECTION 31 05 15 - SOILS AND AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Soils: Soil materials and topsoil materials.
2. Aggregates: Coarse aggregate materials and fine aggregate materials.

B. Related Sections:

1. City of Georgetown Standard Specifications.
2. Section 31 20 00 “Earthwork.”
3. Section G4 “Pipe Excavation, Trenching, Embedment, Encasement and Backfilling.”
4. Section G5 “Granular Fill Materials.”
5. Section G6 “Sedimentation and Temporary Erosion Control.”

1.3 ACTION SUBMITTALS

A. Samples - Soils: Submit in 5-gallon air-tight containers, 50 lbs. sample of each type of fill to testing laboratory when requested by the Owner or Engineer.

B. Samples - Aggregates: Submit, in 5-gallon air-tight containers, 50 lbs. sample of each type of aggregate fill to ENGINEER at least 15 days prior to placement of backfill or fill when requested by the Owner or Engineer.

C. Quality Control Testing: Submit conformance testing performed by a certified independent laboratory engaged by Contractor for all fill materials. Verify maximum density, gradation, Atterberg limits, sand equivalent, and other applicable criteria at least 72 hours prior to importing or placing any fill. Perform additional conformance testing at a minimum frequency of 1 per every 2,000 cubic yards or change in material.

1.4 INFORMATIONAL SUBMITTALS

A. Materials Source: Submit name and location of imported materials suppliers.

B. Source’s Certificate: Certify materials meet or exceed specified requirements.

C. Material Test Reports: For each on-site and borrow soil and aggregate material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D698 and TEX-113-E.
3. Grain size analyses according to ASTM D422.
4. Atterberg limits (liquid limit, plastic limit, and plasticity index) per ASTM D4318.
5. Test Reports: Submit any test reports required by this Section to the Engineer.

1.5 QUALITY ASSURANCE

A. Furnish each subsoil and topsoil material from single source throughout the Work, unless an alternate source is approved by the Engineer.

B. Furnish each coarse and fine aggregate material from single source throughout the Work, unless an alternate source is approved by the Engineer.

C. Perform Work according to City of Georgetown Standard Specifications.

D. Quality Control and Quality Assurance consists of laboratory conformance testing of samples supplied from each coarse and fine aggregate source and quality control during installation.

1. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.6 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Tree and Plant Protection Zones: Comply with requirements and measures specified in Section 015639 "Temporary Tree and Plant Protection."

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Common Fill:

1. Meet all requirements of “common fill” in Section G5 “Granular Fill Materials” and supplemented herein.
2. Approved onsite excavated material or imported fill material that is composed of durable soil free of debris, organic matter, or other deleterious materials.

3. Not contain stones larger than 4 inches in largest diameter, have a maximum of 75 percent passing the No. 200 sieve, and a maximum dry density of at least 85 pounds per cubic foot (pcf) as determined by ASTM D698.
4. Not contain granite blocks, broken concrete, masonry rubble, asphalt pavement or other similar materials and have physical properties such that it can be readily spread and compacted during filling.

B. Select Common Fill:

1. Meeting all requirements of "select common fill" in Section G5 "Granular Fill Materials" and as specified above for common fill

C. Select Structural Fill:

1. Consist of SC, SM, GC or SP classified soil free of organic material, loam, debris, frozen soil or other deleterious material which may be compressible, or which cannot be properly compacted., and meeting the following requirements:

Sieve Size	Percent Finer by Weight
1-1/4-inches	100
1-inch	95 to 100
3/4-inch	70 to 95
3/8-inch	30 to 90
No. 4	30 to 80
No. 40	15 to 70

2. Maximum liquid limit of 35 percent, maximum plasticity index of 12 percent, and a maximum dry density of at least 95 pcf as determined by ASTM D698.
3. No on-site mixing of various materials shall be permitted.
4. Non-expansive material with sufficient soil binder for proper compaction.
5. Crushed fines or scalpings are not acceptable for select structural fill.

Alternate material: flexible base material complying with TxDOT Item 247, Type A or B, Grade 3 or better.

D. Impervious Fill (Clay Cap):

1. Be classified as CL or CH soil according to the Unified Soil Classification System (USCS) in accordance with ASTM D2488.
2. Have a liquid limit of at least 30 percent and a plasticity index between 20 and 60 percent.
3. Have less than 5 percent organic content in accordance with ASTM D2974.
4. Percent passing per Sieve Size:

a. 1.5 inches 100 percent
b. No. 200 50 percent

2.2 TOPSOIL MATERIALS

A. Topsoil: Conforming to City of Georgetown Standard Specification G7.03.

1. Excavated and reused material or imported borrow.
2. Fertile, friable, natural topsoil typical of topsoil of the locality.
3. Free of roots, rocks larger than 1/2-inch, subsoil, debris, large weeds, and foreign matter.

    a. Screening: Single screened.

4. Containing minimum of 3 percent and maximum of 25 percent inorganic matter.

2.3 AGGREGATE MATERIALS

A. Coarse Aggregate - Crushed Stone: Natural stone; washed, free of clay, shale, organic matter; conforming to ASTM C33 standard.

1. Coarse Aggregate Designation: No. 57.

B. Coarse Aggregate – Roadway Base: Natural stone; washed, free of clay, shale, organic matter; conforming to State of Texas DOT standard Item 247, Type A, Grade 1.

1. Coarse Aggregate Designation: Type A Flexible Base.

C. Coarse Aggregate - Screened Gravel: Natural stone; washed, hard, durable, rounded, or sub-angular particles of proper size and gradation, and shall be free from sand, loam, clay, excess fines, and other deleterious materials, and contain no more than 5 percent by weight of any one or combination of slate, schist, or soft particles of sandstone. Screened gravel is to conform to the following gradation limits:

1. Percent Passing per Sieve Size:

    a. 5/8- inch: 100 percent.
    b. 1/2-inch: 40 to 100 percent.
    c. 3/8-inch: 15 to 45 percent.
    d. No. 10: 0 to 5 percent.

D. Coarse Aggregate - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter; graded according to ASTM C136; to the following limits:

1. Percent Passing per Sieve Size:

    a. 1/2- inch: 100 percent.
    b. 3/8-inch: 90 percent.
    c. No. 4: 30 percent.
    d. No. 8: 10 percent.
    e. No. 16: 5 percent.

E. Fine Aggregate - Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded according to ASTM C33; within the following limits:

1. Percent Passing per Sieve Size:

    a. 3/8-inch: 100 percent.
    b. No. 4: 95 to 100 percent.

c. No. 8: 80 to 100 percent.
d. No. 16: 50 to 85 percent.
e. No. 30: 25 to 60 percent.
f. No. 50: 10 to 30 percent.
g. No. 100: 2 to 10 percent.

2.4 SOURCE QUALITY CONTROL

A. Testing and Inspection Services: Submit test result reports to the Engineer.

B. Subsoil Material - Testing and Analysis: Perform in accordance with ASTM D698.

C. Topsoil Material - Testing and Analysis: Perform in accordance with ASTM D698.

D. Aggregate Material - Testing and Analysis: Perform according to ASTM D698 and TEX-113-E, as specified elsewhere.

E. When tests indicate materials do not meet specified requirements, change material and retest.

F. Furnish materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.

B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.

C. Remove excess excavated materials not intended for reuse, from site.

D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

3.2 STOCKPILING

A. Stockpile materials on site at locations designated by Engineer or Owner’s representative.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate different soil and aggregate materials with dividers or stockpile individually to prevent mixing. Prevent intermixing of soil types or contamination.

D. Stockpile topsoil 8 feet high maximum.

E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.3 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 31 05 15

SECTION 312000 – EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. General: Earthwork includes clearing and stripping, procurement of on-site and imported fill material, excavating, placing, and compacting fill and backfill, structural excavating and backfilling, transportation and storage of excess earthwork materials; disposal of unsuitable, waste, and surplus materials; restoration of excavation and trench surfaces; and subsidiary work necessary to complete the grading of developed areas to conform with required lines, grades, and slopes.

B. Work includes but is not necessarily limited to; excavation for structures, tanks, foundations, manholes, vaults, electrical manholes, conduits, cables, raceways and ducts, pipes, paving; embankments; grading; and related work such as sheeting, bracing and dewatering.

C. Provide services of a licensed Professional Engineer, registered in the State of Texas, to prepare temporary excavation support system, dewatering system designs, and submittals.

D. Provide temporary excavation support systems, including sheeting, shoring, and bracing, to ensure the safety of personnel and protect adjacent structures, piping, and other materials in accordance with Federal, State and local laws, regulations, and requirements. Temporary excavation support systems are specified in Section 315000 “Excavation Support and Protection.”

E. Provide temporary dewatering, surface water control systems, and operate to dewater and maintain excavations in a dry condition. Control drainage into excavations and remove seepage water and rainwater. Dewatering and surface water control are specified in Section 312319 “Dewatering.”

F. Examine site and review available geotechnical report prior to submitting a proposal, taking into consideration project conditions that may affect the work. Owner and Design Engineer do not assume responsibility for variations of subsurface conditions at locations other than places shown and at the time investigations were made.

G. Owner to provide field testing for compaction of subgrade and fill materials by an independent testing laboratory. The costs of this testing to confirm compliance with this Section will be paid by the Owner. Should any test fail to meet the requirements of this section, that work shall be repaired and retested. Retesting will be at the Contractor’s expense.

H. Do not initiate extra work without written notification to Owner and Engineer and receiving Owner’s written approval in response.

I. Excavation includes material of every description and of whatever substance encountered regardless of the methods or equipment required to remove the materials.

J. Protect existing structures and utilities that remain.

K. Related Requirements:

1. Section G5 “Granular Fill Materials” for fill materials.
2. Section 310515 “Soils and Aggregates for Earthwork” for fill materials.
3. Section G3 "Site Clearing" for site preparation work, including stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
4. Section G4 “Pipe Excavation, Trenching, Embedment, Encasement and Backfilling” for stated work.
5. Section 312319 "Dewatering" for controlling surface and groundwater and disposing of water during construction.
6. Section G6 “Sedimentation and Temporary Erosion Controls” for temporary stated work.
7. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

C. Coverage: Pass of compaction equipment over the complete surface area of exposed lift or subgrade to receive compaction.

D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Additional Excavation: Excavation as directed by Engineer to correct Contractor’s work not in compliance with Contract Documents, which will be performed without additional compensation.
3. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
4. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be provided without additional compensation.

E. Finished Grade: Required final grade elevation indicated on Drawings. Spot elevations take precedent over proposed contours.

F. In-the-Dry: An excavation subgrade where groundwater level: has been lowered to at least 2 feet below lowest level of excavation; is stable with no ponded water, mud, or muck; is able to support construction equipment without rutting or disturbance; and is suitable for placement and compaction of fill material, pipe, or concrete foundations.

G. Objectionable Material: Includes topsoil, organic matter, contaminated soil, construction debris, perishable materials, snow, ice, frozen earth, and rocks or lumps of cemented soils over 6 inches in maximum dimension.

H. Optimum Moisture Content: Moisture content (percent by dry weight) corresponding to maximum dry density of the same material as determined by ASTM Test Method D698.

I. Overexcavation: Removal of unsuitable soil or objectionable material at or below the normal grade of excavation or subgrade as indicated on Drawings.

J. Percent Compaction: Required in-place dry density of the material, expressed as a percentage of the maximum dry density of the same material, as determined in the laboratory by ASTM Test Method D698.

K. Structural Fill: Backfill which is placed against the exterior side of the structure walls.

L. Structures: Buildings, wet wells, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, manholes and vaults, or other man-made stationary features constructed above or below the ground surface.

M. Subgrade: Required surface of subsoil, borrow fill, or compacted fill that is immediately beneath site improvements, especially dimensioned fill, paving, or other surfacing material.

N. Unsuitable Soil: Includes existing fill materials, organic soils, weak native soils, or clays with a plasticity index of greater than 30, and any materials that cannot be properly placed and compacted as specified.

O. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

P. Zone of Influence: A line extending at least 2 feet beyond foundation or pipeline edge, then outward and downward at a slope of 1 horizontal to 1 vertical. Do no excavation below foundation of existing structures or pipeline.

Q. Professional Engineer: Registered Professional Engineer meeting project qualifications and who is hired by Contractor.

R. Professional Geologist: Registered Professional Geologist meeting project qualifications and who is hired by Contractor.

S. The Engineer: The Engineer or designated representative hired by Owner.

1. Approval given by the Engineer shall not relieve Contractor of its responsibilities for performing the work in accordance with Contract Document requirements.

1.4 ACTION SUBMITTALS

A. Coordinate various submittal types required by this Section with requirements of dewatering, support of excavation, rock removal, and geotechnical instrumentation submittals specified in other Sections.

B. Slope Stability Evaluation: Submit a temporary excavation slope stability evaluation in accordance with OSHA for temporary slopes over 20 feet in height or where existing or proposed facilities or property limits are located at the top of the slope and within a distance from the top of the slope equal to the slope height.

1. Prepare evaluation by a licensed Professional Engineer registered in the State of Texas.

C. Site Characterization Data: Submit following information regarding off-site source and material:

1. Site location.
2. Present and past usage of the source site and material.
3. Previously existing reports associated with an assessment of source site relating to presence of oil or other hazardous materials.
4. Location within the site from which the material will be obtained.

D. Samples: Submit a representative sample weighing approximately 50 pounds of each fill material, filter sand, and crushed stone contained in sealed 5 gallon containers, at least 30 calendar days prior to date of anticipated use of each material.

E. Submit laboratory test results for fill materials that include maximum density, gradation, Atterberg limits, sand equivalent, and other applicable criteria, at least 72 hours prior to importing or placing fill.

F. Prepare excavation support system designs by a licensed Professional Engineer, registered in State in which the work is located and having a minimum of 5 years of professional experience in design and construction of excavation support systems.

1. Submit an original and three copies of licensed Professional Engineer's certification, on PE form specified in Section 01 33 00 “Submittal Procedures,” stating excavation support systems designs have been prepared by Professional Engineer who is responsible for their execution.

1.5 INFORMATIONAL SUBMITTALS

A. Construction and Operations Plan: Submit proposed methods of construction, including earthwork operations, excavation limits, slopes, fill material moisture conditioning and handling, compaction equipment, excavation support systems designs, backfilling and filling and compaction, and material sources.

1. Include additional submittal requirements related to schedule, work sequence, and on-site and off-site storage when necessary based on project conditions.
2. Submit excavation support system plan as prepared by registered Professional Engineer complying with requirements stated in previous Article.

B. Submit copies of field daily reports by soil technician at the end of each work day that earthwork and grading operations occur.

C. Upon completion of earthwork and grading operations, submit an as-graded map showing density test numbers and locations, a table of density test results and depths, and a certification of compliance by geotechnical engineer in charge.

D. Qualification Data: For qualified testing agency to conduct geotechnical observation, testing and documentation. include qualifications of firm, resumes of soil technicians assigned to the project, and licensed geotechnical engineer in charge.

1. Firm Qualifications: Meet ASTM D3740.
2. Soil Technicians: Have minimum three years demonstrated experience in earthwork and grading operations and satisfy certification requirements of agency having local jurisdiction.

    a. The Engineer reserves right to request substitution of soil technicians assigned to field work. Do not substitute assigned soil technicians without prior approval of the Engineer.

E. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.6 QUALITY ASSURANCE

A. Excavation, trenching, sheeting, bracing, and similar work shall comply with requirements of OSHA excavation safety standards, 29 CFR Part 1926 Subpart P and State and local authorities having jurisdiction. Where conflict between OSHA, State and local regulations exists, apply most stringent requirements.

B. At least three working days prior to starting any excavation, notify the appropriate regional notification center for underground utilities and underground utility owners who are not members of notification center. To obtain area specific information for project site, refer to www.texas811.com.

C. Quality Control Testing for Off-site Borrow Materials:

1. Chemical testing will not be required where site characterization of off-site borrow sources indicates that soils are acceptable for use. If site characterization data or materials are suspected of being contaminated, perform chemical testing as directed by The Engineer with no additional compensation.
2. Chemical Test Data: Test each material source requiring testing by a person experienced in sample collection who is a registered Professional Engineer or geologist, or certified groundwater or environmental professional registered in the State of Texas. Submit samples of each proposed material to a chemical analytical laboratory, certified by the governing agency, for following analyses:

    a. Volatile Organic Compounds: EPA 8240 plus Hazardous Substance List (HSL) Parameters.
    b. Acid and Base Neutral Extractable Organic Compounds: EPA 8270.

c. Pesticides and PCBs: EPA 8080.
d. Total Petroleum Hydrocarbons: Infrared Method, EPA 9071/418.1.
e. Thirteen Priority Pollutant Metals: EPA 7000 Series.
f. Total Cyanide: EPA 9012.

3. Obtain and test off-site borrow samples in accordance with criteria established by the Engineer. Submit results for review and approval prior to use on site.

1.7 FIELD CONDITIONS

A. Be responsible for construction layout and reference staking necessary for proper control and satisfactory completion of structures, cutting, filling, grading, drainage, fencing, embankment improvements, curbing, and other appurtenances.

B. Perform construction layout and staking by a Professional Surveyor or Professional Engineer registered in State of Texas, experienced and skilled in construction layout and staking requirements.

C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earthwork operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

D. Utility Locator Service: Notify utility locator service "One Call" for area where Project is located before beginning earthwork operations.

E. Do not commence earthwork operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section G6 "Sedimentation and Temporary Erosion Control" and Section G3 "Site Clearing" are in place.

F. Do not commence earthwork operations until plant-protection measures are in place.

G. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

H. Do not direct vehicle or equipment exhaust towards protection zones.

I. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Fill materials designated for use in this Section are specified in Section G5 “Granular Fill Materials” and Section 310515 “Soils and Aggregates for Earthwork.”

B. On-Site Fill Material: Earth and rock material obtained at project site during excavation, following clearing and stripping, from which any Unsuitable Soil or Objectionable Material has been removed.

C. General: Provide imported fill materials when sufficient satisfactory soil materials are not available from excavations.

D. Provide fill or bedding material as noted on the Drawings or as referenced in the Contract Documents.

E. Lean concrete fill used for a working mat, seal slab or to replace over excavated material: Cast-in-Place concrete meeting requirement of Section 033000, with the concrete compressive strength equal to a minimum of 3,500 psi.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, tanks, utilities, sidewalks, pavements, fencing, landscaping, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

1. If necessary, remove and restore or replace curbing, driveway aprons, and fencing after performing backfilling work.
2. Replace existing facilities damaged by construction with new material fully equal to existing without additional compensation.

B. Prior to and During Earthwork Operations:

1. Provide, monitor, and maintain geotechnical instrumentation regarding settlement; coordinate with Section 310900 “Geotechnical Instrumentation and Monitoring.”.
2. Provide, monitor, and maintain excavation support; coordinate with Section 315000 “Excavation Support and Protection.”

a. Use excavation support system for excavations within the zone of influence for existing structures or utilities.
b. Do not permit excavations below base level of adjacent foundations or retaining walls, unless excavation design and bracing includes an analysis of structure’s stability supported by the foundation. When necessary due to project conditions, incorporate required bracing and foundation underpinning.

3. Provide, monitor, and maintain dewatering and drainage systems; coordinate with Section 312319 “Dewatering.”

C. Test Pits:

1. Perform exploratory excavation work, test pits, for purpose of verifying the location of underground utilities and structures and to check for unknown utilities and structures, prior to commencing excavation work.
2. Backfill and compact test pits as soon as desired information has been obtained. Stabilize backfilled surfaces in accordance with approved erosion and sedimentation control plans.

D. Clearing and Stripping. Initially clear and strip ground surfaces beneath planned structures and in areas requiring excavation or filling of organic material and debris. Do not use those materials as On-Site Fill Material; remove from the site and properly disposed or reuse as topsoil in landscape areas.

E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

F. Saw cut existing pavement with a saw, wheel, or pneumatic chisel along straight lines before excavating.

3.2 DEWATERING AND DRAINAG

A. Provide dewatering and drainage in accordance with Section 312319 “Dewatering”. This Article supplements those requirements.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff and groundwater seepage away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Prior to excavation, verify groundwater will be at required level indicated on approved dewatering and drainage submittal.

E. Accomplish dewatering by methods that preserve undisturbed state of subgrade soils. Dewater in a manner to prevent boiling, detrimental under-seepage, or disturbance at excavation base.

3.3 SUPPORT OF EXCAVATION

A. Provide excavation support as required by federal, state, or local laws, ordinances, regulations, and safety requirements and in accordance with Section 315000 “Excavation Support and Protection.” This Article supplements those requirements.

B. Install excavation support in accordance with reviewed Shop Drawings prior to beginning excavation work.

C. Construct temporary excavation slopes in accordance with the requirements of OSHA excavation safety standards and approved Shop Drawings.

D. Where allowed, carefully remove excavation supports in a manner without endangering the Work or other adjacent structures, utilities, or property. Immediately fill voids left or caused by withdrawal of supports with sand and compact.

3.4 EXCAVATION

A. Include material of every description and of whatever substance encountered as an unclassified excavation.

B. General: Excavate on-site soils using standard earthmoving equipment. Excavation in dense soil or rock may require special equipment. Do not plough, scrape, or dig earth with machinery so near to finished subgrade to result in excavation of or disturbance of below grade material.

C. Seal slabs or working mats are specifically required in areas indicated on the Drawings. In areas not specifically indicated, seal slabs may be used at the Contractor's option.

D. Make excavations to grades indicated on Drawings and in widths sufficient for laying of pipe, construction of the structure, installing bracing, excavation supports, dewatering and drainage facilities, and working clearances.

E. Perform excavation in-the-dry and accomplished by methods which preserve the natural undisturbed condition of subgrade soils.

F. Moisture Sensitive Soils: Use a smooth-edge bucket to excavate last one foot of depth when excavation is to end in such soils.

G. If excavation bottom is removed below the limits shown on Drawings, specified, or directed by the Engineer, refill with structural fill, lean concrete or other material satisfactory to the Engineer without additional compensation.

H. When excavation has reached prescribed depths, notify the Engineer who will observe the conditions. If materials and conditions are not satisfactory, the Engineer will issue instructions for corrective procedures. The Engineer will be the sole judge as to whether the work has been accomplished satisfactorily.

I. Subgrade soils that have become soft, loose, quick, or otherwise unsatisfactory due to inadequate excavation, dewatering, or other construction methods in the opinion of the Engineer, remove existing soil and replaced with structural fill or other material as acceptable to the Engineer at Contractor's expense.

J. Exposed subgrades for foundations shall be proof rolled with at least two overlapping coverages of a vibratory drum roller with a minimum static drum weight of 20 ton. Conduct proof-rolling in presence of the Engineer or the Engineer’s designated representative. The Engineer will waive this requirement, if in its opinion the subgrade will be rendered unsuitable by such proof-rolling.

1. Confined Areas: Proof-roll with hand operated vibratory equipment that is approved by the Engineer.

K. Perform overexcavation at the Engineer's request to remove unsuitable soil, objectionable material, or other materials as determined by the Engineer and to such depth and width as directed. Replace with suitable material as directed by the Engineer.

1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

L. Perform excavation for pipelines beneath structures and excavation for footings with excavating equipment operating from the subgrade for the structure, while in-the-dry and in a manner preserving the undisturbed state of subgrade soils.

M. When excavations have reached the required subgrade, including any allowances for working mats or base materials and prior to their placement, notify soils testing laboratory to verify suitability of existing subgrade soils for anticipated foundation and structural loadings.

1. If existing subgrade soils are determined to be unsuitable, follow direction provided by the Engineer regarding removal and replacement with suitable materials.
2. Notify the Engineer if the revised work scope would modify Contractor's cost and thereby entitle a change to the Contract Sum. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

N. Replace overexcavation beyond the limits and depths required by Contract Documents using structural fill, lean concrete or other material satisfactory to the Engineer without additional compensation.

O. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots.

3.5 SUBGRADE PREPARATION

A. Notify Engineer or the Engineer's designated representative when excavations have reached required subgrade.

B. Maintain excavated subgrade in-the-dry condition.

C. Prior to fill placement, remove objectionable material which includes, but not be limited to, pavement, topsoil, organic matter, contaminated soil, construction debris, perishable materials, snow, ice, frozen earth, and rocks or lumps of cemented soils over 6 inches in maximum dimension.

D. For subgrades consisting of granular soils, proof roll the final subgrade using at least four coverages of a vibrator plate compactor.

E. If subgrade slopes more than 10 percent, step subgrade to produce a stable, horizontal surface for placement of fill materials. Scarify existing subgrade slope to a depth of at least 6 inches. Adjust the moisture content of the scarified zone to or slightly above optimum, and compact the subgrade as specified.

F. Where existing subgrade contains a significant amount of clay or cohesive soils, over-excavate sufficiently below the bottom of structure for placement of a lean concrete working mat. Remove loose or soft material from the subgrade immediately prior to placing lean concrete working mat (seal slab).

G. Remove and replace soft subgrades or unusable material with structural fill, lean concrete or other material satisfactory to the Engineer.

H. During wet or freezing weather, or in areas where exposed subgrade consists of moisture-sensitive soils, take measures to protect foundation excavations once they have been approved by the Engineer. Protective measures include, but are not limited to, placing insulation blankets, placing a layer of fill, pea gravel, crushed rock, or lean concrete on the exposed subgrade, or covering the exposed subgrade with a plastic tent.

1. If additional overexcavation is required due to the subgrade not being protected against wet or freezing weather, perform additional work without additional compensation.

I. Notify the Engineer to observe conditions following subgrade preparation and prior to fill placement. If existing subgrade soils are determined to be unsuitable, follow direction provided by the Engineer regarding removal and replacement with suitable materials.

1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

3.6 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. Protect from precipitation.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.7 FILL PLACEMENT AND COMPACTION PROCEDURES

A. Fill and Backfill: Place materials in lifts to suit specified compaction requirements to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil or sod. Correct soft spots or uncompacted areas.

B. Do not place or compact fill and backfill when materials are too wet to properly compact.

1. In-place Soil Moisture Content: Maximum of three percentage points above optimum moisture content of soil, as determined by laboratory test of moisture-density relation appropriate to specified level of compaction.

C. Structural Fill and Embankment Fill: Construct to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil and sod. Correct soft spots or uncompacted areas.

D. Fill material shall be free of snow, ice, frost, and frozen earth. Do not place fill materials on frozen surfaces or surfaces covered by snow, ice, or frost.

E. Complete structure water-tightness tests and installation of dampproofing or waterproofing systems prior to placing various types of fill or backfill around structures.

F. Do not backfill against walls or grade beams until the structures bracing them at the top and bottom have been installed and, in the case of cast-in-place concrete, have achieved their 28-day compressive strength as specified in Section 033000 “Cast-in-Place Concrete." Place fill so that its depth is increased uniformly and gradually around the perimeter of any structure.

G. Compact filled slopes by slope rolling and trimming or overfill and trim back to plan grade to expose a firm, smooth surface free of loose material.

H. Do not allow fill lifts to contain stones with a dimension larger than 2/3 the specified loose measure lift thickness.

I. Stones or rock fragments larger than 4-inches in their greatest dimensions will not be permitted within the finished grade of fills and embankments.

J. Perform compaction in open areas using compaction equipment by any of the following methods:

1. Fully loaded ten-wheel trucks or front-end loaders.
2. Tractor dozers weighing minimum of 30,000 pounds.
3. Heavy vibratory rollers.

K. Confined Compaction: Perform compaction in confined areas, including areas within a 45-degree angle extending upward and outward from the base of a wall, and in areas where the use of large equipment is impractical, using hand-operated vibratory equipment or mechanical tampers. Do not allow heavy roller compaction equipment closer than 6-foot from the wall of any structure.

1. Do not exceed lift thickness of 6 inches, measured before compaction, when using hand operated equipment.

L. Moisture condition on-site fill material prior to placement, unless Contractor demonstrates to the Engineer in-place moisture conditioning methods can achieve the required moisture content.

M. Conduct compaction of each specified lift of fill materials by a minimum of four complete coverages with acceptable compaction equipment to a specified density as a percentage of maximum dry density as determined by ASTM D698, unless otherwise specified. Backfill compaction by means of "puddling" is not allowed.

N. Use select structural fill required beneath foundations or slabs on grade, except sidewalks, unless shown or otherwise specified. Place and compact structural fill in even lifts having a maximum thickness of 8 inches, measured before compaction.

O. Use select fill material placed within 10 feet of all structures, unless shown or otherwise specified. Uniformly place and compact select fill around the structure in even lifts having a maximum thickness of 8 inches, measured before compaction.

P. Use common fill in areas beyond those designated for select structural fill or select fill, unless shown or otherwise specified. Place in even lifts having a maximum thickness of 8 inches, measured before compaction.

Q. Place impervious fill in controlled, even lifts having a maximum thickness (measured before compaction) of 6 inches.

1. Permeability: Compact to attain a reading of less than 1×10^{-7} cm/sec.
2. Moisture Content: Compact to minus 2 percent to plus 3 percent of optimum moisture content.

3.8 COMPACTION REQUIREMENTS

A. Perform in-place testing of compacted fill lifts to measure in-place density and water content according to ASTM D6938, ASTM D698, TEX-113-E, and TEX-114-E.

B. Beneath Foundations and Slabs-on-Grade, except sidewalks: Compact top 12 inches of existing subgrade and each layer of fill, if applicable to:

1. Maximum Dry Density: For fills less than or equal to 5 feet in depth, minimum of 98 percent for ASTM D698. For fills greater than 5 feet in depth, minimum of 100 percent for ASTM D698.
2. Moisture Content: At or near its optimum moisture content, minus 2 percent to plus 3 percent.

C. Area Around Structures (within 10 feet): compact each fill or backfill layer to:

1. Maximum Dry Density: Minimum of 95 percent for ASTM D698.
2. Moisture Content: At or near its optimum moisture content, minus 2 percent to plus 3 percent.

D. Embankments, Lawn, or Unimproved Areas: Does not include embankments under roadways. Compact each fill or backfill layer to:

1. Maximum Dry Density: Minimum of 95 percent for ASTM D698.
2. Moisture Content:

a. For soils with plasticity index less than or equal to 25: At or near its optimum moisture content, minus 3 percent to plus 3 percent.
b. For soils with plasticity index greater than 25: At its optimum moisture content to plus 4 percent.

E. Sidewalks: Compact each fill layer to:

1. Maximum Dry Density: Minimum of 95 percent for ASTM D698.
2. Moisture Content: At or near its optimum moisture content, minus 2 percent to plus 3 percent.

F. Roads, Paved Areas, and Roadway Embankments: Compact each layer of fill or backfill to:

1. Maximum Dry Density: Minimum of 98 percent for TEX-113-E.
2. Moisture Content: At or near its optimum moisture content, minus 2 percent to plus 3 percent.

3.9 DISPOSAL OF UNSUITABLE, WASTE, AND SURPLUS EXCAVATED MATERIALS

A. Unsuitable soil, objectionable material, waste, and surplus excavated material shall be removed and disposed of off-site. Materials may be temporarily stockpiled in an area within the limits of construction that does not disrupt construction activities, create any nuisances or safety hazards, or otherwise restricts access to work site.

B. Topsoil or loam excavated under this Section may be salvaged for use as specified under Section G7 “Loaming, Hydroseeding and Permanent Erosion Control”, as approved by the Engineer.

3.10 GRADING

A. Perform grading to lines and grades shown on Drawings. Remove objectionable materials encountered within the limits indicated and disposed of off-site. Completely and continuously drained and dewatered subgrades throughout the grading process. Install temporary drains and drainage ditches to intercept or divert surface water that may affect the execution or condition of grading work.

B. If it is not possible at the time of grading to place material in its proper section of the Work, stockpile it in approved areas for later use. No additional compensation will be made for stockpiling or double handling of excavated materials.

C. Stones or rock fragments larger than 4-inches in their greatest dimensions will not be permitted within the top 6-inches of the finished grade of fills and embankments.

D. In cut areas, remove loose or protruding rocks in slopes to line or finished grade of the slope. Uniformly dress, cut, and fill slopes to slope cross-section and alignment shown on Drawings, unless otherwise directed by the Engineer.

3.11 RIPRAP AND SLOPE STABILIZATION

A. Prior to installation of riprap, install erosion control blankets on slopes in accordance with manufacturer's instructions.

1. Properly prepare area to be covered before the blanket is applied.
2. When the blanket is unrolled, place netting on top with fibers in contact with the soil over the entire area.

3. Butt blankets snugly at ends and sides, placing blankets a minimum of three rows, each four-foot wide, for a total width of 12 feet.
4. Staple blankets together in accordance with manufacturer's instructions.
5. Secure blankets by driving staple vertically into the ground, spaced approximately 6 feet apart, on each side and one row in the center, alternately spaced between each side.
6. Do not overlap adjoining blankets. Utilize a common row of staples to attach to ground.

B. Place riprap in conjunction with embankment construction with only sufficient lag in construction of riprap protection necessary to allow for proper construction of the portion of embankment protected and to prevent mixture of embankment and riprap material.

1. Place and grade bank run gravel to a depth of 6 inches to obtain a continuous uninterrupted bed of required thickness within the required limits.
2. Compact by a minimum one coverage by a crawler-type tractor with a total weight, including blade and equipment, of not less than 30,000 pounds.

C. Hand-place riprap on compacted gravel bed; do not dump materials. Lay stones so maximum dimension is perpendicular to the bed. Place stones so weight of each stone is carried by underlying material and not by adjacent stones. Place large stones at the bottom of slope. Fill spaces between stones with spalls of suitable size to construct a solid, stable slope, free from large voids and defects, and to protect embankments against erosion.

3.12 FIELD QUALITY CONTROL

A. Test and observe materials as described in this Article. Cooperate by allowing free access to work for selection of test materials and observations.

B. General Testing Requirements:

1. At Structures: Prior to placement of bedding material, concrete work mats, structural fill or structural concrete, coordinate with the Owner’s representative to verify suitability of existing subgrade soil.
2. Backfill and Fill: Prior to and during the placement of backfill and fill coordinate with the Owner’s representative to perform in-place soil density tests to verify that backfill and fill material has been placed and compacted in accordance with specified compaction requirements.

    a. Provide minimum 48 hours’ notice prior to placement of backfill and fill.

3. Subgrade: Do not cover with fill without observation, testing, and approval by the Owner’s representative.

    a. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer without additional compensation.

C. Test materials as described in CIP7.

D. If field test results are not in conformance with project requirements, costs involved in correcting deficiencies in compacted materials to satisfaction of the Engineer without additional compensation.

E. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer without additional compensation.

F. Testing methods shall comply with latest ASTM or equivalent AASHTO Standards applicable during bidding.

G. During placement of bedding, backfill, and fill, perform in-place soil density testing to confirm that fill material has been compacted in accordance with project requirements. The Engineer or Owner's representative may designate areas to be tested. Notify the Engineer and Owner's representative at least 72 hours in advance of scheduled compaction testing. In place soil density tests on backfill and fill material shall be as required by authorities having jurisdiction, project geotechnical report, but in no instance, shall less than those listed:

1. Structures, Pavements and Embankments: At least one density and moisture content test for each 5,000 square feet of surface area for each lift of fill at embankment, structure, pavement and manhole locations.
2. Trench Excavations: At least one nuclear density and one moisture content test at a maximum of 100 feet intervals for each lift of fill placed or as directed by the Engineer.
3. The Engineer may designate supplemental areas to be tested at additional compensation.

H. Materials which have been previously tested may be subjected to further testing from time to time and may be rejected, if it is determined that results do not conform to project requirements. Immediately remove rejected materials when directed by the Engineer, notwithstanding results of previous testing.

I. The Engineer or Owner may conduct additional soil testing. Cooperate fully in allowing additional test to be made, including free access to the work.

3.13 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by the Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 312000

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Temporary construction dewatering and surface water control and incorporates the design, equipment, materials, installation, operation, protection, monitoring and removal of dewatering and drainage system. Provide dewatering system sufficient to lower groundwater and collect surface water, regardless of groundwater level or rainfall at any time during the work.
2. Delegated Design.

B. Obtain and pay for permits required for dewatering and drainage systems. Implement measurements to comply with dewatering and discharge permits requirements.

C. Related Requirements:

1. Section 310515 “Soils and Aggregates for Earthwork” for soil and aggregate materials.
2.
3. Section 312000 "Earthwork" for excavating and backfilling in open areas.
4. Section G4 “Pipe Excavation, Trenching, Embedment, Encasement and Backfilling” for trenching, backfilling, and compaction.
5. Section G6 “Sedimentation and Temporary Erosion Control” for controlling surface-water runoff and ponding.
6. Section 315000 “Excavation Support and Protection” for temporary support of excavations.

1.3 DEFINITIONS

A. In-the-Dry: An excavation subgrade where all of the following are met:

1. Groundwater level has been lowered to at least 2 feet below lowest excavation level (or to top of rock).
2. Subgrade is stable with no ponded water, mud, or muck.
3. Subgrade is able to support construction equipment without rutting or disturbance.
4. Subgrade is suitable for placement and compaction of fill material, pipe, or concrete foundations.

B. Contractor's Engineered Design: Design prepared on behalf of Contractor by a registered Professional Engineer.

C. Professional Engineer: Licensed Professional Engineer meeting project qualifications and who is hired by Contractor.

D. The Engineer: Engineer hired by Owner.

1. Approvals given by The Engineer shall not relieve Contractor of its responsibilities for performing the work in accordance with Contract Document requirements.

1.4 DELEGATED DESIGN SUBMITTALS

A. Design Plan: Submit written dewatering and drainage system design plan, prepared by a qualified Professional Engineer, that includes:

1. Description of proposed dewatering system and installation methods to be used for system elements and observation wells.
2. Description of equipment, drilling methods, holes sizes, filter sand placement techniques, sealing materials, development techniques, number and location of dewatering points and observations wells.
3. Dewatering system design calculations demonstrating that the proposed system meets all requirements herein and elsewhere.
4. Sequence of well and well-point placement coordinated with support of excavation system installation and control procedures to be adopted, if dewatering problems arise.
5. Identification of anticipated area influenced by dewatering system and address impacts to adjacent existing and proposed structures.
6. Coordinate dewatering and drainage submittals with excavation and support of excavation submittals.

B. Shop Drawings: For dewatering system, prepared by a qualified Professional Engineer.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
3. Include pump capacity and anticipated discharge rate.
4. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
5. Show areas and depths of excavation to be dewatered and adjacent structures or facilities within the anticipated area influence.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and Professional Engineer.

B. Field quality-control reports.

C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.

D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in installation of dewatering systems and dewatering work and having a minimum of 5 years' experience.

B. Professional Engineer Qualifications: Licensed Professional Engineer registered in the State of Texas; having a minimum of 5 years' experience in design and construction of dewatering and drainage systems; and having completed not less than 5 successful dewatering and drainage projects of equal type, size, and complexity to that required for the work.

C. Land Surveyor Qualifications: Land Surveyor licensed in State of Texas.

D. Comply with authorities having jurisdiction for the following:

1. Drilling and abandoning of well-points used for dewatering systems.
2. Water discharge and disposal from dewatering operations.

E. Obtain required permits for storm water discharge from construction sites.

1.7 FIELD CONDITIONS

A. Project-Site Information: Geotechnical data has been prepared for this Project and is available for information only. Owner is not responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
2. Groundwater levels may vary during the work and should not be assumed to be accurately represented by groundwater level readings reported in the geotechnical data.
3. The geotechnical data is included elsewhere in Project Manual.

B. Survey Work: Engage a qualified land surveyor or Professional Engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Delegated Design: Engage a qualified professional engineer, as defined in Sections 013300 “Submittal Procedures” and 014000 “Quality Requirements”, to submit the items listed in the DELEGATED DESIGN SUBMITTALS Article.

B. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of surface and ground water and permit excavation and construction to proceed in-the-dry in accordance with the requirements herein and elsewhere.

1. Design dewatering system, including comprehensive engineering analysis by the Contractor’s Design Engineer.
2. Continuously monitor and maintain dewatering operations to ensure required groundwater lowering, erosion control, stability of excavations, excavation support, and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

C. Primary Purpose of Work: Preserve natural undisturbed condition of subgrade soils in areas of proposed excavations.

1. Prior to excavation, lower groundwater to at least 2 feet below lowest excavation subgrade elevation.
2. Additional groundwater lowering may be necessary beyond 2 feet requirement, depending on construction methods, equipment used, and prevailing groundwater and soil conditions. Lower groundwater as necessary to complete construction in accordance with Contract Documents without additional compensation

D. Design groundwater control system components to prevent loss of fines from surrounding soils. Use sand filters with dewatering installations, unless screens are properly sized by Contractor's design engineer to prevent passage of fines from surrounding soils.

E. Maintain standby pumping systems and sources of standby power at various sites.

F. Design dewatering system to prevent damage to adjacent properties, buildings, structures, utilities, and facilities from dewatering operations. Be responsible for damage to properties, buildings or structures, sewers and other utility installations, pavements, and work that may result from dewatering or surface water control operations.

G. Regulatory Requirements: Comply with governing regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

2.2 MATERIALS

A. Equipment: Piping, pumping, and other equipment and materials to provide control of surface water and groundwater in excavations.

B. Grout: Mixture of portland cement and bentonite clay or sand suitable for sealing abandoned well-points and piping.

PART 3 - EXECUTION

3.1 GENERAL

A. Control surface water and groundwater such that:

1. Excavation to final grade is made in-the-dry.
2. Natural undisturbed conditions of subgrade soils are maintained.
3. Softening, instability, or disturbance due to presence or seepage of water does not occur.
4. Construction and backfilling proceeds in-the-dry.
5. Floatation of completed portions of work shall be prohibited.

B. Methods of groundwater control may include but are not limited to perimeter trenches and sump pumping, perimeter groundwater cutoff, well points, ejectors, or any combination.

C. Where groundwater levels are above proposed bottom of excavation level, provide a pumped dewatering system for pre-drainage of soils prior to excavation and for maintaining lowered groundwater level until construction has been completed such that structure, pipeline, or fill will not be floated or otherwise damaged.

D. Vary type of system, spacing of dewatering units, and other details of the work depending on soil and water conditions at each location.

E. Do work in a manner to protect adjacent structures and utilities without causing loss of ground or disturbance to pipe bearing soils or soils supporting overlying or adjacent structures.

F. Install, monitor, and report data from observation wells. Evaluate collected data relative to groundwater control system performance and modify systems necessary to dewater site.

G. Locate groundwater control system components where they will not interfere with construction activities adjacent to the work area or interfere with installation and monitoring of geotechnical instrumentation including observation wells. Do not make excavations for sumps or drainage ditches within or below 1H:1V slopes extending downward and out from edges of existing or proposed foundation elements or from downward vertical footprint of pipe without approval by the Engineer.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways, if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section G7 “Sedimentation and Temporary Erosion Control” during dewatering operations.

3.3 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.

C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.4 SURFACE WATER CONTROL

A. Construct surface water control measures, including dikes, ditches, sumps and other methods to prevent flow of surface water into excavations and to allow construction to proceed without delay.

B. Grade excavation to divert surface water and seepage water within excavation areas into sumps and dewatering well-points.

3.5 EXCAVATION DEWATERING

A. Provide and maintain equipment and facilities to promptly remove and properly dispose of water entering excavations. Maintain excavations in-the-dry.

B. Excavation dewatering shall maintain the subgrade in a natural undisturbed condition and be in operation until the fill, structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

C. Do not place pipe, masonry, and concrete in water or submerge within 24 hours after being installed. Prevent water from flow over new masonry or concrete within four days after placement.

D. Prevent water from rising to cause unbalanced pressure on structures until concrete or mortar has set at least 24 hours. Prevent pipe flotation by promptly placing backfill.

E. Conduct dewatering to preserve natural undisturbed condition of subgrade soils at bottom of excavation.

F. If trench subgrade or excavation bottom becomes disturbed due to inadequate dewatering or drainage, excavate below normal grade as directed by the Engineer and refill with structural fill, screened gravel, or other material as approved by the Engineer without additional compensation.

G. It is expected that initial dewatering plan may be modified to suit variable soil and water conditions encountered. Dewater and excavate in a manner without causing loss of ground or disturbance to pipe bearing soil or soil that supports overlying or adjacent structures.

H. If methods do not properly dewater excavation, install additional groundwater observation wells as directed by the Engineer. Do not place pipe or structure until readings obtained from observation wells indicate that groundwater has been lowered to specified minimum of below bottom of final excavation.

I. Surround dewatering units with suitable filter sand with no fines being removed by pumping. Pump continuously from dewatering system until pipe or structure is adequately backfilled. Provide stand-by pumps.

J. Collect water entering excavations from precipitation or surface runoff in shallow ditches around excavation perimeter, drained to a sump, and pump from excavation to maintain a bottom free from standing water.

K. Dispose of drainage to an approved area. Do not use existing or new sanitary sewers to dispose of drainage.

3.6 WELL-POINT SYSTEMS

A. Where necessary, install a vacuum well-point system around excavation for dewatering purposes. Surround each well-point and riser pipe by a sand filter. Use sand of gradation that after initial development of well-points, quantity and size of soil particles discharged shall be negligible. Provide well-point systems capable of operating continuously under highest possible vacuum. Include sufficient valves and gauges to accurately monitor and control the system. Develop and redevelop well-points to provide reliable performance throughout the duration of the work.

B. Install well point systems in the Engineer's presence according with approved submittal.

3.7 OBSERVATION WELLS

A. Install observation wells in accordance with the approved submittal to monitor groundwater levels beneath and around excavated areas until adjacent structures and pipelines are completed and backfilled.

B. Observation well locations and depths to be sufficient to confirm operation of groundwater control system designed under Delegated Design is performing as intended. Locations and depths are subject to approval by Engineer.

C. Protect observation wells at ground surface by providing a lockable box or outer protective casing with lockable top and padlock. Design surface protection to prevent damage by vandalism, construction operations, and surface water infiltration.

1. Provide two copies of padlock keys at each well for the Engineer's access.
2. Develop observation wells to provide a reliable indication of groundwater levels. Re-developed wells: if well clogging is observed; in event of apparent erroneous readings; or as directed by the Engineer.
3. Submittal observation well installation logs, top of casing elevation, and well locations to the Engineer within 24 hours of completing well installation.

D. Observation Well Maintenance:

1. Maintain each observation well until adjacent structures and pipelines are completed and backfilled. Clean out or replace any observation well which ceases to be operable before adjacent work is completed.
2. Repair or replace wells without additional compensation, whether damage is caused by Contractor's operations or third parties.

E. Monitoring and Reporting of Observation Well Data:

1. Begin monitoring of groundwater levels in work areas prior to initial operation of drainage and dewatering system. Continue monitoring in areas where groundwater control is in operation until time that adjacent structures and pipelines are completed and backfilled or until time that groundwater control systems are turned off.
2. Be responsible for processing and reporting observation well data to the Engineer on a regular (minimum monthly) basis. Provide data to the Engineer on a form that includes following information: observation well number, depth to groundwater, total depth of well, top of casing elevation, groundwater level elevation, and date and time of reading.

F. Keep groundwater level at a minimum of 2 feet below lowest subgrade level for a given excavation, or to top-of-rock where applicable.

3.8 REMOVAL OF SYSTEMS

A. At completion of excavation and backfilling work and when approved by the Engineer, remove from site various pipe, well-points, pumps, generators, observation wells, other equipment, and accessories used for groundwater and surface water control systems.

1. Removed materials and equipment become property of Contractor.

B. Restore areas disturbed by installation and removal of groundwater control systems and observation wells to their original condition.

C. Leave in place well-points and observation wells located:

1. Within plan limits of structures or pipelines.
2. Within zone below 1H:1V planes extending downward and out from edges of foundation elements or from downward vertical footprint of pipe.
3. Where removal would result in ground movements causing adverse settlement to adjacent ground surface, utilities, or existing structures.

D. Fill pulled casings holes with sand. Where left in place, fill casings with cement grout and cut off a minimum of 3 feet below finished ground level or 1 foot below foundation level to prevent interference with finished structures or pipelines.

E. When directed by the Engineer, leave observation wells in place for continued monitoring. Cut casings flush with final ground level when directed and provide protective lockable boxes with locking devices. Provide protective boxes suitable for traffic and other conditions to which observation wells will be exposed.

F. All required regulatory permits and notifications are to be made by the Contractor’s licensed well driller upon removal/abandonment of wells.

END OF SECTION 31 23 19

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SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes temporary excavation and trench support and protection systems.

B. Related Requirements:

1. City of Georgetown Standard Specifications.
2. Section 312000 "Earthwork" for excavating and backfilling.
3. Section G3 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
4. Section 312319 "Dewatering" for lowering and disposing of ground water during construction and dewatering excavations.

1.3 DELEGATED DESIGN SUBMITTALS

A. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer, meeting the minimum performance requirements in Part 2 of this Section.

1. Include overall system plan, indicating clearances, dimensions, material properties, member sizes, locations, spacing and member penetrations depths, and locations of various types of lateral supports.
2. Show details, layout, arrangement, equipment requirements, and method of construction of proposed excavation support system.
3. Indicate existing and proposed utilities, structures or other obstructions.
4. Show wall elevations and locations of bracing.
5. Show overall installation sequence and removal of bracing. Indicate work levels to be performed before bracing is installed or removed.
6. Method of preloading bracing, if required, including preload for each member, and method of locking-off the preload. Submit detailed drawings of connections, jacking supports, and method of shimming.
   Include procedures for resolving difficulties arising from misalignment of members exposed during excavation and criteria for implementing those procedures.

B. Design Calculations: For excavation support and protection system. Include analysis data prepared, signed, and sealed by professional engineer responsible for their preparation.

1. Include loads on excavation support system for all stages of excavation, bracing removal, and concrete placement, including material and equipment loads on adjacent ground during construction.
2. Include design of wall and bracing members including details for all construction stages.
3. Include theoretical deflections of excavation support system and deformation of structures, pipelines, and other improvements located within areas influencing excavations.

C. Submit to the Engineer for review and acceptance, a plan of action to be implemented in the event any deformation threshold value is reached. Identify positive measures in action plan to further limit wall movement, including but not limited to trenching for struts and wales, placement of granular earth berms against the wall, installation of additional struts, or combinations thereof.

1. Include description and details of mitigating measures, work schedule, location and availability of materials, and structural details for connections to wall and support elements.
2. Be prepared to work 24 hours per day to implement such measures.
3. Perform remedial work and mitigating measures at no additional cost to Owner.

1.4 INFORMATIONAL SUBMITTALS

A. Submit quality control measures to ensure that performance of excavation support system complies with project requirements.

B. Submit welder qualifications and weld procedures in accordance with AWS D1.1.

C. Qualification Data: For land surveyor.

D. Maintain at least one copy of design at job site during excavation that includes a plan indicating sizes, types, and configurations of the materials to be used in protective system. Identity registered Contractor’s design engineer who stamped the design.

E. Do not proceed with excavation support or protection activities until submittals have been reviewed by the Engineer.

1.5 QUALITY ASSURANCE

A. Contractor Qualifications: Minimum 5 years’ experience compatible to indicated Work, and who employs labor and supervisory personnel similarly experienced in Work of this Section.

B. Contractor's Design Engineer: Registered Professional Engineer in State where the work is located with at least 5 years’ professional experience in design and construction of support of excavation systems and having completed a minimum of 5 successful excavation support projects of equal type, size, and complexity to specified work.

C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

D. Regulatory Requirements: Comply with authorities having jurisdiction, including OSHA requirements.

E. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.6 FIELD CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Contact utility companies and other responsible authorities to locate and mark underground utilities.
2. Notify Owner no fewer than two days in advance of proposed interruption of utility.
3. Do not proceed with interruption of utility without Owner's written permission.

B. Project-Site Information: Geotechnical data has been collected for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent soil borings and tests, conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
2. The geotechnical data is included elsewhere in Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Delegated Design: Engage a qualified professional engineer, as defined in Sections 013300 “Submittal Procedures” and 014000 “Quality Requirements”, to submit the items listed in the DELEGATED DESIGN SUBMITTALS Article.

B. Provide, design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads within specified movement criteria.

1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems to minimize horizontal and vertical movements without damaging existing buildings, structures, and site improvements adjacent to excavation.

4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

C. Do not permit excavations below the level of the base of adjacent existing foundations or retaining walls, unless excavation design and bracing includes an analysis of stability of structure supported by foundation and if necessary, incorporates required bracing or underpinning of foundation.

D. For support systems in which bracing is installed between opposite sides of the excavation, design excavation support of both sides to be nearly the same as feasible.

E. Where necessary to resist point loads, fill pipe piles used as soldier piles with concrete. Do not consider concrete strength in design of pipe pile for bending stress.

F. Design, install, operate, and maintain ground water control system to control ground water inflows, prevent piping or loss of ground, and maintain stability of the excavation. Refer to the requirements of Section 312319 “Dewatering.”

G. Design review and field monitoring activities by Owner or the Engineer does not relieve Contractor of its work responsibilities.

2.2 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Provide all material and equipment as required to install, monitor and maintain the excavation support system as designed by the Contractor’s Professional Engineer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that instrumentation is installed and initialized prior to start of work required by this Section.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Obtain permits from local authority having jurisdiction prior to initiating excavation work.

B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

C. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
2. Install fencing, gates, lights, and signs around excavations and staging areas to provide for public safety.

D. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.3 GENERAL

A. Install excavation support systems in accordance with the shop drawings and applicable permits.

B. Fill voids between excavation support system and earth with materials acceptable to the Engineer.

C. If unstable material is encountered during excavation, take immediately measures to contain it in place and prevent ground displacement.

D. If settlement or deflections of supports indicate that support system requires modification to prevent excessive movements, redesign and resubmit revised shop drawings and calculations to the Engineer without additional compensation.

E. Maintain sufficient quantity of material on site for protection of work and for use in case of accident or emergency.

3.4 PORTABLE TRENCH BOXES

A. Use portable trench boxes or sliding trench shields only for worker protection.

B. Do not use trench boxes as tunnel launch and exit shafts unless specifically approved by Contractor’s Professional Engineer. Additional excavation, backfilling, and surface restoration required as result of trench box use shall be provided without additional compensation.

C. Design, construct, and maintain trench boxes or shields to meet acceptable engineering and industry standards.

D. Install shields in a manner to restrict lateral or other hazardous movement of the shield in the event of sudden lateral loads.

E. Maintain a written copy of trench box manufacturer's specifications, recommendations, and limitations at job site during excavation work.

3.5 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation.

1. Install using impact hammer or vibratory hammer in predrilled holes.
2. Soldier Piles in Predrilled Holes:

    1. Provide casing or other methods of support to prevent caving of holes and loss of ground.
    2. Backfill with concrete from elevation of bottom excavation to pile tip elevation. Backfill remainder of predrilled hole with lean concrete or sand.
    3. Predrilled hole of sufficient diameter allowing for proper alignment and concrete backfilling of pile.

3. Install driven piles with driving shoes where hard driving is anticipated.
4. Advance driven soldier piles without aid of a water jet.

B. Extend soldier piles below excavation grade level to depths shown on reviewed Shop Drawings. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

C. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging.

1. Install lagging so ground loss does not occur between adjacent or below lowest board. As excavation proceeds, do not maximum height of 4 feet for unlagged face of excavation.
2. Do not exceed unlagged face of 2 feet, if water seeps or flows from excavation face or excavation face becomes unstable.

D. Fill voids behind lagging with soil, and compact.

E. Install wales at locations indicated on Drawings and secure to soldier piles.

3.6 STEEL SHEET PILING

A. Thoroughly cleaned and inspect sheet piles for defects and proper interlock dimensions prior to installation. Provide a tool for checking interlock dimensions.

B. Before starting excavation, drive one-piece sheet piling lengths in plumb position and tightly interlock vertical edges for its entire length to form a continuous barrier. Form a continuous diaphragm throughout length of each run of wall, bearing tightly against original ground.

1. Exercise care in driving so interlocking members can be extracted without damaging adjacent structures or utilities.
2. Use driving, cutting, and splicing methods conforming to approved Shop Drawings.
3. Use templates or other temporary alignment facilities to maintain piling line.

C. Accurately place piling, using templates and guide frames unless otherwise recommended in writing by sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 5 feet . Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

D. Install each sheet pile having sufficient clearance in interlocks to slide under its own weight into interlock of previously placed sheet pile.

E. Do not excavate in advance of steel sheet piling installation.

F. Where obstructions are anticipated, pre-excavate or pre-drill along sheet pile wall alignment without additional compensation. Do not extend pre-excavation and pre-drilling below lowest excavation level or into bearing soils for existing or future structures.

G. Remove obstructions encountered before the specified embedment for piles. Where obstructions cannot be removed, re-evaluate sheet pile system by Contractor's design Professional Engineer to show reduced embedment and additional toe stability measures to be implemented for sheet pile wall realignment. Submit proposed design measures to the Engineer for review.

H. Withdraw damaged or faulty aligned pilings with provide new piling, driven properly in its place without additional compensation.

I. Cut tops of sheet piling to uniform elevation at top of excavation.

3.7 LINER PANELS

A. Install liner plates as soon as excavation has progressed sufficiently to install next complete circumferential ring of liner plates. Complete ring of liner plates prior to continuing excavation.

1. Do not install more than one ring of liner plates at any time.

B. Stagger plates in vertical direction to facilitate shaft strength and leakage resistance.

C. Grout liner plates in accordance with approved Shop Drawings.

3.8 INTERNAL BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by the Engineer.
2. Install internal bracing if required to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

B. Provide internal bracing to carry maximum design load without distortion or buckling.

C. Include web stiffeners, plates, or angles required to prevent rotation, crippling, or buckling of connections and points of bearing between structural steel members. Allow for eccentricities caused by field fabrication and assembly.

D. Install and maintain bracing support members in tight contact with each other and with the surface being supported.

E. Coordinate excavation work with installation of bracing. Extend excavation no more than 2 feet below any brace level prior to installation of the bracing.

F. Use procedures that produce uniform loading of bracing member without eccentricities, overstressing, or distortion of system members.

3.9 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.10 REMOVAL

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.

1. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earthwork."
2. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Do not remove vertical support members that were installed within zone of influence of new or existing structures. Cut off support members installed within this zone at 5 feet below finished grade and abandon in place.

C. Do not remove internal bracing or transfer loads to permanent structure without prior acceptance of the Engineer.

D. Begin removal at excavation bottom and progress upward. Slowly release members noting indication of possible failure of remaining members or possible cave-in of excavation sides.

E. Progress backfilling together with removal of support systems from excavations.

F. Remove all portions of excavation support, unless otherwise indicated by approved Shop Drawings.

1. Zone of Influence Definition: Zone extending down and away from outer edge of the structure at 1 horizontal to 1 vertical.

G. Do not leave wood as part of abandoned portion of the work.

H. When removing excavation support system, do not disturb or damage adjacent buildings, structures, waterproofing material, or utilities. Fill voids immediately with lean concrete or well-graded cohesionless sand or as directed by the Engineer.

I. Immediately remove excavation support system material from site.

END OF SECTION 315000

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SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. General building applications of concrete are included in Section 033000 “Cast-in-Place Concrete.”

C. Joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction are included in Section 321373 “Concrete Paving Joint Sealants.”

D. Pavement Markings are included in Section SD5 “Striping.”

1.2 SUMMARY

A. Section Includes:

1. Aggregate base course.
2. Concrete paving: Constructing Portland cement concrete pavement, plain or reinforced in accordance with these specifications and with the lines, grades and dimensions shown on the plans. Specifically, the work includes:

    a. Designing the concrete mix.
    b. Preparation of subgrade and subbase material.
    c. Installation of steel reinforcement, dowel bars and tie bars.
    d. Furnishing, transporting, placing, consolidating, finishing and texturing of concrete.
    e. Furnishing concrete admixtures and additives.
    f. Constructing all joints and furnishing joint materials.
    g. Marking the pavement.
    h. Curing the pavement and furnishing all curing materials.

3. Quality Control of Concrete paving includes:

    a. Furnishing concrete necessary for making test beams and/or cylinders.
    b. Performing maturity testing.
    c. Coring and patching the pavement.
    d. Calibrating and checking the operation of batching equipment.
    e. Taking actions necessary to prevent or to repair cracking.
    f. Sawing and sealing joints.
    g. Verifying dowel bar alignment.
    h. Removing and replacing, or repair of defective pavement.

B. Related Requirements:

1. Section 033000 “Cast-In-Place Concrete” for general building applications of concrete.
2. Section 321373 “Concrete Paving Joint Sealants” for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
3. Section SD5 “Striping” for pavement markings.

1.3 PRE-INSTALLATION MEETINGS

A. Pre-installation Meeting: Conduct meeting at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete paving Subcontractor.
e. Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.

1.4 ACTION SUBMITTALS

A. Submit detailed information on materials proposed and installation methods.

B. Product Data: Submit data on material and equipment to be used in concrete pavement including:

1. Sources of aggregate, manufacturer data sheets for cement and concrete admixtures used in the concrete mix design.
2. Dowels and dowel bar assemblies.
3. Reinforcement or welded wire mesh.
4. Equipment to be used for placement, consolidation finishing, texturing and curing of concrete pavement.
5. Material and equipment to be used for joint installation including joint fillers, joint sealants, and saw-cutting and joint cleaning equipment.

C. Proposed Techniques: submit proposed techniques for placement, consolidation, finishing texturing and curing of concrete, and methods of concrete joint installation.

D. Pavement jointing plan showing joint types based on the proposed methods of installation.

E. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

F. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:

1. Exposed Aggregate: 10 lb Sample of each mix.

G. Concrete Mix Design Data:

1. Submit concrete mix design for each concrete strength.
2. Identify mix ingredients and proportions, including admixtures.
3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

H. Source Quality Control Submittals: Indicate results of factory tests and inspections.

1.5 PRECONSTRUCTION TESTING

A. Construct a test section consisting of minimum three panels in length by one panel width, including or as approved by the Engineer. Include paving, joints, surface texture, exposed aggregate, and specified slope in test section.

B. Locate the test section as directed or approved by the engineer**.** The test section will be part of the actual pavement area.

C. Incorporate accepted test section as part of Work.

1.6 FIELD CONDITIONS

A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

B. Do not begin placement of concrete unless the ambient temperature is at least 35 degrees F and rising.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Mix Design Requirements: Design concrete mix in accordance with 325.14R-17 (Guide for Design and Proportioning of Concrete Mixtures for Pavements).

B. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

D. Steel Reinforcement

1. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from as-drawn steel wire into flat sheets.
2. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
3. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.
4. Reinforcing Bars: ASTM A615/A615M, Grade 60; deformed.
5. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A615/A615M, Grade 60 deformed bars.
6. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.
7. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60 deformed bars; assembled with clips.
8. Plain-Steel Wire: ASTM A1064/A1064M, as drawn.
9. Deformed-Steel Wire: ASTM A1064/A1064M.
10. Epoxy-Coated-Steel Wire: ASTM A884/A884M, Class A; coated..
11. Dowel Bars: ASTM A615/A615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
12. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 plain-steel bars.
13. Tie Bars: ASTM A615/A615M, Grade 60; deformed.
14. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
15. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
16. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
17. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
18. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
19. Zinc Repair Material: ASTM A780/A780M.

2.2 CONCRETE MATERIALS

A. Cementitious Materials: Provide cementitious materials consisting of portland cement, blended, cement or only portland cement in combination with supplementary cementitious materials (SCM), that conform to appropriate specifications listed below. Use cementitious materials, of same type, brand, and source throughout Project.

1. Portland Cement: ASTM C150/C150M, gray portland cement Type I.

2. Blended Hydraulic Cement: Provide blended cement conforms to ASTM C595/C595M, Type IP or IS. Type IP blend shall only include ASTM C618 Class F or Class N pozzolan. Include in written statement from the manufacturer that the amount of pozzolan in the finished cement does not vary more than plus or minus 5 mass percent of the finished cement throughout production for the project.
3. Supplementary Cementitious Materials (SCMs):

    a. Fly Ash: ASTM C618, Class F.
    b. Raw or Calcined Natural Pozzolan: ASTM C618, Class N.
    c. Slag Cement: ASTM C989/C989M, Grade 120.

B. Aggregates:

1. Normal-Weight Aggregates: ASTM C33/C33M, Class 4M, uniformly graded. Provide aggregates from a single source.
2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Admixtures:

1. Air-Entraining Admixture: ASTM C260/C260M.
2. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
3. Water-Reducing Admixture: ASTM C494/C494M, Type A.
4. Retarding Admixture: ASTM C494/C494M, Type B.
5. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
7. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
8. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

2.3 CURING MATERIALS

1. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.
2. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
3. Water: Potable.

B. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. BASF Corporation-Construction Systems.
    b. Bon Tool Co.
    c. Brickform; a division of Solomon Colors.
    d. ChemMasters, Inc.
    e. Dayton Superior.

f. Euclid Chemical Company (The); an RPM company.
g. Kaufman Products, Inc.
h. L&M Construction Chemicals, Inc.
i. Lambert Corporation.
j. Metalcrete Industries.
k. Nox-Crete Products Group.
l. Sika Corporation.
m. SpecChem, LLC.
n. TK Products.
o. Vexcon Chemicals Inc.
p. W.R. Meadows, Inc.
q. Or equal.

C. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork in preformed strips.

D. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

E. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

F. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

G. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ChemMasters, Inc.
b. Dayton Superior.
c. Euclid Chemical Company (The); an RPM company.
d. Kaufman Products, Inc.
e. Nox-Crete Products Group.
f. QC Construction Products.
g. Scofield, L. M. Company.
h. Sika Corporation.
i. SpecChem, LLC.
j. TK Products.
k. Vexcon Chemicals Inc.
l. W.R. Meadows, Inc.
m. Or equal.

H. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anti-Hydro International, Inc.
    b. BASF Corporation-Construction Systems.
    c. Bon Tool Co.
    d. Brickform; a division of Solomon Colors.
    e. Butterfield Color.
    f. Dayton Superior.
    g. Decosup Inc.
    h. Dynamic Color Solutions, Inc.
    i. Euclid Chemical Company (The); an RPM company.
    j. H&C Concrete Care Products.
    k. Kaufman Products, Inc.
    l. L&M Construction Chemicals, Inc.
    m. Lambert Corporation.
    n. Metalcrete Industries.
    o. Proline Concrete Tools, Inc.
    p. QC Construction Products.
    q. Scofield, L. M. Company.
    r. Specialty Concrete Products, Inc.
    s. Stampcrete International, Ltd.
    t. SuperStone, Inc.
    u. SureCrete Design Products.
    v. Or equal.

2. Color: As indicated by manufacturer's designation.
3. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8 inchsieve and 85 percent retained on a No. 8 sieve.

2.4 STAMPED DETECTABLE WARNING MATERIALS

A. Detectable Warning Stamp: Semi-rigid polyurethane mats with formed underside capable of imprinting detectable warning pattern on plastic concrete; perforated with a vent hole at each dome.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADA Solutions, Inc.
2. Advanced Surfaces Inc.
3. Butterfield Color.
4. Stampcrete International, Ltd.
5. Transpo Industries, Inc.
6. Or equal.

C. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation designed to facilitate release of stamp mats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advanced Surfaces Inc.
b. Artcrete, Inc.
c. Bon Tool Co.
d. Brickform; a division of Solomon Colors.
e. Butterfield Color.
f. Decosup Inc.
g. Matcrete Inc.
h. Proline Concrete Tools, Inc.
i. QC Construction Products.
j. Scofield, L. M. Company.
k. Southern Color N.A., Inc.; a division of Rockwood Pigments.
l. Specialty Concrete Products, Inc.
m. Stampcrete International, Ltd.
n. SuperStone, Inc.
o. Or equal.

2.5 CONCRETE MIXTURES REQUIREMENTS

A. General:

1. Prepare design mixtures, proportioned according to ACI 325.14R-17, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
2. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
3. Design the mix to achieve a 28-day compressive strength of 4000 psi.
4. Design the mix with 0.50 maximum W/C ratio at the point of placement.
5. Maximum slump at the point of placement: 4 inch.
6. Provide a concrete mix with minimum cementitious material (i.e. Portland cement + supplemental cementitious material) content meeting the requirements of Table 5.4.5.1a of ACI 325.14R-17.

B. Aggregate:

1. Provide coarse and fine aggregate for the concrete mix from sources approved by Texas DOT.
2. Provide coarse and fine aggregate consisting of clean, hard, durable particles meeting the requirements of ASTM C33/C33M.
3. Provide coarse aggregate with 1-1/2 inch nominal maximum aggregate size.
4. Coarse and fine aggregate shall consist of particles that are generally spherical or cubical in shape.
5. Coarse aggregates shall be clean and free of deleterious material as follows:

a. Clay lumps and friable particles (ASTM C142/C142M) < 0.25 percent by mass.

b. Material finer than 0.075 mm No. 200 sieve (ASTM C117): < 1.0 percent.
c. Lightweight particles (ASTM C123/C123M): < 1.0 percent.
d. Total of all deleterious substances, exclusive of material finer than 0.075 mm No. 00 sieve: < 5.0 percent.

6. Fine aggregates shall be clean and free of deleterious material as follows:

a. Clay lumps and friable particles (ASTM C142/C142M) < 1.0 percent by mass.
b. Material finer than 0.075 mm No. 200 sieve (ASTM C117): < 3.0 percent.
c. Lightweight particles ASTM C123/C123M: < 0.5 percent.

7. The aggregate shall not have potential for alkali-silica reactivity (ASR) with cement as determined by ASTM C1778 or AASHTO PP65.
8. Provide coarse aggregate with no more than 40 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C131/C131M.
9. The combined coarse and fine aggregate grading shall be optimized in accordance with the guidelines of Section 5.4.10 of ACI 325.14R-17.

C. Portland Cement:

1. Provide ASTM C150/C150M Portland Cement Type I or II.

D. Supplementary Cementitious Materials (SCMs): Supplementary Cementitious Materials used in paving concrete shall conform to the following requirements:

1. Fly Ash: Provide fly ash that conforms to ASTM C618, Class F.
2. Natural Pozzolan: natural pozzolan that is raw or calcined shall conform to ASTM C618, Class N.
3. Slag Cement: Provide slag cement (ground-granulated blast-furnace slag) that conforms to ASTM C989/C989M, Grade 100 or Grade 120.
4. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

a. Fly Ash + Natural Pozzolan: 35 percent.
b. Slag Cement: 50 percent.
c. Combined Fly Ash and Slag Cement: 50 percent, with fly ash not exceeding 25 percent.
d. Combined Pozzolan and Slag Cement: 50 percent, with Pozzolan not exceeding 25 percent.

E. Concrete Admixtures:

1. General: Concrete chemical admixtures may include water reducers, retarders, accelerators, air-entrainers. When multiple admixtures in the same mixture, incompatibility issues should be avoided by using admixtures from the same manufacturer.
2. Air Entrainment Admixture (ASTM C260): Add air-entraining admixture to result in normal-weight concrete at point of placement having an air content of 4.5+/-1.5 percent. The amount of air entrainment admixtures to be added shall be determined based on the admixture’s manufacturer recommendations and trial mixes.

3. Water-Reducing Admixtures (WRAs): Use water-reducing admixture when required to increase strength and improve workability. Normal WRAs, ASTM C494/C494M Type A and water-reducing and retarding admixtures, Type D. High-range water-reducing admixtures (HRWRAs) shall be of Types F or G.
4. Retarding Admixtures: When used, retarders shall be ASTM C494/C494M Type A or Type D.

2.6 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch tickets for each batch discharged and used in the Work.

B. When air temperature is between 85 and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

C. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

2.7 SOURCE QUALITY CONTROL

A. Provide mix design for concrete roadway pavement, concrete driveway pavement, and concrete sidewalk.

B. Submit proposed mix design of each class of concrete to appointed firm for review prior to commencement of Work.

C. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.

D. Test samples according to ASTM C94/C94M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

C. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.

D. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

E. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

G. Ensure that sufficient area is prepared and compacted beyond the edge of paving. This area will be used as a wheel track for the paver or as a foundation for the side forms.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

B. The grade must be kept uniformly moist immediately before concrete is placed. Verify that the base is sprinkled sufficiently ahead of the paving train to keep the material moist without ponding water.

3.3 INSTALLATION

A. Edge forms and screed:

1. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
2. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

B. Steel Reinforcement:

1. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
2. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
3. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
4. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
5. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
6. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.

7. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2 inch overlap of adjacent mats.
8. Install dowel bars and support assemblies at joints as shown on the plans. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint. Ensure that dowel bars and tie bars are placed in accordance with the dimensions and provisions of the Contract Plans. Ensure that dowels are of the correct size and length. Apply lubricant to one half of the dowel length but not to the tie bars. Ensure that joint locations are properly and accurately marked for the saw crew.

C. Joints:

1. Construct joints that conform to the locations and details in the plans. Joints shall be constructed perpendicular to the finished grade of the pavement. Provide joints that are straight and continuous from edge to edge or end to end of the pavement with no abrupt offset and no gradual deviation greater than 1/2 inch.
2. Change from the jointing pattern shown on the design drawings or the approved shop drawings is not allowed without written approval.
3. Seal joints immediately following curing of the concrete or as soon thereafter as weather conditions permit.
4. When Joints intersect each other, it should be at a right angle. Also, joints should form 90-degree angles with free pavement edges. When the alignment of a joint is less than 90 degrees with a free edge, route the last 3 feet of the joint to run perpendicular to the free edge.
5. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated on the plans. When new joints mismatch existing joints, provide steel reinforcement for the first row of panels in the new concrete pavement.
6. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
7. Provide tie bars at sides of paving strips where indicated.
8. Contraction (Control) Joints: The purpose of contraction joints is to relieve early shrinkage stress within the pavement.

    a. Contraction joints must be cut as soon as the concrete has hardened enough to support the saw equipment and allow cutting without excessive chipping, spalling or tearing of the cut.
    b. Require immediate correction of the operation if excessive raveling occurs during sawing.
    c. If a sharp edge joint is being obtained on control cutting, it can generally be regarded that the concrete has hardened excessively, and sawing is being conducted late.

9. Verify that joints are centered over dowels.

    a. Saw the joints at the required spacing consecutively in the sequence of the concrete placement.
    b. Immediately after the joint is sawed, thoroughly flush the saw cut and adjacent concrete surface with water and vacuumed until all waste from sawing is removed from the joint and adjacent concrete surface.
    c. Respray the surface around the joint with curing compound as soon as free water disappears.

d. Take necessary precautions to ensure that the concrete is properly protected from damage and cured at sawed joints.
e. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, or as shown on the plans. Construct contraction joints by grooving or saw-cutting as follows:

10. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8 inch radius. Repeat grooving of contraction joints after applying surface finishes.

    a. Tolerance: Ensure that grooved joints are within 3 inch either way from centers of dowels.

11. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

    a. Tolerance: Ensure that sawed joints are within 3 inch either way from centers of dowels.

12. Construction Joints: Set construction joints at side forms and at end terminations of paving where paving operations are stopped for more than one-half hour. Provide construction joints at a planned joint location. Install dowels, tie bars in the construction joints, or thicken the edges as indicated.
13. Isolation/ Expansion Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

    a. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
    b. Terminate joint filler not less than 1/2 inch or more than 1 inchbelow finished surface if joint sealant is indicated.
    c. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
    d. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

14. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8 inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

D. Concrete Hauling and Placement:

1. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
2. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

3. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
4. Provide transporting equipment designed and operated to deliver and discharge the required concrete mixture completely without segregation.
5. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
6. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing is completed.
7. Deposit and spread concrete in a continuous operation inside formed area. Transporting equipment is not to be allowed to operate on the prepared and compacted underlying material. Do not push or drag concrete into place or use vibrators to move concrete into place.
8. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Insert vibrators into the concrete to a depth that provides the best full-depth consolidation but not closer to the underlying material than 2 inches (50 mm). Insert hand-operated vibrators between 6 to 15 inches (150 to 400 mm) on centers. Excessive vibration is not permitted. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) requires the immediate stopping of the paving operation and approved adjustment of the equipment or procedures.
9. Consolidate concrete along face of forms with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.
10. Screed paving surface with a straightedge and strike off.
11. Initial floating stage between screeding and final float finish is included in this article rather than in "Concrete Protection and Curing" Article.
12. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
13. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

E. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

F. Detectable Warning Installation:

1. Blockouts: Form blockouts in concrete for installation of detectable paving units.
2. Tolerance for Opening Size: Plus 1/4 inch, no minus.
3. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles. Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete immediately after screeding concrete surface.

4. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.

    a. Before using stamp mats, verify that the vent holes are unobstructed.
    b. Apply liquid release agent to the concrete surface and the stamp mat.
    c. Stamping: While initially finished concrete is plastic, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
    d. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.

5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.
6. Insert requirements for concrete stain, pigmented sealer, or pigmented curing and sealing compound if pigment is required. Pigmented mineral dry-shake hardener is not used for stamped detectable warnings.

3.4 TOLERANCES

A. Comply with tolerances in ACI 117 (ACI 117M) and as follows:

B. ACI 117 (ACI 117M) establishes few paving tolerances; those in subparagraphs below are based on ACI 330.1. Revise to suit Project.

C. Elevation: 3/4 inch.

D. Thickness: Plus 3/8 inch, minus 1/4 inch.

E. Surface: Gap below 10 feet long; unleveled straightedge not to exceed 1/2 inch.

F. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.

G. Lateral Alignment and Spacing of Dowels: 1 inch.

H. Vertical Alignment of Dowels: 1/4 inch.

I. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inchesof dowel.

J. Joint Spacing: 3 inch.

K. Contraction Joint Depth: Plus 1/4 inch, no minus.

L. Joint Width: Plus 1/8 inch, no minus.

3.5 FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.6 SPECIAL FINISHES

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:

1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch.

1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. of dampened, slip-resistive aggregate over paving surface in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.
2. Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage and embed by power floating.
3. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
4. After curing, lightly work surface with a steel-wire brush or abrasive stone and water to expose nonslip aggregate.

D. Rock-Salt Finish: After initial troweling, uniformly spread rock salt over paving surface at the rate of 5 lb/100 sq. ft..

1. Embed rock salt into plastic concrete with roller or magnesium float.
2. Cover paving surface with 1-mil- thick polyethylene sheet and remove sheet when concrete has hardened and seven-day curing period has elapsed.
3. After seven-day curing period, saturate concrete with water and broom-sweep surface to dissolve remaining rock salt, thereby leaving pits and holes.

E. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surface according to manufacturer's written instructions and as follows:

1. Uniformly spread dry-shake hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer to match paving color required.
2. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color and embed hardener by final power floating.
3. After final power floating, apply a hand-troweled finish followed by a broom finish.
4. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 5000 sq. ft. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg Fand below and when it is 80 deg Fand above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
7. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

F. Coring: provide concrete cores at least 4 inch in diameter by full depth cut from points selected in the test section by the Engineer. The cores will be evaluated for surface paste, uniformity of aggregate distribution, segregation, voids, and thickness.

G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.

H. Concrete paving will be considered defective if it does not pass tests and inspections.

I. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

J. Prepare test and inspection reports.

K. Strength Test Samples:

1. Sampling Procedures: ASTM C172.
2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, standard cured.

3. Sample concrete and make one set of three cylinders for every 150 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area paving.
4. Make one additional cylinder during cold weather concreting, and field cure.

L. Field Testing:

1. Slump Test Method: ASTM C143/C143M or Tex-415-A.
2. Air Content Test Method: Tex-414-A, Tex-416-A or ASTM C457.
3. Temperature Test Method: ASTM C1064/C1064M or Tex-422-A.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

M. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39/C39M or Tex-418-A.
2. Test Acceptance: according to TxDOT standards.
3. Test one cylinder at 7 days.
4. Test two cylinders at 28 days.
5. Dispose remaining cylinders when testing is not required.

N. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.8 PROTECTION

A. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.

B. Coordinate minimum requirements for concrete strength with expected traffic conditions.

C. Do not permit pedestrian or vehicular traffic over paving for 7 days minimum after finishing.

D. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.

E. Drill test cores, where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

F. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

G. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

H. Concrete Protection:

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
2. Comply with ACI 306.1 for cold-weather protection.

I. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

J. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

K. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12 inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inch, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.
4. Maintain temperature of air next to concrete above 40 degrees F for the full curing periods.

3.9 ATTACHMENTS

A. Concrete Sidewalks and Median Barrier: 3,000 psi 28 day concrete, 4 inches thick, gray color Portland cement, exposed aggregate finish.

B. Concrete Area Paving: 4,000 psi 28 day concrete, 6 inches thick, 6/6 - 6 x 6 inch mesh reinforcing, wood float finish.

C. Concrete Roadways and Parking Areas: 4,000 psi 28-day concrete, with thickness and reinforcing as specified on drawings, wood float finish.

END OF SECTION 321313

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.
3. Cold-applied, fuel-resistant joint sealants.
4. Hot-applied, fuel-resistant joint sealants.
5. Joint-sealant backer materials.
6. Primers.

B. Related Requirements:

1. Section 321313 “Concrete Paving” for surface concrete pavement is pedestrian and traffic areas.

1.3 UNIT PRICES

A. Quantity of sealant will be paid based on actual measurement of the number of linear feet of in-place material that has been approved.

1.4 ACTION SUBMITTALS

A. Product Data: submit manufacturer certificate (data sheet) for each type of product and installation recommendations.

B. Copies of test reports.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Paving-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.

4. Joint-sealant color.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Testing: Perform testing of materials in an approved independent laboratory and submit certified copies of test reports for approval 15 days prior to use of materials at the job site.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When temperature within the joint wall is outside limits permitted by joint-sealant manufacturer or is below 40 degrees F.
2. When moisture is observed within joint.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
5. On same day as sawing occurred.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Provide joint sealants for various areas of types indicated in drawings and summarized below.

C. Hot-Applied Joint Sealants:

1. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type I or Type II.

D. Cold-Applied Joint Sealants:

1. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D 5893M, Type NS.
2. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893/D 5893M, Type SL.
3. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.
4. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.

E. Hot-Applied, Fuel-Resistant Joint Sealants:

1. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D7116, Type I or Type II.

F. Joint-Sealant Backer Materials:

1. Provide backer material that is a compressible, nonshrinking, nonabsorbing material. Use backer material that is 20 to 30 percent larger in diameter than the nominal width of joint. Backer material shall be nonreactive with proposed joint sealant. Material shall have a melting point at least 5 degrees F (3 degrees C) greater than pouring temperature of sealant being used when tested in accordance with ASTM D789. Material shall also have a water absorption of not more than 5 percent of sample weight when tested in accordance with ASTM C1016.
2. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
3. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
4. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

G. Primers:

1. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Inspect application equipment to ensure conformance to temperature requirements, proper proportioning and mixing (if two-component sealant) and proper installation. Evidences of bubbling, or improper installation will result in suspending operations until causes of deficiencies are determined and corrected.

3.2 PREPARATION

A. Removal of existing sealant: cut loose in-place sealant from both joint faces and to depth indicated on drawings, using routing equipment, concrete saw, or waterblaster. Prior to further

cleaning operations, remove loose old sealant remaining in joint opening by blowing with compressed air.

B. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions. Thoroughly clean joints to remove laitance, curing compound, and protrusions of hardened concrete.

1. Remove foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

C. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION

A. Seal joints immediately following final cleaning of joint walls and following placement of backup material. Open joints, that cannot be sealed under conditions specified, or when rain interrupts sealing operations shall be recleaned and allowed to dry prior to installing sealant.

B. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless installation instructions are modified by Engineer.

C. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

D. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability:

1. Do not leave gaps between ends of joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.
2. Completely fill joint from the bottom up to 1/4 inch plus or minus $1/16^{th}$ inch (6 mm plus or minus 2.0 mm) below pavement surface.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
4. Remove and discard excess or spilled sealant from pavement by approved methods.
5. Install sealant in such a manner as to prevent formation of voids and entrapped air.
6. Do not permit traffic over newly sealed pavement until authorized.

F. Tooling of Non-sag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3.4 PROTECTION

A. Clean off excess joint sealant as Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from original work.

END OF SECTION 321373

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SECTION 323113 – CHAIN LINK FENCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Chain-link fences.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete equipment bases/pads and post footings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Fence and gate posts, rails, and fittings.
b. Chain-link fabric, reinforcements, and attachments.

B. Shop Drawings: For each type of fence.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include accessories, hardware, and operational clearances.

C. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:

1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of chain-link fence.

B. Product Test Reports: For framework strength according to ASTM F1043, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of chain-link fences that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to comply with performance requirements.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Chain-link fence shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.

1. Design Wind Load: As indicated on Drawings

a. Minimum Post Size: Determine according to ASTM F1043 for post spacing not to exceed 10 feet for Material Group IA, ASTM F1043, Schedule 40 steel pipe.
b. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.

B. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

2.2 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:

1. Fabric Height: 8-feet.
2. Steel Wire for Fabric: 9 GA Galvanized Steel with 7 GA Galvanized bottom tension wire.

    a. Mesh Size: 2 inches.
    b. The chain link fabric shall conform to Federal Specification RR-F-191/1D.
    c. Fabric shall be fastened to intermediate posts with No. 6 aluminum fabric wire spaced approximately 15-inches apart and to top rail with 9 gauge wires spaced approximately 18-inches apart. The fabric shall be securely fastened to all terminal and gate posts with 3/4-inch by 1/10-inch stretcher bars with No. 11 gauge pressed steel bands spaced approximately 12-inches apart.
    d. Galvanized steel Fabric: ASTM A392, Type I, with hot dipped galvanized coating applied after weaving.
    e. Polymer-Coated Fabric: ASTM F668, over zinc-coated steel wire.

        1) Color: As selected by Engineer from manufacturer's full range, according to ASTM F934. Color shall be coordinated with the Owner.

    f. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.

3. Selvage: Twisted top and knuckled bottom.

2.3 FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 based on the following:

1. Fence Height: 96 inches.
2. Heavy-Industrial-Strength Material: Group IA, round steel pipe, Schedule 40.

    a. Line Post: 2.375 inches in diameter.
    b. End, Corner, and Pull Posts: 2.875 inches in diameter.

3. Horizontal Framework Members: Intermediate, top and bottom rails according to ASTM F1043.

    a. 1.66 inches in diameter.

4. Brace Rails: 1.66 inches in diameter according to ASTM F1043.

5. Polymer coating over metallic coating.

    a. Color: As selected by Engineer from manufacturer's full range, according to ASTM F934. Color shall be coordinated with the Owner.

2.4 TENSION WIRE

A. Polymer-Coated Steel Wire: 7 gauge galvanized steel, tension wire according to ASTM F1664.

1. Color: Match chain-link fabric, according to ASTM F934.

2.5 FITTINGS

A. Provide fittings according to ASTM F626.

B. Post Caps: Provide for each post.

1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: round-steel tubing not less than 6 inches long.
2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails to posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: According to ASTM F626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:

    a. Hot-Dip Galvanized Steel: 0.106-inch- diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.
    b. Aluminum: ASTM B211; Alloy 1350-H19; 0.148-inch- diameter, mill-finished wire.

I. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.

a. Polymer coating over metallic coating.

2. Aluminum: Mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Engineer.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.

1. Install fencing on established boundary lines inside property line.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect above ground portion of posts from concrete splatter.

D. New posts for all fences shall be anchored directly into new concrete footings as shown on the Drawings.

E. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 30 degrees or more. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.

F. Line Posts: Space line posts uniformly at 10 feet.

G. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at mid height of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

H. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

I. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

J. Intermediate and Bottom Rails: Secure to posts with fittings.

K. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

L. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 12 inches o.c.

M. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

N. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side.

3.4 GROUNDING AND BONDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fence Grounding:

1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
2. Install ground rods and connections at maximum intervals of 1500 feet.
3. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
4. Ground fence on each side of gates and other fence openings.

    a. Bond metal gates to gate posts.
    b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a ground rod located a maximum distance of 150 feet on each side of crossing.

D. Fences Enclosing Electrical Power Distribution Equipment: Ground according to IEEE C2 unless otherwise indicated.

E. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

F. Connections:

1. Make connections with clean, bare metal at points of contact.
2. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
4. Make above-grade ground connections with mechanical fasteners.
5. Make below-grade ground connections with exothermic welds.
6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

G. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests.

B. Prepare test reports.

3.6 ADJUSTING

A. Lubricate hardware and other moving parts.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences.

Table 1 – Coating Performance Requirements		
Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90 percent of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,000 hours (Scribed per D1654; failure mode is accumulation of 1/8 inch coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625 inch ball).
Weathering Resistance	D822 D2244, D523 (60 degree Method)	Weathering Resistance over 1,000 hours (Failure mode is 60 percent loss of gloss or color variance of more than 3 delta-E color units).

END OF SECTION 323113

SECTION 331210 - TEMPORARY BYPASS PUMPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish all labor, materials, equipment and incidentals required and install, field test, and operate temporary bypass pumping systems as proposed by the Contractor for the purpose of diverting flow around work areas as required by the provisions specified in Section CIP3 “Summary of Work”.

B. The design, installation and operation of temporary bypass pumping systems shall be the Contractor's responsibility. The Contractor shall provide the services of a professional bypass company who can demonstrate to the Owner and Engineer that the company specializes in the design and operation of temporary bypass pumping systems. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

C. Maintain temporary bypass pumping systems so that they are completely functional throughout the required period of service.

D. Following the required period of service, remove temporary bypass pumping systems from site.

E. Provide all maintenance including manufacturer recommended preventive maintenance and on-call repair services. Contractor shall provide repair services and/or replacement equipment 24 hours per day, seven days per week within 4 hours of being called.

F. Should the Contractor elect to use diesel fuel for temporary bypass pumping, the storage and handling of fuel shall be in strict accordance with the rules and regulations of the City of Georgetown, and the State of Texas. Provide a refueling service to maintain continuous 24-hours per day, seven days per week pumping system operation.

G. Related Requirements:

1. Section CIP3 “Summary of Work”.
2. Section WW3, “Connections to and Work on the Existing Wastewater System”

1.3 DELEGATED DESIGN SUBMITTALS

A. Submit the following:

1. A detailed description of each proposed temporary bypass pumping system including pumps, pump drives, piping, hoses, valves, fittings, controls, wiring and any other related

accessories required to provide a complete operating system in conformance with the requirements of this Section.

2. Detailed plans and sections showing the proposed pumping system layout including dimensions and elevations. Plan shall include but not be limited to the following:

    a. Staging area and access requirements for all pumps.
    b. Number, size, material, location and method of installation of suction piping.
    c. Number, size, material, location and method of installation of discharge piping.
    d. Pump size, capacity, number of units, diesel engine specifications, fuel tank capacity, fuel consumption requirements, and method of refueling.
    e. Calculations of static lift, pipe size selection, friction losses, flow velocity and pump selection.
    f. Pump curves showing pump operating range and the anticipated operating point at the anticipated pump on and pump off liquid elevations in the pump manhole.
    g. Proposed method of freeze protection.
    h. Proposed method of noise control for each pump.
    i. Temporary pipe supports, anchorage, cover material and other accessories as required to stabilize the piping system.
    j. Installation schedule and maintenance schedule.
    k. Vendor phone number and pager number for 24-hour service.
    l. A minimum of five reference installations of projects with similar size in wastewater pumping applications. Include contact names and phone numbers.
    m. List of recommended spare parts to be stored on-site for emergency maintenance.

3. Provide information on the vendor's service staff capabilities and replacement parts inventory to show that the vendor has sufficient resources to provide emergency service and replacement equipment and/or parts to the site within 4 hours of a service call.
4. A description of system operation and controls. Include a list of all alarm conditions and procedures for correcting problems including equipment replacement.
5. A description and schedule for the proposed procedures for start-up and testing of the facilities to demonstrate compliance with specified automatic operation and maintenance of a constant discharge pressure.
6. A plan of operations for inclement weather including winter storms. The plan shall demonstrate the ability to maintain pumping system operations throughout inclement weather events.
7. A description and schedule for the proposed procedures for dismantling the system, and restoring normal operations at the WWTP.

1.4 QUALITY ASSURANCE

A. Employ the services of a vendor who can demonstrate five years of recent and continuous specialization in the design, installation, operation and removal of temporary bypass pumping systems in wastewater applications. The complete system shall be furnished from a single vendor who shall be capable of providing service staff, repair parts and replacement of any deficient system component within four hours of a service call, 24-hours per day, seven days per week.

B. Provide the services of the manufacturer's representative for physical checkout field testing and operation and maintenance instruction for a minimum of one person day per pumping system. See requirements in PART 3.

C. Provide the services of the manufacturer's representative or designated alternative, who shall be contactable 24-hours per day via telephone or pager and shall be available to be on site within four hours of being contacted at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Xylem, Inc (Godwin Pumps of America).

B. Acme Dynamics.

C. Thompson Pump and Manufacturing Co.

D. Precision Pump Systems (Gorman-Rupp Pumps).

E. Or Equal.

2.2 SYSTEM DESCRIPTION

A. All pumping units and all accessories shall be in good operating condition. Each temporary bypass pumping system shall be complete including pumps, drives, piping, piping headers, valves, flow meter, controls and appurtenances as required for a complete system.

B. The pumps, drives and controls shall be designed and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, without cavitation, and without excessive vibration or strain. All parts shall be so designed and proportioned as to have the strength, stability and stiffness and be constructed to meet the specified requirements. Methods shall be provided for inspection, repairs, and adjustment.

C. All necessary foundation bolts, nuts, and washers shall be furnished.

D. Each piece of equipment shall be furnished with a nameplate (with embossed data) securely mounted to the body of the equipment to confirm that the equipment matches that described in the submittals. As a minimum, the nameplate for the pumps shall include the manufacturer's name and model number, serial number, rated flow capacity, head, speed and all other pertinent data.

E. Noise shall not exceed 85 dBA at a distance of 5 feet from any part of the system.

F. All equipment shall be suitable for outdoor operation under adverse weather conditions. Provide protection from freezing as required to maintain system operation.

G. Pumping system control panels shall be NEMA 4 and include flow indication, a flow totalizer, indicator lamps showing which pumps are operating, selector switch for auto or manual start and stop for each pump and visual and audible alarms for indication of operation failure and alarm conditions.

H. The temporary bypass pumping system shall comply with all City of Georgetown and Texas Commission on Environmental Quality (TCEQ) requirements.

2.3 PERFORMANCE REQUIREMENTS

A. Capacities and Characteristics:

1. Pumps shall be selected specifically for the flow and total dynamic head conditions of the specific bypass pumping setup proposed.

2. The flow capacities specified for the services listed below are provided for Contractor's convenience in the event Contractor deems that temporary bypass pumping is needed to meet the Owner's requirements in Section CIP3 "Summary of Work".

3. Each application requiring temporary bypass shall be designed for the following conditions of service. All pumps shall have a rising head capacity curve for stable pump operation from the minimum head operating point to the shut-off head.

a. <u>Application #1 – Filtrate Lift Station Temporary Bypass:</u>

1)	Number of pumps:	As required by the Application.
2)	Liquid:	Filtrate / Process Drain.
3)	Design capacity total peak (gpm):	694 gpm
4)	Typical dry weather flow (gpm):	440 gpm
5)	Type of drive:	Diesel engine.

4. Pumping System Components:

a. All pumps shall be centrifugal, end suction, fully automatic self-priming units that do not require the use of foot-valves, vacuum pumps, diaphragm pumps, or isolation valves or float apparatus in the priming system.
b. Pump seals shall be high pressure, mechanical self-adjusting type with solid carbide faces capable of withstanding suction pressures to 100 psi without the pump running. The mechanical seal shall be cooled and lubricated in an oil bath reservoir, requiring no maintenance or adjustment. The oil bath reservoir shall not come in contact with or leak into the pumped water. Each pump shall be capable of running dry, with no damage for extended periods of time. All pump seal metal parts shall be stainless steel. All elastomers shall be Viton.
c. Each pump shall be driven by a diesel engine or electric motor. Diesel engine shall be water cooled. If the Contractor uses electric motor driven pumps, power costs are the responsibility of the Contractor.
d. If using diesel driven pumps, each pump and diesel engine shall be skid mounted with integral fuel tank and skid lifting bracket.
e. Provide automatic start/stop controls for the pumping system to automatically maintain system flow. Controls shall be contained in a local control panel with provision to manually operate each pump, provide indication of pump operation, and indicate the total flow being pumped.
f. Provide all required suction and discharge pipe and fittings, discharge manifold pipe and fittings, shutoff valves, check valves, flow meter, pressure regulating valves, insulation, freeze protection, and all required accessories. All pipe and fittings shall

be steel with flanged or quick connect coupling connections, or high density polyethylene pipe with fused joints. All joints must be 100 percent restrained. Suction piping shall be rated for 25-inch Hg vacuum. Discharge piping, fittings, connections, valves, and other discharge piping accessories shall be rated for a minimum working pressure of 150 psi.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the system supplier's recommendations and approved shop drawing submittals.

B. Install pumping units on a firm level surface.

C. Furnish the services of the pump system supplier's representative for a minimum of one day per temporary bypass system to assist equipment installation and physical checkout.

3.2 FIELD QUALITY CONTROL

A. Provide field testing in accordance with the approved shop drawing submittal. Field tests shall demonstrate conformance with system requirements.

B. The Contractor shall require that field testing be conducted by the pump system supplier's representative in the presence of the Engineer. Furnish the services of the pump system supplier's representative for a minimum of one day per temporary bypass system to conduct required testing.

C. Field testing shall demonstrate a minimum of 24-hours of continuous operation. During the 24-hours of continuous operation, the system shall demonstrate the ability to automatically start and stop pumps in response to changing flow conditions.

D. Remove and replace any system component that fails to perform in accordance with specified requirements.

3.3 SYSTEM OPERATION

A. Perform all required maintenance on the equipment to maintain the system integrity and capacity as specified.

B. Provide clean-up and disposal of contaminated material and reporting for all product spills.

3.4 EQUIPMENT REMOVAL

A. At the completion of the period of service, disconnect all temporary piping and remove all system components from the site. Restore the work site to its original condition.

END OF SECTION 331210

SECTION 400506 - COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe penetrations.
2. Restrained joints.
3. Flexible connections.
4. Expansion joints.
5. Expansion loops.
6. Sleeve-type couplings.
7. Flange isolation kits.

B. Related Requirements:
1. Section 055000 “Metal Fabrications” for miscellaneous metalwork and fasteners as required by this Section.
2. Section 079200 “Joint Sealants” for sleeve sealant for pipe penetrations.
3. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
4. Section 400519 “Ductile Iron Process Pipe” for ductile-iron piping materials and appurtenances.
5. Section 400523 “Stainless Steel Process Pipe and Tubing” for stainless steel piping materials and appurtenances.
6. Section 400524 “Steel Process Pipe” for galvanized steel piping materials.
7. Section 400551 “Common Requirements for Process Valves” for common product requirements for valves for placement by this Section.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Submit manufacturer catalog information for each specified product, including installation instructions.
2. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

3. Expansion Joints: Indicate maximum temperature, pressure rating, and expansion compensation.

B. Shop Drawings:

1. Identification:

a. Submit list of wording, symbols, letter size, and color coding for pipe identification.
b. Comply with ASME A13.1.

2. Indicate restrained joint details and materials.
3. Submit layout drawings showing piece numbers and location, indicating restrained joint locations.
4. Indicate layout of piping systems, including flexible connectors, expansion joints and compensators, loops, offsets, and swing joints.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.

C. Manufacturer Instructions: Submit special procedures and setting dimensions.

D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statements:
1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.
3. Welders: Qualify procedures and personnel according to AWS D1.1/D1.1M.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping appurtenances.

B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.

B. Perform Work according to ASME B31.9 for installation of piping systems and according to AWS D1.1/D1.1M for welding materials and procedures.

C. Perform Work according to ASME B31.3 and manufacturer’s installation requirements for installation of piping systems and appurtenances.

D. Perform Work according to State of Texas Commission of Environmental Quality and City of Georgetown standards.

E. Surface-Burning Characteristics: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

C. Welders: AWS qualified within previous 12 months for employed weld types.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 ROTAMETERS

A. Direct Reading Scale for Air Service

1. Provide model IF2711 by Dwyer or equal.

    a. Maximum Temperature: 200 F
    b. Maximum Pressure: 200 PSI
    c. Accuracy: +/- 3%
    d. Repeatability: +/- 0.5%
    e. Turn-down Ratio: 10:1
    f. Materials:

        1) Flowtube: Borosilicate glass
        2) Guide Rods and Floats: 316 SS
        3) O-Rings: Fluoroelastomer
        4) Front Shield: Polycarbonate
        5) Side Panels: 304 SS

2.2 PIPE SLEEVES

A. All construction except new concrete walls:

1. Material: Schedule 40 galvanized steel conforming to ASTM A53.
2. 2-inch minimum circumference water stop welded to exterior sleeve at midpoint
3. Ends cut and ground to be:

    a. Flush with ground.
    b. Flush with ceiling.
    c. 2 inches above finished floors.
    d. Sealed with caulking.
    e. Sized as required.

B. New concrete walls with pipes up to 20 inches in diameter:

1. Material: non-metallic High-Density Polyethylene Sleeves (HDPE).
2. Integral hollow molded water stops:

    a. 4 inches larger than the outside diameter of the sleeve.

3. End caps for forming and reinforcing ribs.
4. Domestically manufactured by:

    a. Century-Line as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or equal.

C. New concrete with pipes 20 to 60 inches in diameter:

1. Material: molded HDPE modular interlocking discs to make the width of the wall.

    a. Corrugated.
    b. Cell-Cast as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or equal.

D. External Wall Penetrations:

1. 36-inch diameter and less may be made by means of a ductile iron sleeve capable of being bolted directly to the formwork:
2. Seal of the annular space between the carrier pipe and the sleeve made by means of a confined rubber gasket and be capable of withstanding 350 psi.:
3. Sleeve to have an integrally cast waterstop of 1/2-inch minimum thickness, 2-1/2-inches minimum height.
4. Manufacturers: Omni-Sleeve, Malden, MA or equal.

E. Stainless Steel Wall Penetrations (Submerged service, chemical storage and feed areas, sludge or wastewater):

1. Material: Schedule 40 stainless steel Type 316L.
2. 2-inch minimum circumference water stop welded to exterior sleeve at midpoint.
3. Ends cut and ground to be:

    a. Flush with ground or ceiling.
    b. 2 inches above finished floors.
    c. Sealed with caulking.
    d. Sized as required.

2.3 WALL CASTINGS

A. Ductile iron conforming to ANSI/AWWA A21.51/C151, thickness Class 53.

B. Diameter as required.

C. Flanges and mechanical joint bells drilled and tapped for studs where flush with the wall.

D. Castings provided with a 2-inch minimum circumferential flange/waterstop integrally cast with or welded to the casting.

E. Located as follows:

1. For castings set flush with walls: Located at center of overall length of the casting,
2. For castings which extend through wall: Located within middle third of the wall.

2.4 SEALING MATERIALS

A. Mechanical Seals:

1. Of rubber links shaped to continuously fill annular space between pipe and wall opening or sleeve.
2. Link pressure plates molded of glass reinforced nylon:

    a. Colored throughout elastomer.
    b. Permanent identification of the size and manufacturer's name molded into the pressure plate and sealing element.

3. Hardware:

a. Mild steel with a 60,000 psi minimum tensile strength.
b. 2-part Zinc Dichromate coating per ASTM B633.
c. Organic Coating, tested in accordance with ASTM B117 to pass a 1,500-hour salt spray test.
d. Use Type 316 stainless steel hardware:

1) In chemical areas.
2) For submerged service.
3) For penetrations in tanks containing sludge or wastewater.
4) For Wastewater Treatment Plants.

4. Completed Sealing System:

a. Duty pressure rated for 20 psig differential pressure.
b. EPDM for all services.
c. Manufacturer: PSI-Thunderline/ Link-Seal as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or pre-approved equal.

B. Sealant:

1. A two-part foamed silicone elastomer manufactured by:

a. Dow Corning Co., Product No. 3-6548 silicone R.T.V.
b. 3M brand fire barrier products caulk C.P. 25 and 3M brand moldable putty MP+.
c. Flame-Safe fire stop systems FS-900 by Rectorseal.

2. Sealant bead configuration, depth, and width in accordance with manufacturer's recommendations.

2.5 MISCELLANEOUS MATERIALS

A. Bonding Compound: Provide products by one of the following or equal:

1. Sikadur Hi-Mod epoxy by Sika Corp.
2. Euco 452 by Euclid Chemical Corp.; Master Builders Company.

B. Escutcheons plates: Hot dipped galvanized steel unless otherwise indicated on the Drawings. Provide Type 316 stainless steel hardware for treatment basins and wet submerged areas.

2.6 FLEXIBLE CONNECTIONS

A. Manufacturers:

1. For pressure pipe applications and applications with steel and copper piping: Flexicraft Industries, Chicago, IL; Hyspan Precision Products, Inc.; Metraflex Company, Chicago, IL; Victaulic Company, Easton, PA; or equal.
2. For non-pressurized applications involving plastic, clay, asbestos cement, or cast-iron applications: Fernco or equal.
3. For pressure pipe applications with ductile iron piping: Flex Lok Ball Joint Pipe by American Ductile Iron Pipe; or equal.

B. Steel Piping:

1. Inner Hose: Type 316 stainless steel.
2. Exterior Sleeve: Double-braided Type 316 stainless steel.
3. Pressure Rating: 125 psig WSP at 450 degrees F.
4. Joints: Flanged, threaded, threaded with union, or soldered.
5. Size: Use pipe-sized units.
6. Maximum Offset: 1 inch on each side of installed center line.

C. Flanged Adaptors:

1. Flanged adaptor connections for grooved or shouldered end pipe compatible with split couplings at fittings, valves and equipment shall be VIC-Flange Style 341 or 342 as by the Victaulic Company of America; Gustin-Bacon; or approved equal.
2. Flanged adaptor connections for plain end pipe at fittings, valves and equipment shall be Dresser Style 127 or 128; Uni-Flange Adapter by Ford Meter Box Co.; similar models by Smith-Blair; or approved equal.

2.7 EXPANSION JOINTS

A. Single Arch Type for Air Service

1. Provide model 1101 manufactured by General Rubber or equal.

a. Minimum Temperature Rating: 300F
b. Minimum Pressure Rating: 25 PSIG

2.8 SLEEVE-TYPE COUPLINGS

A. Manufacturers:

1. GE Oil & Gas (Dresser); Xylem (Smith-Blair); or equal.

B. Description:

1. Comply with AWWA C213, C219.
2. Middle Ring: Ductile iron.
3. Followers: Ductile iron.
4. Gaskets:

a. Material: EPDM or Compatible with service conditions.
b. Comply with ASTM D2000.

5. Bolts: Type 316 Stainless Steel.

C. Finishes:

1. Factory fusion bonded epoxy coated.

2.9 COMPOSITE FLANGE ISOLATION KITS

A. Install composite flange isolation kits for use with aqueous applications where dissimilar metallic piping flanges are joined; where metallic pipe flanges mate with valve connecting flanges and other equipment of dissimilar metallic construction; where exposed piping makes a vertical transition to buried piping; and where otherwise indicated on Drawings.

1. Pipe flange materials applicable to this section include ductile iron, cast iron, cast copper alloy, forged stainless steel alloys, forged copper-nickel alloy and forged nickel alloy (Monel, Hastelloy, etc.), all of which having an adequate difference in potential to steel for internal electro-chemical corrosion.

B. Provide insulating flange gaskets comprised of a composite retainer constructed of G-10, FR-4 glass-reinforced epoxy sheet stock in accordance with NEMA LI-1, having a dielectric strength of 400 to 500-volts/mil in accordance with UL 94.

C. Provide a full-faced Type “E” configuration retainer, 1/8 inch thick, with bolt holes cut to match ASME B16.5 drilling.

1. Provide retainer containing a precision tapered groove designed to accommodate controlled compression of an extruded elastomer sealing element. Pressure energize Quad-ring seal.
2. Provide glass-reinforced epoxy retainer with 550-volts/mil dielectric strength and a minimum 50,000-psi compressive strength.

D. Construct sealing element on one of the following materials as required for working temperatures indicated on Drawings:

1. Ethylene propylene diene monomer rubber for pipe with a working temperature of -30 to 250 degrees F.
2. Provide fluoroelastomer for pipe with a working temperature of 20 to 300 degrees F.

E. Provide insulating bolt sleeves manufactured of Mylar having a dielectric strength of not less than 4000-volts/mil.

F. Provide insulating washers manufactured of same G-10 FR-4 epoxy fiberglass materials as gasket.

1. Install insulating washers with metallic follower washers specified below to prevent damage to insulating washer during field assembly.

G. Molded sleeve washers may be used as an alternate to separate washers and sleeves, provided material of construction has equivalent properties to those specified herein.

H. Provide one of the following dielectric insulating flange gasket kits:

1. Trojan manufactured by Pipeline Seal and Insulator, Houston, Texas.
2. PSI GasketSeal® manufactured by GPT Division of EnPro Industries, Charlotte, North Carolina.
3. IsoGuard™ manufactured by Lamons Gasket Company Inc., Houston, Texas.

2.10 INSULATION – **NOT USED**

2.11 FINISHES

A. Prepare piping appurtenances for field finishes.

2.12 SOURCE QUALITY CONTROL

1. Provide shop inspection and testing of completed assemblies.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolthole configurations or design and verify that new pipe and flanges mate properly.

C. Verify that pipe plain ends to receive sleeve-type couplings are smooth and round for 12 inches from pipe ends.

D. Verify that pipe outside diameter conforms to sleeve manufacturer's requirements.

3.2 PREPARATION

A. Cleaning: Thoroughly clean end connections before installation.

B. Close pipe and equipment openings with caps or plugs during installation.

C. Surface Preparation: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

A. Coating: Finish piping appurtenances as specified in Section 099676.23 for service conditions.

B. Pipe Penetrations:

1. Flashing:

    a. Provide flexible flashing and metal counterflashing where piping penetrates weatherproofed or waterproofed walls, floors, and roofs.
    b. Flash floor drains with topping over finished areas with lead, 10 inches clear on sides, with minimum 36-inch by 36-inch sheet size.
    c. Fasten flashing to drain clamp device.

2. Sleeves:

    a. Exterior Watertight Entries: Seal with mechanical sleeve seals.
    b. Set sleeves in position in forms and provide reinforcement around sleeves.
    c. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.
    d. Extend sleeves through floors 2 inches above finished floor level and calk sleeves.
    e. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.
    f. Install escutcheons at finished surfaces.

C. Flexible Connections: Install flexible couplings at connections to equipment and where indicated on Shop Drawings.

D. Expansion Joints:

1. Install flexible couplings and expansion joints at connections to equipment and where indicated on Shop Drawings.
2. If expansion joint is supplied with internal sleeve, indicate flow direction on outside of joint.

E. Air Release and Vacuum Breakers: Provide vacuum breakers as indicated on Drawings.

F. Backflow Preventers:

1. Install with nameplate and test cock accessible.
2. Install according to local code requirements.
3. Do not install in vertical position.

G. Insulation: As indicated on Drawings and Section 404213 “Process Piping Insulation”.

3.4 FIELD QUALITY CONTROL

A. After installation, inspect for proper supports and interferences.

B. Repair damaged coatings with material equal to original coating.

3.5 CLEANING

A. Keep equipment interior clean as installation progresses.

END OF SECTION 400506

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SECTION 400507 - HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Hanger and support assemblies for process piping.

1. All supports for process piping associated with the Temporary Package Plant shall be designed by a pipe support design engineer hired by the Contractor (delegated design).

a. Package Plant pipes requiring delegated design by Contractor include:
1) Package Plant Influent (Yelo-mine pipe) from Headworks to Package Plant.
2) Package Plant Effluent (Yelo-mine pipe) from Package Plant to UV Basin.
3) Package Plant Sludge Transfer (Yelo-mine pipe) from Package Plant Sludge Storage Basin to Aerated Sludge Holding Tank No. 2.
4) Package Plant Low Pressure Air (Galvanized Steel pipe) from Temporary Blowers to Package Plant Aeration Basins.

b. Where Drawings show support types and/or locations, they shall be analyzed for adequacy to support loads and stresses calculated by the pipe support designer, modified if required, installed generally where shown, and integrated with the pipe support system design provided by Contractor.

2. All pipe supports for other process piping, listed below, have been designed by Engineer and shall be followed exactly as shown on the Drawings.

a. Low Pressure Air Pipe for Treatment Units 1 and 2 (Stainless Steel pipe).

B. Related Requirements:

1. Section 031000 “Concrete Forming and Accessories” for execution requirements for placement of inserts or sleeves in concrete forms specified by this Section.
2. Section 033000 “Cast-in-Place Concrete” for execution requirements for placement of concrete housekeeping pads specified by this Section.
3. Section 400506 “Couplings, Adapters, and Specials for Process Piping.”
4. Section 400523 “Stainless Steel Process Pipe and Tubing.”
5. Section 400524 “Steel Process Pipe”

1.3 DEFINITIONS

A. Ferrous Metal: Iron, steel, stainless steel, and alloys with iron as principal component.

B. Wetted or submerged: Submerged, on the wet side of basins, below top of channel or tank wall, under cover or slab of channel or tank, or in other damp locations.

C. “Pipe” or “piping” shall mean all piping, piping system(s), hose, tube, fittings, joints, valves, and similar appurtenances.

D. Supports: wherever the word “supports” or “pipe supports” are used, they shall mean pipe supports, hangers, structural connections, concrete inserts (if allowed), anchors, guides, bolts, expansion units, restraints and all restraint, hanging, supporting, allowing controlled expansion, or other means of attaching piping along with the necessary appurtenances.

1.4 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.5 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's catalog data including load capacity for each support type.

B. Shop Drawings:

1. Submit scaled piping layouts for each system. Indicate flow stream, pipe size(s), material(s), schedule(s), lining(s), critical dimensions between pipes, equipment, and building features.
2. Indicate by schedule pipe hanger/support type and locations to be used.
3. Provide detail of each type of hanger, support, anchor and guide.

C. Delegated Design Submittals: Support System Design

1. Engage the services of an independent registered professional engineer licensed in the State of Texas ordinarily engaged in the business of pipe support systems analysis and design, to analyze system piping and service conditions, and to develop a detailed support system design, specific to the piping material, pipe joints, valves, and piping appurtenances proposed for use.

    a. The proposed support system engineer shall have at least 5 years of experience in the analysis and design of similar systems, including the use of commercial and custom pipe supports and in the use of commercial pipe stress software programs.

    b. Submit qualifications of proposed support designer for Engineer approval.

2. The support system design shall include:

    a. Criteria by piping system.

b. Summary of Contractor-selected related components including joints, class, valves, appurtenances, etc., and commercial supports and especially including pipe materials.
c. Dead weight and dynamic analysis, including system thermal effects and pressure thrusts. Computer-based software system equivalent to Bentley Systems AutoPIPE or SST Systems CAEPIPE.

1) Present each system in an isometric graphic and show the resolved and resultant force and moment systems, as well as all recommended hangers, supports, anchors, restraints, and expansion/flexible joints.

d. Submit support system design to the Engineer for review. The submittal needs to be stamped by a professional engineer registered in State of Texas.
e. All aspects of the analysis and design to comply with the provisions of ANSI and the referenced standards.

3. Coordinate support arrangements to eliminate interference with similar systems to be installed under HVAC, Plumbing, and Electrical; to account for structural expansion joints and to maintain access for both personnel and for the removal of equipment.

D. Manufacturers' Instructions: Submit special procedures and assembly of components.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Welders' Certificate: Submit welders' certification of compliance with AWS D1.1, verifying qualification within previous 12 months.

C. Qualifications Statements: Submit qualifications for delegated designer of pipe support systems

1.7 DELIVERY, STORAGE AND HANDLING

A. Supports and hangers shall be crated, delivered, and uncrated to protect against damage.

B. Parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.

C. Finished metal surfaces not galvanized, that are not of stainless-steel construction, or that are not coated, shall be grease coated, to prevent rust and corrosion.

1.8 QUALITY ASSURANCE

A. Perform Work according to AWS D1.1 for welding hanger and support attachments to building structure.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years' documented experience.

B. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' documented experience.

C. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Texas.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.

B. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

C. Finished metal surfaces not galvanized, that are not of stainless-steel construction, or that are not coated, shall be grease coated, to prevent rust and corrosion.

1.11 CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

A. Support pipe and appurtenances connected to equipment to prevent any strain being imposed on the equipment. Comply with manufacturer’s requirements regarding piping loads being or not being transmitted to their equipment. Submit certification stating that such requirements have been met.

B. Support and secure all pipe and tubing in the intended position and alignment to prevent significant stresses in the pipe or tubing material, valves, fittings, and other pipe appurtenances. Install all supports to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact. Any structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 055000 “Metal Fabrications” and shall be furnished and installed under this Section.

C. Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.

D. Where flexible sleeve, split ring, vibration, or other couplings are required at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc., shall be rigidly supported to prevent transfer of force systems to the equipment. Do not install fixed or restraining supports between a flexible coupling and the piece of equipment.

E. Pipe supports:

1. Shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.
2. Provide supports at changes in direction and elsewhere as shown in the Drawings or as specified herein.
3. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless specifically indicated on Drawings or authorized by the Engineer.
4. Provide pipe supports to minimize lateral forces through valves, both sides of flexible split ring type couplings and sleeve type couplings, and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.
5. Effects of thermal expansion and contraction of the pipe to be accounted for in the pipe support installation.

F. Insofar as is possible, floor supports shall be given preference. Where specifically indicated, concrete supports, as shown on the Drawings, may be used. Base elbow and base tees shall be supported on concrete pedestals.

G. Restraints, flexible connections, expansion items, and related items as included in other specifications (especially Sections 400506 “Couplings, Adapters, and Specials for Process Piping” and other individual pipe sections) and shown on Drawings.

2.2 PERFORMANCE REQUIREMENTS/DESIGN CRITERIA

A. All supports and appurtenances shall be standard products from approved manufacturers wherever possible and shall be adequate to maintain the supported load in proper position under all operating conditions. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary. Note that different materials required, as specified in Part 2 MATERIALS, may require different figures or model numbers than those shown.

1. The minimum working factor of safety for all items, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10 feet of water-filled pipe being supported and normal test pressures.
2. Design for all loads using a safety factor of 5.

B. Pipe Schedule is included in the Contract Drawings.

C. All items shall be designed with strength and stiffness to support, restrain, and allow expansion of the respective pipes under the maximum combination of peak loading conditions to include

pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces.

D. Support spacing shall be per ASME B31.3 for process piping. In addition, requirements of MSS SP 58 shall apply.

E. Complete details of the pipe system components shall be submitted for review and approval as specified in Part 1. No support specified as Delegated Design shall be installed without approved support system Drawings.

F. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

1. 12" Temporary Package Plant Influent Pipe will be supported by existing headworks structure designed by CDM Smith in 2005. Engineer and Contractor to coordinate piping loads to determine with Structural Engineer that the existing structure can withhold the additional load. Include associated loads from the pipe on the structure in the Delegated Design Pipe Submittal.

G.

G. Seismic Design and restraint requirements, in accordance with the Structural Design criteria.

2.3 MATERIALS

A. For support of metallic pipe:

1. Submerged, all treatment basins and facilities, Buried, or Within Outdoor Structures (vaults, etc.): Type 316 stainless steel.
2. Within Chemical Areas: Vinyl ester fiberglass reinforced plastic (FRP)
3. Other Locations: Steel with galvanizing where noted.
4. Additional Requirements (including dielectric insulation): See following Paragraphs.

B. For support of non-metallic pipe:

1. Submerged, Buried, or Within Vaults: Type 316 stainless steel or FRP.
2. Within Chemical Areas: vinyl ester FRP.
3. Other Locations: steel with galvanizing where noted; all with local stress protection shields.
4. Additional Requirements (including stress protection shields): See following Paragraphs.

C. Wherever stainless steel is noted, it shall be Type 316 unless noted otherwise.

2.4 INSULATION – **NOT USED**

2.5 SUPPORT AND RESTRAINT SYSTEMS

A. Steel, Stainless Steel, or Ductile Iron Piping:

1. Cast iron and ductile iron, steel, and stainless steel piping shall be supported at a maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.
2. Support spacing for ductile iron, steel, and stainless steel piping 2-inches and smaller diameter shall not exceed 5 feet.

B. Non-Metallic Piping:

1. All uninsulated non-metallic piping such as PVC, CPVC, HDPE, PVDF, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by non-metallic protection shields or other method as approved by Engineer.

    a. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360-degree arc support is required, such as U-bolts, protection shields shall be provided for the entire pipe circumference. All U-bolts or clamps for non-metallic pipes shall be plastic coated.
    b. Protection shields shall have an 18-gauge minimum thickness, not be less than 12 inches in length and be securely fastened to pipe with Type 316 stainless steel straps not less than 1/2 inch wide.

2. Individually supported PVC pipes shall be supported as recommended by the pipe manufacturer except that support-spacing shall be manufacturers recommendation minus 2 feet down to 5 feet spacing recommendation, then spacing shall be 3 feet.

3. Supports for horizontal multiple PVC plastic piping:

    a. Shall be continuous wherever possible.
    b. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as: Husky Ladder Flange Out by MPHusky; or equal.
    c. Rung spacing shall be 12 inches. Tray width shall be approximately 6 inches for single runs and 12 inches for double runs.
    d. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to: Globe, Series 600; Unistrut Pipe/Conduit Clamps and Hangers; or equal.
    e. Spacing between clamps shall not exceed 9 feet. Cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers, and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

C. Framing Support System:

1. Beams: Size such that beam stress does not exceed 25,000 psi and maximum deflection does not exceed 1/240 of span.
2. Column Members: Size in accordance with manufacturer's recommended method.
3. Support Loads: Calculate using weight of pipes filled with water.
4. Maximum Spans:

a. Steel and ductile iron pipe 3 inch diameter and larger: 10 feet centers, unless otherwise shown.
b. Other pipelines and special situations: Same as noted in previous paragraphs. Supplementary hangers and supports may be required.

D. Support vertical pipes at each floor or at intervals of not more than 12 feet by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to ensure rigid construction. Secure vertical pipes passing through pipe sleeves using a pipe collar.

2.6 ANCHOR BOLTS/SYSTEMS

A. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear, and pullout loads imposed by loading and spacing on each particular support.

1. DO NOT USE ADHESIVE ANCHOR BOLTS ON ANY PIPE SUPPORT HUNG FROM A ROOF OR CEILING, unless specifically noted otherwise.

B. Post-installed anchors in concrete shall have current published ICC-ES Evaluation Report indicating the anchor is approved for installation in cracked concrete.

C. Latest edition of the following specification and recommended practices shall become part of this specification as if written herein. Wherever requirements conflict, the more stringent shall govern.

1. ACI 318, Appendix D.
2. ACI 355.2, Mechanical Anchors “Qualification of Post-Installed Mechanical Anchors in Concrete”.
3. Anchor manufacturer’s published installation requirements.

D. Expansion anchors:

1. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1 inch behind the steel reinforcement.
2. Manufacturers:

a. Power-Stud+ SD4 and Power-Stud+ SD6 by Powers Fasteners, Brewster, NY.
b. Kwik Bolt as manufactured by Hilti USA, Tulsa, Oklahoma.
c. Wej-it by Wej-it Expansion Products, Inc., Broomfield, Colorado.

E. Unless otherwise noted: Type 316 stainless steel for all anchors.

F. Size of anchor bolts as designed by manufacturer, 1/2 inch minimum diameter, or as shown on Drawings.

G. Anchors to concrete in chemical areas shall be epoxy secured vinyl ester FRP all thread, insertion depth and size as required by the manufacturer for the design loads. Nuts, bolts, and hardware shall all be vinyl ester FRP construction.

2.7 HANGER RODS

A. Where use of steel is allowed, hanger rods shall be hot-rolled steel, machine-threaded, and, except for stainless steel, galvanized after fabrication. The strength of the rod shall be based on its root diameter.

1. Hanger rods shall be attached to concrete structures using single or continuous concrete inserts by the named support manufacturers above. Where use of steel is allowed, inserts shall be malleable iron or steel with galvanized finish.
2. Beam-clamps, C-clamps, or welded-beam attachments shall be used for attaching hanger rods to structural steel members.

B. Minimum rod size for metallic rod hangers:

	Nominal Pipe / Tube Diameter	Minimum Hanger Rod Diameter
1	Less than 2-1/2 inch	1/4 inch*
2	3 to 8 inches	1/2 inch
3	10 to 14 inches	3/4 inch*
4	16 to 20 inches	2 at 1 inch
5	24 inches	2 at 1-1/4 inch
6	30 inches	2 at 1-1/2 inch

* For pipe diameters less than 14 inch, if using pipe roller, use 2 hanger rods with minimum diameter noted below for pipe's diameter.

2.8 SINGLE PIPE HANGERS

A. Unless otherwise indicated, pipe hangers and supports shall be standard catalogued components, conforming to the requirements of MSS-41, 58, or 69 and shall be of the following type:

1. Anvil International.
2. Equal models by: Carpenter & Patterson, Inc., Woburn, MA; Cooper B-Line; Gulf State Manufacturing; or Unistrut Northeast, Cambridge, Massachusetts.

B. Single pipes shall be supported by hangers suspended by hanger rods from structural steel members, concrete ceilings, bottom of trapeze hangers, and wall-mounted steel angle brackets.

C. Where pipes are near walls, beams, columns, etc., and located an excessive distance from ceilings or underside of beams, welded steel wall brackets similar to Carpenter and Patterson, Figure Nos. 68, 79, 84, or 139 shall be used for hanging pipe. Where single pipes rest on top of bracket pipe supports, attachments shall meet requirements as specified under multiple pipe hangers.

2.9 MULTIPLE PIPE HANGERS

A. Suspended multiple pipes, running parallel in the same horizontal plane that are adjacent to each other, shall be suspended by trapeze type hangers or wall brackets. Where use of steel is allowed, trapeze hangers shall consist of galvanized structural steel channel supported from galvanized threaded rod or attached to concrete walls, columns, or structural steel support members. See previous paragraphs about multiple PVC pipe supports.

B. Except as otherwise specified herein, pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs similar to:

1. Anvil Fig. 175.
2. Cooper B-Line B3147A or B3147B.
3. Where use of steel is allowed, material of construction shall be galvanized steel. Chair U bolts shall be tightened to allow freedom of movement for normal expansion and contraction except where pipe must be anchored to control direction of movement or act as a thrust anchor.

2.10 SINGLE PIPE SUPPORTS FROM BELOW

A. Single pipes located in a horizontal plane close to the floor shall be Pedestal type: Schedule 40 pipe stanchion, saddle, and anchoring flange.

1. Nonadjustable Saddle: MSS SP 58, Type 37 with U-Bolt.

   a. Anvil, Figure 259.
   b. Cooper B-Line, Figure B3090.

2. Adjustable Saddle: MSS SP 58, Type 38 without clamp.

   a. Anvil, Figure 264.
   b. Cooper B-Line, Figure B3093.

B. Pipes less than 3 inches in diameter:

1. Hold in position by supports fabricated from steel C channel, welded post base similar to Unistrut, Figure P2072A, where use of steel is allowed; and pipe clamps similar to Unistrut, Figures P1109 through 26.
2. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected by horizontal member of sufficient load capacity to support pipe.
3. Fasten supports to nearby walls or other structural member to provide horizontal rigidity.
4. More than one pipe may be supported from a common fabricated support.

C. Pipes 3 inches in diameter and larger:

1. Support by adjustable stanchions.
2. Provide at least 4 inch adjustment.
3. Flange mount to floor.

D. Use yoked saddles for piping whose centerline elevation is 18 inches or greater above the floor and for all exterior installations.

E. Pipe roller type supports shall be used where required to accommodate thermal movement in conjunction with axial supports.

2.11 WALL SUPPORTED SINGLE AND MULTIPLE PIPES

A. Single or multiple pipes located adjacent to walls, columns, or other structural members shall be supported using welded steel wall brackets, where use of steel is allowed, as manufactured by Carpenter and Patterson, Figure No. 69, 84, or 139.

B. Where noted, multiple pipes may be supported on C-channel with steel brackets similar to Unistrut pipe clamps; with pipe anchor chairs; or equal.

C. Individual pipes, up to 8-in diameter, where noted, may use MSS Type 8 pipe clamps as noted on the Drawings.

D. Securely fasten all members to wall, column, etc., using double-expansion shields or other method as approved by the Engineer. Provide additional wall bearing plates as required.

2.12 BASE ANCHOR SUPPORT

A. Bend Support: Where pipes change direction from horizontal to vertical via a bend, install a welded or cast base bend support to carry the load. Fasten to the floor, pipe stanchion, or concrete pedestal using expansion anchors or other method as approved by the Engineer.

B. Concrete Supports: Where indicated, securely fasten pipe bends to concrete supports with suitable metal bands as required and approved by the Engineer. Isolate piping from poured concrete with a neoprene insert.

2.13 VERTICAL PIPE SUPPORTS

A. Where vertical pipes are not supported by a Unistrut type system as specified, they shall be supported in one of the following methods.

1. For pipes 1/4 to 2 inches in diameter:

    a. Provide extension hanger ring with an extension rod and hanger flange.
    b. The rod diameter shall be as recommended by the manufacturer for the type of pipe to be supported.
    c. Where use of steel is allowed, the hanger ring shall be steel- or PVC-clad depending on the supported pipe material of construction. The hanger ring shall be equal to Carpenter & Patterson, Figure Nos. 81.
    d. Where use of steel is allowed, the anchor flange shall be galvanized malleable iron similar to Carpenter and Patterson, Figure No. 85.

2. For pipes equal to or greater than 2 inch diameter:

a. Extended pipe clamps similar to Carpenter & Patterson, Figure No. 267 may be used.
b. Attach hanger to concrete structures using double expansion shields,
c. Attach hanger to metal support members using welding lugs similar to Carpenter & Patterson, Figure No. 114.

B. Pipe supports shall be provided for closely spaced vertical piping systems required to provide a rigid installation. The interval of vertical support spacing shall be as specified, but in no case shall vertical interval exceed 12 feet. The support system shall consist of a framework suitably anchored to floors, ceilings, or roofs.

C. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding 12 feet shall be supported by base elbows/tees, clamps, brackets, wall rests, and pipe collars, all located as required to ensure a rigid installation.

D. Pipe riser clamps, per MSS SP58, shall be used to support all vertical pipes extending through floor slabs. Where use of steel is allowed, riser clamps shall be galvanized steel manufactured by:

1. Carpenter & Patterson, Figure No. 128.
2. Anvil, Figure 261.
3. Cooper B-Line, Figure B3373.
4. Or equal.

E. Copper-clad or PVC-coated clamps shall be used on copper pipes. Insulation shall be removed from insulated pipes prior to installing riser clamps. Insulation shall not be damaged by clamp installation.

2.14 SPECIAL SUPPORTS

A. Frame Work Supports:

1. Vertical and horizontal supporting members shall be U-shaped channels similar to Unistrut, Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps. See pipe clamp and strap requirements.
2. For piping 3 inch and smaller, framework shall be as manufactured by:

a. Unistrut Corporation.
b. Power-Strut (or Ackinstrut where fiberglass systems are specified).
c. Multi-Strut by Carpenter-Paterson.
d. Or equal.

3. For piping larger than 3 inches, the support frame shall be fabricated from structural stainless steel or steel shapes, depending upon the support location, and secured through the use of drop in, adhesive or expansion anchors.
4. Furnish assemblies complete with all nuts, bolts, and fittings required for a complete assembly including end caps for all Unistrut members.
5. Electrical Conduit Support: Under Division 26.
6. Design of each individual framing system shall be responsibility of Contractor. Submit shop drawings and show all details of installation, including dimensions and types of

supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached. See also Article SUPPORT AND RESTRAINT.

B. Supports not otherwise described in this Section shall be fabricated or constructed from standard structural stainless steel or steel shapes in accordance with applicable provisions of Section 055000 “Metal Fabrications,” or Unistrut-type frame; have anchor hardware similar to items previously specified herein; shall meet the minimum requirements listed below; and be subject to the approval of Engineer.

C. Additional Pipe Support Situations:

1. Supporting Multiple Chemical and Related Piping:

a. Location: As indicated on Drawings or otherwise required, especially adjacent to chemical pumps.
b. Use: Framework support.
c. Materials: FRP, with proper local stress protection.

2.15 SHOP FACTORY FINISHING

A. Prepare and prime metallic (except stainless steel) supports.

2.16 ACCESSORIES

A. Insulation Shield: Install on insulated non-steel piping. Oversize the rollers and supports, as required. Manufacturers:

1. Anvil, Figure 167.
2. Cooper B-Line, Series B3151.

B. Welding Insulation Saddle: Install on insulated metal pipe. Oversize the rollers and supports, as required. Manufacturers:

1. Anvil, Figure 160.
2. Cooper B-Line, Series B3160.

C. Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.

1. Isolation pads to be neoprene, waffle type.
2. Manufacturers:

a. Mason Industries, Type W.
b. Korfund.

D. Dielectric Barrier:

1. Install between carbon steel members and copper or stainless-steel pipe.
2. Install between stainless steel supports and non-stainless steel ferrous metal piping.

3. Isolate stainless steel piping from ferrous materials, including galvanized steel by use of neoprene sheet material and protection shields.

E. Electrical Isolation: Install 1/4 by 3 inch neoprene rubber wrap between submerged metal pipe and oversized clamps.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field dimensions as indicated on Drawings.

3.2 INSTALLATION

A. Obtain permission from Engineer before using powder-actuated anchors.

B. Obtain permission from Engineer before drilling or cutting structural members.

C. Inserts:

1. Install inserts for placement in concrete forms. Before setting inserts, all drawings and figures shall be checked that have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

D. Pipe Hangers and Supports:

1. Support horizontal piping as indicated on Drawings, depending upon pipe size.
2. Install support systems in accordance with MSS SP69 and MSS SP89, unless shown otherwise. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
3. Install hangers with minimum 1/2 inch space between finished covering and adjacent Work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment.
6. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
7. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
8. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
9. Support riser piping independently of connected horizontal piping.
10. Provide sheet lead packing between hanger or support and piping.
11. Design hangers for pipe movement without disengagement of supported pipe.

12. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
13. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
14. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
15. Use beam clamps where piping is to be suspended from building steel.
16. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.
17. Use offset clamps where pipes are indicated as offset from wall surfaces.
18. Proceed with installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.
19. The installation of pipe support systems shall not interfere with the operation of any overhead bridge cranes, monorails, access hatches, etc. No piping shall be supported from stairs, other pipes, ladders, and walkways unless authorized by Engineer.
20. Repair mounting surfaces to original condition after attachments are made.
21. Brace horizontal pipe movements by both longitudinal and lateral sway bracing.
22. Where supports are required in areas to receive chemical resistant seamless flooring, install supports prior to application of flooring system.

E. Insulation:

1. Provide clearance in hangers and from structure and other equipment for installation of insulation.

F. Equipment Bases and Supports:

1. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Comply with Section 033000 “Cast-in-Place Concrete.”
2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
3. Construct supports of steel members, channel, pipe, and fittings. Brace and fasten with flanges bolted to structure.
4. Provide rigid anchors for pipes after vibration isolation components are installed.

3.3 FIELD QUALITY CONTROL

A. After the work is installed, but before it is filed for start-up and testing, the Support System Design Engineer shall inspect each system and certify it as conforming to the support system design.

B. Test pipe support systems after installation in conjunction with respective piping pressure tests. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired, augmented or replaced to the satisfaction of Engineer.

3.4 CLEANING

A. Keep equipment interior clean as installation progresses.

B. Galvanized Surfaces: Clean bolted connections and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION 400507

SECTION 400519 - DUCTILE IRON PROCESS PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ductile-iron pipe.
2. Ductile-iron, malleable-iron, and cast-iron fittings.
3. Accessories.

B. Related Requirements:

1. Section 099679 “Atmospheric Protection and Plant Service Areas Coatings” for product and execution requirements for non-buried ductile iron pipe specified by this Section.
2. Section 400506 “Couplings, Adapters, and Specials for Process Piping” for piping appurtenances.
3. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
4. Section 400551 “Common Requirements for Process Valves” for common product requirements for valves for placement by this Section.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information regarding pipe and fittings.

B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe fittings, gaskets, linings, and exterior coating

for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified.

B. Prior to Pipe Shipment:

1. Certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, along with a sworn affidavit of compliance that the pipe complies with the referenced standards.
2. Copies of shop tests, including hydrostatic tests.

C. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and invert or centerline elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 WARRANTY

A. Provide Manufacture/Supplier warranty in accordance with CIP16, “Warranty”.

1.8 QUALITY ASSURANCE

A. Hydrostatically test each length of ductile iron pipe at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Furnish certified test results in duplicate to the Engineer prior to time of shipment.

B. Inspect and test by Manufacturer the ductile-iron pipe and fittings at the foundry as required by the AWWA C600, Hydrostatic Testing; ASTM A716, Standard Specification for Ductile Iron Culvert Pipe; and ASTM A746, Standard Specification for Ductile Iron Gravity Sewer Pipe as applicable. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.

C. Pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by Owner at their expense.

D. Owner will inspect the pipe and fittings after delivery. Products are subject to rejection at any time on account of failure to meet any of the specified requirements, even though accepted as

satisfactory at the place of manufacture. Immediately mark pipe rejected after delivery and remove from the job site.

E. Permanently mark pipe and fittings with the following information:

1. Manufacturer name and trademark.
2. Manufacturing date.
3. Size, type, class, or wall thickness.
4. Production standard (AWWA, ASTM, etc.).
5. Apply pipe labelling per ASME A13.1-2015 Label Color Coding for Background and Lettering.

F. Perform Work according to City of Georgetown, TCEQ, and manufacturer's standards.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Texas.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Photograph and provide written documentation of damaged materials.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Coverall openings to prevent entrance of dirt, water, and debris.
3. Protect piping and appurtenances by storing off ground.
4. Limit stacking height to manufacturers specified maximum.
5. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. Piping:

1. Comply with AWWA C115, C150 or C151 as applicable for service.
2. Ductile Iron pipe as manufactured by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; all divisions of the McWane Company or an approved equal who is a member of the Ductile Iron Pipe Research Association (DIPRA).
3. Pressure Ratings:

	Pipe Diameter	Minimum Pressure Rating (psi)
a.	4-inches through 12-inches	350
b.	14-inches and larger	250

B. Fittings:

1. Material: AWWA C110, ductile iron AWWA C153, ductile iron.

    a. Pressure Rating: 150 psi

2. Mechanical Joints: Comply with AWWA C110 and AWWA C111.
3. Push-on Joints: Comply with AWWA C111.
4. Restrained Joints: Comply with AWWA C111.
5. Flanged Fittings (for above grade piping): Comply with AWWA C110 and ASME B16.1 Class 125

    a. Assembly bolts: square headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Threads conform to ANSI B1.1. Bolt length: 1/8 inch to 5/8 inch protrusion from nut after torquing.
    b. Flange gaskets shall be full face type per AWWA C111 to provide positive sealing for the flanged ductile iron joints. Thickness shall be 1/8-inch unless otherwise indicated.
    c. Steel flanges in conformance with AWWA C207, Class D, may be mated to iron valves, fittings, or other parts having either integral Class 125 iron flanges or screwed Class 125 companion flanges. When such construction is used, the raised face on mating flanges shall be removed.

6. Grooved joints: Comply with AWWA C606.

    a. Rigid couplings: Style 31 couplings as manufactured by Victaulic, Anvil International, or equal.
    b. For direct connection of ductile pipe to steel pipe of IPS sizes: Victaulic Style 307 transition coupling with offsetting, angle-pattern, bolt pads.
    c. Grooved end fittings for AWWA ductile iron pipe: Conform to ANSI A21.10/AWWA C110 for center-to-end dimensions and ANSI A21.10/AWWA C110 or AWWA C153 for wall thickness, with AWWA C606 grooved ends.

7. Sleeve type couplings: Dresser Style 38 or 138 as manufactured by Dresser Industries, or equivalent products of Smith-Blair, Romac Industries, Ford Meter Box Company, or equal.
8. Flanged coupling adaptors: Smith-Blair Type 913, or equivalent products of Klamflex Pipe Couplings (PTY) LTD, Robar Industries LTD, or equal.

C. Interior Linings:

1. Ductile iron pipe and fittings shall have epoxy lining.
2. Epoxy Lining:

   a. Line ductile iron pipe and fittings with a ceramic-filled amine-cured epoxy, Protecto 401 by Induron.
   b. Lining thickness of 40 mils minimum. Applicator approved by the coating manufacturer and applied in accordance with manufacturer's instructions and under controlled conditions at the applicator's shop or the pipe manufacturer's plant.
   c. Submit a certified affidavit of compliance with manufacturer's instructions and requirements specified.

D. Exterior Coating:

1. Exposed Service: As specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coatings.”
2. If required, coatings "hold-backs" to be provided at pipe and fitting ends for satisfactory installation for joint connections in the field.
3. Provide all necessary coating materials to perform field coating applications at joints compatible with or equal to the shop applied material.
4. Field repair of pipe with damaged coating shall receive prior approval of Engineer. If, in the opinion of Engineer coating damage is beyond repair, replace pipe at expense of Contractor.
5. All flange bearing surfaces shall be uncoated.
6. Mechanically clean or brush blast all surfaces to have exterior coating applied to ductile iron surfaces. Chemical cleaning or wiping with solvent is not acceptable.

2.2 ACCESSORIES

A. Gaskets:

1. Full face type SBR per AWWA C111 to provide positive sealing for the flanged ductile iron joints.
2. Thickness 1/8-inch.

B. Pipe Hangers and Supports:

1. Pipe hangers and supports shall be specified in Section 400507 “Hangers and Supports for Process Piping”.
2. Pipe hangers and supports shall be provided at suitable distance along the pipeline regardless whether they are shown or not shown on the Drawings.

C. Base bends and base tees shall have machined and drilled bases.

D. Filler flanges and beveled filler flanges shall be furnished and installed as required. Filler flanges and beveled filler flanges shall be furnished faced and drilled complete with extra length bolts. Filler flanges shall be equal to Clow Figure F 1984 and beveled filler flanges shall be equal to Clow Figure F 1986.

2.3 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly. See Section 400551 “Common Requirements for Process Valves” for pipe testing requirements.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Thoroughly clean pipe and fittings before installation.

B. Surface Preparation:

1. Clean surfaces to remove loose rust, mill scale, and other foreign substances by power wire brushing.
2. Touch up shop-primed surfaces with primer as specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coatings.”
3. Solvent-clean surfaces that are not shop primed.

3.3 INSTALLATION

A. Buried Service Piping: As specified in Section W1 Ductile Iron Pipe and Fittings.

B. Exposed Service Piping:

1. According to ASME B31.3.
2. In compliance with manufacturer’s instructions.

3. Run piping straight along alignment as indicated on Drawings, with minimum number of joints.
4. Clean each length prior to installation.
5. Support per Section 400507 “Hangers and Supports for Process Piping”.
6. Do not use equipment flanges for support; support pipe separately.

C. Fittings:

1. According to manufacturer instructions.
2. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer instructions.
4. Flanged joints to be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts to conform to the same ANSI Standard as the flanges. Bolts shall be ASTM A307, grade B, heavy hex nut.
5. Provide required upstream and downstream clearances from devices as indicated on Drawings.

D. Make taps to ductile iron piping only with service saddle, tapping boss of a fitting or valve body, or equipment casting.

E. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.

F. Support exposed piping as specified in Section 400507 “Hangers and Supports for Process Piping.”

G. Provide expansion joints as specified in Section 400506 “Couplings, Adapters, and Specials for Process Piping”, and pipe guides as specified in Section 400507 “Hangers and Supports for Process Piping”, to compensate for pipe expansion due to temperature differences.

H. Dielectric Fittings: Provide between dissimilar metals.

I. Field Cuts: According to pipe manufacturer instructions. Cutting by abrasive saw only, leaving a smooth cut at right angles to the axis of the pipe. Damage to the lining repaired to the satisfaction of the Engineer. Seal Field cut ends approved epoxy coating in accordance with manufacturer's instructions.

J. Finish primed surfaces according to Section 099679 “Atmospheric Protection and Plant Service Areas Coatings.”

K. Installation Standards: Install Work according to City of Georgetown standards.

3.4 TOLERANCES

A. Deflection at joints not to exceed that recommended by the pipe manufacturer.

B. Supply and install fittings, in addition to those shown on Drawings, in areas where conflict exists with existing facilities.

3.5 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Engineer.
2. Repair damaged piping or provide new, undamaged pipe at no additional cost to the project.
3. After installation, inspect for proper supports and interferences.

B. Pressure Testing:

1. Test Pressure: 150 psi
2. Conduct hydrostatic test for minimum two hours.
3. Filling:

    a. Fill section to be tested with water slowly and expel air from piping at high points.
    b. Install corporation cocks at high points.
    c. Close air vents and corporation cocks after air is expelled.
    d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.
5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
6. Leakage:

    a. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
    b. Maintain pressure within plus or minus 5 psi of test pressure.
    c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
    d. Compute maximum allowable leakage by following formula:

        1) L = SD x sqrt(P)/C.
        2) L = testing allowance in gph.
        3) S = length of pipe tested in feet.
        4) D = nominal diameter of pipe in inches.
        5) P = average test pressure during hydrostatic test in psig.
        6) C = 148,000.
        7) If pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

    e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
    f. Correct visible leaks regardless of quantity of leakage.

3.6 CLEANING

A. Keep pipe interior clean as installation progresses.

B. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION 400519

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SECTION 400523 - STAINLESS STEEL PROCESS PIPE AND TUBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Stainless steel pipe and fittings.
2. Accessories.

B. Related Requirements:

1. Section 400506 "Couplings, Adapters, and Specials for Process Piping" for pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.
2. Section 400551 "Common Requirements for Process Valves" for common product requirements for valves for placement by this Section.
3. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves and sealing of piping to adjacent structures.
4. Section 400564 “Butterfly Valves.”
5. Section 431118 “Vertically Split Multistage Centrifugal Blowers.”

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections as specified in other Sections and as indicated on Drawings.

1.4 SUBMITTALS

A. Section 013000 – Submittals: Requirements for submittals.

B. Product Data: Submit manufacturer information on pipe materials and fittings.

C. Shop Drawings:

1. Indicate piping layouts and schedules, with dimensions, fittings, expansion joints, locations of valves and appurtenances, joint details, wall penetration details, methods, types, and locations of hangers and supports, and pertinent technical specifications for piping to be furnished.
2. Include data and information required for complete piping systems. Base pipe layout and dimensions on actual equipment to be furnished under Section 431118. Show types and

locations of pipe hangers and/or supports on layouts for each pipe submittal. Since not all dimensions will be checked by Engineer, nor will every detail be reviewed by Engineer, Contractor will be responsible for accurate dimensioning of piping systems.

D. Cleaning Methods:

1. Include pre-cleaning, descaling, chemicals to be used, or mechanical descaling method, post-weld cleaning to restore corrosion resistance and final cleaning/passivation/pickling.
2. Include method and schedule for drying pipe so that it is ready for service as part of proposed cleaning method.
3. Include name and qualifications of firm that will be doing cleaning.
4. Include name and qualifications of independent firm that will be doing inspection of cleaned pipe.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1. Submit ISO 900 certification for manufacturing facility.

F. Welder Certificates: Submit welders' certification of compliance with AWS D1.1/D1.1M, verifying qualification within previous 12 months.

1.5 INFORMATIONAL SUBMITTALS

A. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

C. Qualifications Statements:

1. Submit manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS (NOT USED)

1.7 QUALITY ASSURANCE

A. Furnish stainless steel pipe and fittings by a single manufacturer who is fully experienced, reputable, qualified and regularly engaged for the last 5 years in manufacture of materials to be furnished.

B. Permanently mark each length of pipe with manufacturer's name or trademark, and compliance with standards.

C. Furnish work in new and unused condition.

D. Perform and document quality control (QC) and quality assurance (QA) procedures performed during manufacturing at factory; during loading of Work for transport at factory; during transport to Site; during unloading and storage of Work at Site; and during installation and startup at Site, all part of Work specified herein.

E. If there are difficulties in operation of systems included under this Contract due to defective Work, provide additional services to correct defective Work and meet acceptance testing requirements.

F. Inspection by Owner or Engineer or failure to inspect does not relieve Contractor of his responsibility to provide materials and perform Work in accordance with Contract Documents.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years' documented experience.

B. Welders: ASME qualified within previous 12 months for employed weld types.

C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Texas.

D. Welding Qualifications: Qualify procedures according to AWS D1.1/D1.1M, "Structural Welding Code – Steel."

E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

F. Testing Agency Qualifications: Qualified according to ASTM C 1021 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC Standard 17025.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Document and notify Engineer if product is damaged. No piece shall be installed which is found to be defective. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe and fittings.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect piping and appurtenances by storing off ground.
3. Provide additional protection according to manufacturer instructions.
4. Protect stainless steel materials from contact with carbon steel including but not limited to hoisting and rigging equipment, steel tables, storage racks and hand tools.
5. Do not bundle pipe and fittings using ferrous metal banding at the factory or Supplier’s facility.
6. Do not allow contact between wear surfaces of tools used for carbon steel fabrication and the surfaces of stainless-steel pipe and fittings. These tools include abrasive grinding and

cutting wheels, wheel cutters and rollers, threading taps and dies, tube bending equipment and all other bearing edge tools.

7. Use manual or powered wire brush tools for surface repair and joint preparation manufactured from stainless steel. No brushes with carbon steel wire will be used for fabrication of stainless steel.
8. Shield stainless steel pipe, tube and fittings from all on-site carbon steel pipe and structural steel cutting and blasting operations.

1.10 AMBIENT CONDITIONS

A. Section 015000 – Temporary Facilities: Requirements for ambient condition control facilities for product storage and installation.

B. Minimum Conditions: Do not store or handle uninstalled lined pipes or fittings at temperatures below zero degrees F.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

A. Manufacturer'sWarranty: Manufacturer and Installer agree to repair or replace components of stainless steel pipe that fail(s) in materials or workmanship within specified warranty period.
1. Warranty Period: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE DESIGN CRITERIA

A. Piping shall be installed in those locations indicated and as required for the complete piping system.

B. Provide stainless steel piping for the following systems and conditions:

1. System: Low Pressure Air (LPA) for Blower Systems

a)	Fluid:	Compressed Air
b)	Operating Pressure:	0 to 20 psig
c)	Test Pressure:	30 psig
d)	Flow Velocity:	0 to 4,000 feet per minute
e)	Temperature:	0 to 330 degrees F

2.2 STAINLESS STEEL PIPE AND FITTINGS

A. Piping:

1. Type:
   a) Welded in compliance with ASTM A813/A813M or Seamless in compliance with ASTM A312.

2.	Schedule:	Schedule 10S
3.	Grade:	Type 304/L (dual stamp), pickled and passivated
4.	Dimensions:	As indicated on Drawings

B. Fittings:

1. Type:
   a) Piping 2 Inches and Smaller: Socket welding.
   b) Piping 2-1/2 inches and Larger: Butt welding.

2. Dimensions: Comply with ASTM A312/A312M.

3. Butt-Welding Fittings:

   a) Comply with ASTM A403/A403M.
   b) Grade: Type 304/L.
   c) Class: Comply with ASME B16.9 and MSS SP 43

4. Socket-Welding Fittings:

   a) Comply with ASTM A403/A403M.
   b) Grade: Type 304/L.
   c) Class: WP-W; comply with ASME B16.11.

5. Flanged Fittings:

   a) Type: Welding neck or Slip on
   b) Class: 150.
   c) Comply with ASTM A182/A182M.
   d) Grade: Type 304/L.
   e) Facing and Drilling: Comply with ASME B16.5, with 1/16-inch flat face.
      1)

C. Provide stainless steel pipe and fittings manufactured and/or distributed by:

1. Felker Brothers, Marshfield, Wisconsin.
2. Douglas Brothers, Portland, Maine.
3. Swepco Tube, Clifton, New Jersey.
4. Alaskan Copper Works, Seattle, Washington.

2.3 ACCESSORIES

A. Pipe-Thread Tape:

1. Material: PTFE.
2. Comply with ASTM D3308.

B. Flange Gaskets:

1. Comply with ASME B16.5.
2. Nonmetallic Gaskets:

   a) Material: Viton; suitable for temperatures above 300 degrees F.
   b) Comply with ASME B16.21.

3. Type:

   a) Raised-Face Flanges: Flat ring.
   b) Flat-Face Flanges: Full face.

C. Anti-seize Bolting Lubricants:

1. Install flange bolts using a nickel anti-seize lubricant capable of achieving required bolt torque, sealing stress, and permitting future disassembly with minimal manual input.
2. Remove excess anti-seize compound by degreasing solvent prior to finish painting piping.
3. Anti-seize compound:

   a) Never-Seez Pure Nickel Special Lubricant manufactured by Bostik, Wauwatosa, Wisconsin.
   b) Loctite Heavy Duty Anti-Seize Lubricant Manufactured by Henkel Technologies, Rocky Hill, Connecticut.
   c) Chesterton 772 Premium Nickel Anti-Seize Compound manufactured by Chesterton Technical Products, Stoneham, Massachusetts.

4. Flange Bolts: Degreased of all corrosion inhibiting slush oil and excess anti-seize lubricant prior to field application of prime and finish coatings.

2.4 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements”: Requirements for testing, inspection and analysis.

B. Provide shop inspection and testing of completed assembly.

C. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

C. Inspect pipe, tube and fittings upon delivery and store in a location that will prevent entry of contaminants prior to installation.
   1. Rust spots on new stainless-steel pipe and fittings are nearly always due to surface contamination of free iron and shall not be allowed.
   2. If free iron is not removed, deep corrosion pits can result, especially in an aqueous process environment (water or wastewater).

3.2 PREPARATION

A. Ream pipe ends and remove burrs.

B. Bevel plain-end pipe.

C. Thoroughly clean pipe and fittings before installation.

3.3 INSTALLATION

A. Comply with ASME B31.3. Install pipe, fittings, and specials true to alignment and rigidly supported. Do not exceed deflection at pipe joints recommended by Supplier. Support all pipe and appurtenances connected to equipment to prevent any strain on equipment and valves nozzles, and adjoining pipe flanges.

B. Run piping straight along alignment as indicated on Drawings, with minimum number of joints.

C. Fittings:

   1. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
   2. Install according to manufacturer instructions.
   3. Bolting:

      a) Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight.
      b) Use torque wrench to tighten bolts to manufacturer instructions.

D. Concrete encase pipe under concrete slabs. Wrap stainless steel pipe in a protective material, such as a petrolatum tape or coat pie as needed, prior to encasement.

E. Provide required upstream and downstream clearances from devices as indicated on Drawings.

F. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.

G. Provide expansion joints as specified in Section 400506 “Couplings, Adaptors, and Specials for Process Piping” where shown on the Drawings.

H. Dielectric Fittings: Provide between dissimilar metals.

I. Field Cuts: According to pipe manufacturer instructions.

J. Field welding of stainless steel is permitted.
1. Field welding shall only be done as approved by the Engineer.
2. Field welds shall be performed by welders certified under ASME Section IX.
3. After field welding, all joints shall be thoroughly cleaned and buffed using deburring and finishing wheels.
4. Field welds shall only be done after a demonstration weld is successfully completed by each proposed welder at no additional cost to the Owner.
5. Use line-up clamps for full-penetration butt-welded field joints for pipe larger than 8-inch diameter. Alternative methods to line-up clamps proposed by the Contractor shall be submitted with welding submittals for Engineer’s approval.
6. Prepare pipe joints by a machining process without damage to the pipe exterior. Cut ends shall be smooth and at a right angle to the axis of the pipe and beveled where required in accordance with the approved welding procedure specifications. Pipe shall be deburred as part of the preparation of all joint configurations.

K. Cleaning, Descaling, and Passivation of Field Welds
1. Clean and passivate heat tint defects on the welds and the heat-affected-zone (HAZ) on the pipe exterior after welding, using a chemical cleaning system, in accordance with ASTM A967. The system will include a pre-cleaning solution, pickling paste, and neutralizing rinse. Apply cleaning system in accordance with the manufacturer’s instructions. Only use pickling and passivation products from the same manufacturer. Mixing chemicals from different manufacturers is not allowed.

2. Apply a heavy-duty stainless-steel pickling paste to clean the welds and HAZ. Apply paste using an acid resistant brush and in accordance with the product manufacturer’s instructions. The pickling paste product shall be one of the following:
   a) BlueOne® Pickling Paste 130, manufactured by Avesta Finishing Chemicals, Orchard Park, New York.
   b) Antox® 71E Plus Pickling Paste, manufactured by Chemetall US, New Providence, New Jersey.
   c) Kytex® Pickling Paste 316, manufactured by Harvard Chemical Research, Atlanta, Georgia.

3. Passivate the welds and HAZ using a neutralizing rinse to remove the pickling paste and a follow-up water rinse using purified bottled water shall be used to remove all residuals. The neutralizing rinse product shall be one of the following:
   a) Neutralizing Agent 502®, manufactured by Avesta Finishing Chemicals, Orchard Park, New York.
   b) Antox® NP, manufactured by Chemetall US, New Providence, New Jersey.
   c) Kytex® Neutralizer 408, manufactured by Harvard Chemical Research, Atlanta, Georgia.

4. Use of abrasive blasting is not permitted for passivation of the Work. This or similar physical processes as a substitute for the procedures specified herein will not be requested.

L. Joining preparation and finished welds: Under no circumstances may permanent backer-rings or other consumable inserts be used for field or shop welding of steel pipe. Non-consumable refractory inserts are allowed with Engineer's approval.

M. Prepare pipe joints by a machining process without damage to pipe exterior. Cut ends smooth and at a right angle to axis of pipe and beveled where required in accordance with approved welding procedure specifications. Deburr pipe and tube as part of preparation of all joint configurations.

N. Protect pipe, fittings and valves, and adhere to the following mandatory requirements, and others specified in paragraphs below:

1. Protect stainless steel materials from contact with carbon steel including but not limited to hoisting and rigging equipment, steel tables, storage racks and hand tools.
2. Do not bundle pipe and fittings using ferrous metal banding at factory or Supplier's facility.
3. Do not allow contact between wear surfaces of tools used for carbon steel fabrication and surfaces of stainless-steel pipe, tubes and fittings. These tools include abrasive grinding and cutting wheels, wheel cutters and rollers, threading taps and dies, tube bending equipment and all other bearing edge tools.
4. Use manual or powered wire brush tools for surface repair and joint preparation manufactured from stainless steel. Brushes with carbon steel wire cannot be used for fabrication of stainless steel.
5. Shield stainless steel pipe, and fittings from all on-site carbon steel pipe and structural steel cutting and blasting operations.
6. Remove all exterior surface scratches; surface contamination by ferrous metal grinding kerf; contamination by paint markers and crayons etc.; and labels after installation.

O. Verify Engineer examines exterior surfaces of pipe, and fittings at Site for free iron contamination by ferroxyl test or other method. Clean all contaminated surfaces at Site by pickling using a lean spray-applied pickling cleaner suitable for large surfaces system. Follow pickling with passivation of entire treated surface by a neutralizing rinse. Provide one of the following spray-applied pickling solutions:

1. Avesta Classic Cleaner 401®, manufactured by Avesta Finishing Chemicals, Orchard Park, New York.
2. Antox® 75E Pickling Cleaner, manufactured by Chemetall US, New Providence, New Jersey.
3. Kytex® Brightener 123, manufactured/distributed by Harvard Chemical Research, Atlanta, Georgia.

P. Use wire wheels, to remove defects on pipe surface after installation, constructed of same material as pipe wall or Type 316 stainless steel for super austenitic and duplex stainless steel piping. Verify surface finish on pipe meets specified mill-applied surface finish or better.

3.4 TOLERANCES

A. Piping Laying Tolerance: 5/8 inch.

3.5 FIELD QUALITY CONTROL

A. Cleaning:

1. Keep pipe interior clean as installation progresses.
2. After installation, clean pipe interior of soil, grit, and other debris.

B. Inspection:

1. Inspect for damage to piping or tubing.
2. Repair damaged piping, or provide new, undamaged pipe.
3. After installation, inspect for required supports and anchoring, interferences, and damage to pipe, tube, or fittings.

C. Pressure Testing:

1. Test Pressure: As specified in PART 2.
2. Conduct pneumatic test for sufficient time to visually inspect all joints or a minimum of 30 minutes at specified test pressure. There shall be no drop in test pressure in this time.
3. Observe joints, fittings, and valves under test.
4. Correct visible or audible leaks shall and then re-test the line.
5. After satisfactory completion of the test, vent the line and allow it to return to atmospheric pressure.

END OF SECTION 400523

SECTION 400524 - STEEL PROCESS PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel pipe.
2. Fittings.
3. Hot-dip galvanized coating and lining.

B. Related Requirements:

1. Section 400506 “Couplings, Adapters, and Specials for Process Piping”: Pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.
2. Section 400507 “Hangers and Supports for Process Piping”: Hangers, anchors, sleeves, and sealing of piping to adjacent structures.
3. Section 400551 “Common Requirements for Process Valves”: Common product requirements for valves for placement by this Section.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Submit manufacturer information regarding pipe and fittings.
2. Details of hot dip galvanized procedures for pipe coating and lining.

B. Shop Drawings:

1. Indicate layout of piping systems, including equipment, critical dimensions, sizes, and material lists, locations of all expansion joints, supports, anchors, harnessing, valves, etc.

2. Identify flange locations as required for field connections (field welding not allowed) and for any expansion joints as required per Contractor’s Delegated Design of pipe supports

for all steel pipe for Package Plant Low Pressure Air service as required per Section 400507.

C. Complete schedule of all components included in the pipeline drawings, indicating the materials and schedule number of thickness of all pipe, the materials and class of all fittings and valves.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

C. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.6 QUALITY ASSURANCE

A. Permanently mark each length of pipe with manufacturer's name or trademark and indicate conformance to standards.

B. Perform Work according to ASTM, ANSI, and AWWA standards.

C. Roll or permanently inscribe the manufacturer's name or trademark, the year of manufacture and the ASTM or API specification number on the pipe surface at the manufacturer's plant. Alternately, stencil the manufacturer's name or trademark, year of manufacture and ASTM or API specification number on the pipe surface.

D. Utilize only certified welders, having current certificates conforming to the requirements of the ASME code to perform all welding on steel pipes. Welders to be qualified under the requirements of Section IX Welding Qualifications, of the ASME Boiler and Pressure Vessel Code.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

B. Welders: AWS qualified within previous 12 months for employed weld types.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect piping and appurtenances by storing off ground.
3. Provide additional protection according to manufacturer instructions.

1.9 AMBIENT CONDITIONS

A. Minimum Conditions: Do not store or handle uninstalled lined pipes or fittings at temperatures below zero degrees F.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. General Service Piping (up through 24-inch diameter):

1. Comply with ASTM A53/A53M; Grade A.
2. Type: Welded, Seamless, Butt welded, or Electric welded.
3. Schedule: 10S
4. Finish: Hot-dip galvanized.
5. Minimum yield strength of 30,000 psi, fusion welded in accordance with the Code for Pressure Piping, ASME B31.1, to develop full plate strength.
6. Dimensions for steel pipe in accordance with ASME B36.10M. Pipe fabricated with straight-seam welds or spiral-seam welds. Straight seam pipe will have not more than two longitudinal butt-welded seams. Girth seams butt welded and not be closer than 6 feet apart except in specials and fittings. Spiral lap welded steel pipe is not allowed.
7. Provide pipe in lengths of approximately 20 feet.
8. Circumferential deflection of all pipe in-place shall not exceed 2.0 percent of pipe diameter.
9. Fabricated from carbon steel sheet ASTM A570 (Grades 30, 33, 36, or 40) or from plate ASTM A36, A283 (Grades C or D), A572 (Grade 42), or coil ASTM A139 (Grades B or C). Minimum material yield strength shall be 35,000 psi.
10. Maximum steel carbon content of 0.25 percent. Minimum elongation of 22 percent in a 2-inch gauge length.
11. Pipe wall thickness shall be designed for the design pressure specified herein with an additional allowance for the herein specified surge. Pipe design shall also account for pipe handling considerations.

12. Fittings shall be per AWWA C200 and C208. Fittings shall be of the same wall thickness, lining, and coating as the piping they are connected to. Use largest number of pieces for mitered bends feasible (unless indicated otherwise on Drawings). Maximum deflection angle for any section of the bend shall be 11.25 degrees.
13. Pipe ends/joints shall be flanged at equipment, valves, and where otherwise shown on the Drawings.
14. Flanges

    a. Flanges and blind flanges shall conform to ANSI B16.5, Class 125, AWWA C207, Class D for working pressure of 150 psi or less or Class E for all others and as compatible with valves and appurtenances attached to it; use higher pressure flanges to mate to valves or equipment flanges with higher ratings. They shall be welded neck or slip on type as required to meet the service noted. Welding shall be in accordance with AWWA C206. Slip-on flanges shall be welded to the pipe with fillet welds on both sides. Welding neck type flanges shall be butt-welded to the pipe.
    b. Drilling and size of flanges and bolts must be coordinated to insure compatibility; larger bolt holes as required for insulating flanges.
    c. Flange faces shall be flat faced and shall be normal to the pipe axis with a maximum tolerance of 0.005 in/ft of flange diameter. Angular deflection (or layback) of the flange face shall not exceed 0.75 degree from a plane surface and shall be uniform within 0.010-inch. All flanges, after welding to the pipe, shall be measured and shall be refaced, if necessary, to bring them within the specified tolerances. Flanges shall only be welded in the shop.
    d. The machined faces of all flanges shall be shop-coated with rust-preventive compound. Edges and back faces of attached flanges and blind flanges shall be shop coated with a primer compatible with the application of the final field coating. The inside of blind flanges shall be epoxy coated in accordance with AWWA C210.
    e. Bolts shall be ASTM A307, Grade B, heavy hex nut, installed length to project approximately 1/2-inch beyond surface of nuts.
    f. Gaskets for all services other than air shall be cloth-inserted rubber, 1/8-inch full face type. Garlock 3000, John Crane Co. Style 777, or equal.
    g. Flange insulating kits shall be utilized between all dissimilar metals and where otherwise noted.

        1) Insulating gaskets shall be JM Red Devil Type E full-face gasket, or approved equal.
        2) Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2-inch or smaller and shall be made of acetyl resin. For bolt diameters larger than 1-1/2-inch, insulating sleeves and washers shall be two piece and shall be made of polyethylene or phenolic. Steel washers shall be in accordance with ASTM F436.

15. All piping assemblies shall be shop assembled with flanged ends. Shop welding of fabrications shall be done according to the procedures and by welders certified per ASME Section IX. Welds shall be any inert gas shielding process using only extra low carbon filler metals. Welds shall have a bead height of nor more than 1/16-in. Butt

welds shall have 100 percent penetration to the interior or backside of the weld joint. Cross-sectional thickness of welds shall be equal or greater than that of the parent metal.

2.2 FINISHES

A. Hot dip galvanizing of steel pipe shall conform to ASTM-A53.

2.3 SOURCE QUALITY CONTROL

A. Testing:

1. Provide shop inspection and testing of completed pipe sections.

B. Engineer reserves the right to perform shop inspections of the manufacture of the pipe. Provide at least 30 days' notice to the Engineer prior to the beginning of any work so that inspection may be arranged. Furnish all facilities required for the inspection of materials and workmanship in the shop.

1. Inspection may include, welding inspection, review of certified material test reports, traceability check, and witness of assembly and fit-up.
2. Prior to manufacture, the pipe fabricator shall supply the following information on suppliers of plate, piping, and other components: Items(s) furnished, company name and address, contact name, telephone and fax number. The Engineer reserves the right to visit any or all of the suppliers and conduct inspections at their facilities.
3. The inspector has the authority to reject any material or work that does not meet the requirements of the Contract Documents.
4. Inspection at the shop is intended as a means of facilitating the work and avoiding errors. Shop inspection does not relieve the responsibility for furnishing proper materials or workmanship.
5. Engage inspectors to inspect welded connections and to perform tests and prepare test reports. Perform non-destructive testing as required by the specification under which the pipe is manufactured.
6. Correct or reweld and retest deficient welds to the specified requirements as determined by the Engineer and/or an independent testing lab.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Drawings.

B. Inspect existing flanges for nonstandard bolt-hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Thoroughly clean pipe and fittings before installation.

B. Surface Preparation:
   1. Clean surfaces to remove loose rust, mill scale, and other foreign substances

3.3 INSTALLATION

A. According to AWWA M11

B. Run piping straight along alignment as indicated on Drawings, with minimum number of joints.

C. Fittings:

   1. Clean gasket seats thoroughly and wipe gaskets clean prior to installation.
   2. Install fittings according to manufacturer instructions.
   3. Bolts:

      a. Determine torque per AWWA M11.
      b. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight.
      c. Use torque wrench to tighten bolts to manufacturer instructions.
      d. Project 1/4-inch beyond the nut when joint with gasket is assembled.

D. Provide required upstream and downstream clearances from devices as indicated on Drawings.

E. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.

F. Support exposed piping as specified in Section 400507 “Hangers and Supports for Process Piping.” Where temporary supports are used during construction, provide sufficient strength and rigidity to prevent shifting or distortion of the pipe.

G. Provide expansion joints as specified in Section 400506 “Couplings, Adapters, and Specials for Process Piping”, and provide pipe guides as specified in Section 400507 “Hangers and Supports for Process Piping”, to compensate for pipe expansion due to temperature differences.

H. Dielectric Fittings: Provide between dissimilar metals.

3.4 TOLERANCES

A. Circumferential deflection of all pipe in-place: not to exceed 2.0 percent of the pipe diameter.

3.5 FIELD QUALITY CONTROL

A. Cleaning:

   1. Keep pipe interior clean as installation progresses.
   2. After installation, clean pipe interior of soil, grit, loose mortar, and other debris.

3. Galvanized Surfaces: Clean bolted connections and abraded areas and repair galvanizing to comply with ASTM A780.

B. Inspection:

1. Inspect for damage to pipe galvanizing and for other defects that may be detrimental as determined by Engineer.
2. Repair damaged piping or provide new, undamaged pipe.
3. After installation, inspect for proper supports and interferences.

C. Replace pipe or fittings with mortar cracks wider than 1/16 inch.

D. Pressure Testing:

1. Test Pressure: As specified in PART 2.
2. Conduct pneumatic test for sufficient time to visually inspect all joints or a minimum of 30 minutes at specified test pressure. There shall be no drop in test pressure in this time.
3. Observe joints, fittings, and valves under test.
4. Correct visible or audible leaks shall and then re-test the line.
5. After satisfactory completion of the test, vent the line and allow it to return to atmospheric pressure.

END OF SECTION 400524

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SECTION 400551 - COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Common requirements for valves.
2. Common requirements for valve actuators.
3. Valve tags.
4. Valve Schedule.
5. Delegated Design.

B. Related Requirements:

1. Section 033000 “Cast-in-Place Concrete” for execution requirements for placement of concrete as required by this Section.
2. Section 055000 “Metal Fabrications” for miscellaneous metalwork and fasteners specified by this Section.
3. Section 099679 “Atmospheric Protection and Plant Service Areas Coatings” for field painting requirements.
4. Section 400507 “Hangers and Supports for Process Piping” for product and execution requirements for valve supports specified by this Section.
5. Section 400557 “Actuators for Process Valves and Gates.”

1.3 COORDINATION

A. Coordinate Work of this Section with individual process valve specifications.

1.4 ACTION SUBMITTALS

A. Valve Schedule:

1. Submit valve schedule populated with all Division 40 process valves specified for this project. Include all information shown on the Sample Valve Schedule included in this project.
2. Approval of valve schedule submittal to precede all individual valve submittals. All subsequent individual valve submittals to include the approved valve tag number or group on the submittal cover sheet.

B. Valve Tags:

1. Materials, dimensions and thickness of tags, materials and gauge of cable and splicing hardware.
2. Color palate for Owner selection.
3. Full scale drawing of sample with lettering dimensions and scribe depth.
4. Valve tag lettering provided with Valve Schedule above.

C. Power Actuator Data:

1. Sizing Calculations:

a. Provide fluid pressure and velocity sizing basis.
b. Provide maximum valve torque based on disc shape and flow direction.
c. Clearly indicate safety factors and mechanical ratios of any intermediate gearing.

2. Maximum output torque of actuator and intermediate gearing.
3. Details of actuator mounting, including orientation of actuator and intermediate gearing.
4. Dimensional drawing of actuator assembled on valve.
5. Pneumatic/Hydraulic pressure requirements, electrical power supply, plumbing connection sizes and locations.
6. Wiring diagram, control wiring and protocol.
7. Valve cavitation limits for positioning, modulating and control valves mated to power actuator.

D. Shop Drawings:

1. Valve and actuator model number and size, valve parts list, materials of each part including material standard designation (ASTM or other), position indicators, limit switches, actuator mounting.
2. Confirm actuator mounting location including chainwheels will be operable in the mounting locations shown on the Contractor Drawings.

E. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for all valves.

1.5 DELEGATED DESIGN SUBMITTALS

A. Submit signed and sealed Shop Drawings with design calculations and assumptions for sizing of control valves.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer Instructions: Submit installation and operation instructions for each component including valve, actuator, gearbox, and any included instrumentation.

B. Source Quality-Control Submittals: Indicate results of integrators facility tests and manufacturers factory tests and inspections.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Manufacturer Certification of Installation: Certify that equipment has been installed according to manufacturer instructions.

E. Qualifications Statement:

1. Submit qualifications for manufacturer and licensed professional.

1.7 QUALITY ASSURANCE

A. Maintain clearances as indicated on Drawings and Shop Drawings.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Mate valves to actuators at manufacturer’s or integrator’s facility. Fully test assembled product and certify ready for installation prior to shipment to the job site.

1. Only in special cases for extremely large assemblies where installation requires disassembly, may actuators be mounted to the valves in the field.

D. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

E. Submit affidavit of compliance with testing and manufacturing standards referred in this specification and the individual valve specifications.

F. Provide the services of a qualified and factory-trained service representative of the manufacturer to provide installation inspection and check out, and operational and maintenance instruction, for each type.

G. Obtain Manufacturer’s Certification of Proper Installation for Specified valves and valve assemblies.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing valves and actuators with minimum ten years' experience.

B. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Texas.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage

B. Deliver factory mated power actuated valves on rigid wooden skids, fully braced, and strapped to prevent damage to valve, actuator or coupling system.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
3. Provide additional protection according to manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to materials ordering or any fabrication.
2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

A. Furnish 2-year manufacturer's warranty for valves and actuators from date of Contractor's Substantial Completion, as described in CIP 16.

PART 2 - PRODUCTS

2.1 VALVES

A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required.

B. Provide all valves of the same type by same manufacturer.

C. Valve Ends: Compatible with adjacent piping system.

D. Operation:

1. Close by turning counterclockwise.
2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

E. Valve Marking and Labeling:

1. Marking: Comply with MSS SP-25.
2. Labeling (valve tags):

    a. Fiberglass reinforced plastic, ASTM D709, 70 mil thick, 2-1/2-inch diameter or 2-1/2-inch by 1-1/4-inch.
    b. Lettering 1/16-inch thick of silk screening or other permanent embedment of subsurface printed graphics, permanently sealed.
    c. Colors of lettering and backing as selected by Owner.
    d. Two, 1/4-inch clear opening Type 316 stainless steel grommets at each end, center of hole 3/8-inch from tag edge.
    e. 3/32-inch Type 316 stainless steel cable and splice hardware.

F. Valve Construction: As Specified in Valve Specifications Sections.

G. Do not use Van Stone flanges with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

2.2 VALVE ACTUATORS

A. Provide actuators in accordance with the valve schedule included in specifications**.**

B. Provide mechanical position indicators for power actuated and gearbox actuated valves.

C. Comply with AWWA C541 (Pneumatic and Hydraulic actuators) and C542 (Electric Motor Actuators) as applicable.

D. Provide chain actuators for shutoff valves mounted greater than 7 feet above operating floor level.

E. Gear and Power actuators as specified in Section 400557 “Actuators for Process Valves and Gates.”

2.3 INSULATION

A. Insulate all valves installed in insulated piping systems as part of the Work.

2.4 FINISHES

A. Valve Coating: Comply with AWWA C550.

B. Factory finishes are included in individual valve sections.

C. Exposed Valves: As specified in Section 099676.23. Stainless Body Valves: Do not coat.

D. Do not coat flange faces of valves unless otherwise specified.

2.5 SOURCE QUALITY CONTROL

A. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

B. Owner Inspection:

1. Make completed available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and test at manufacturer's test facility.

2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping system is ready for valve installation.

B. Fully examine valves for debris, damage, and interior finish blemishes prior to installation. Do not install valves with soiled interior or any visible damage to seats, discs, or interior finish.

C. Identify any piping, plant, or equipment clearance issues prior to installation, bring to Engineer’s attention via job meetings, submittal process or request for information process.

3.2 INSTALLATION

A. Install valves, actuators, extensions, valve boxes, and accessories according to manufacturer instructions.

B. Inspect valve interiors before line closure for the presence of debris. At option of Engineer, internal inspection of valve and appurtenances may be required any time that the likelihood of debris is a possibility. Clean connecting pipes prior to installation, testing, disinfection, and final acceptance.

C. Disinfect valves installed in potable water lines with approved pipeline disinfection process.

D. Rigidly support valves to avoid stresses on piping.

E. Coat studs, bolts, and nuts with anti-seizing lubricant.

F. Dielectric Fittings: Provide between dissimilar metals.

G. Clean field welds of slag and splatter to provide a smooth surface.

H. Mate, adjust, and fully test gearboxes, electric, hydraulic, and pneumatic actuators to valves at manufacturer’s or integrator’s facility.

1. Only in special cases for extremely large assemblies where installation requires disassembly may actuators be mounted to the valves in the field. These circumstances require preinstallation meetings.

I. Do not install stems vertically downward.

J. Unless otherwise indicated on Drawings:

1. Install Gate, Globe, and Ball Valves with stem vertical in 12 o'clock position.
2. Install Plug Valves with stem horizontal and plug opening to the top of the body unless position will not allow proper actuator access, in which case stem may be vertical in 12 o'clock position.
3. Install Butterfly Valves 12 inch and smaller with stem horizontal or vertical in 12 o'clock position,
4. Install Butterfly Valves 14 inch and larger with the stem horizontal unless position will not allow proper actuator access, in which case stem may be vertical in 12 o'clock position.
5. Install Control Valves in horizontal pipelines with top works vertically upward.

K. Install brackets, extension rods, guides, and various types of operators and appurtenances as indicated. Before properly setting these items, check all drawings and figures which have a direct bearing on their location.

L. Inspect materials for defects in construction and materials. Clean debris and foreign material out of openings, etc. Verify valve flange covers remain in place until connected piping is installed. Verify operability of operating mechanisms for proper functioning. Check nuts and bolts for tightness. Repair or replace valves and other equipment which do not operate easily or are otherwise defective.

M. Where installation is covered by a referenced standard, install and certify in accordance with that standard, except as herein modified. Also note additional requirements in other parts of this Section.

N. Unless otherwise noted, provide joints for valves and appurtenances utilizing the same procedures as specified under the applicable type connecting pipe joint. Install valves and other items as recommended by the manufacturer. Verify manufacturers' torqueing requirements for all valves.

O. Coordinate direction of flow through offset type and shaped butterfly valve discs with the mated actuator torque capacity.

P. Rotate valve operators and indicators to display toward normal operation locations. Consult with Engineer prior to installing valves with handwheels to confirm final position of handwheel.

Q. Vertically center floor boxes, valve boxes, extension stems, and low floor stands over the operating nut, with couplings as required.

1. Adjust elevation of the box top to conform to the elevation of the finished floor surface or grade at the completion of the Contract.
2. Support boxes and stem guides during concrete placement to maintain vertical alignment.

R. Install brass male adapters on each side of valves in copper-piped system and solder adapters to pipe.

S. Install 1-inch ball valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and equipment.

T. Install valves with clearance for installation of insulation and to allow access.

U. Provide access where valves and fittings are not accessible.

V. Pipe Hangers and Supports: As specified in Section 400507 “Hangers and Supports for Process Piping.”

W. Comply with Division 40 “Process Interconnections” for piping materials applying to various system types.

X. Install insulation as specified in Section 404213 “Process Piping Insulation.”

3.3 FIELD QUALITY CONTROL

A. Valve Field Testing:

1. Test for proper alignment.
2. If specified by valve Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.
3. Engineer will witness field testing.
4. Functional Test:

    a. Prior to system startup, inspect valves and actuators for proper alignment, quiet operation, proper connection, and satisfactory performance.
    b. After installation, open and close all manual valves in the presence of Engineer to show the valve operates smoothly from full open to full close and without leakage.
    c. Cycle valves equipped with electric, pneumatic, or hydraulic actuators 5 times from full open to full closed in the presence of Engineer to exhibit operation without vibration, jamming, leakage, or overheating.
    d. Operate pressure control and pressure relief valves in the presence of Engineer to show they perform their specified function at some time prior to placing the piping system in operation and as agreed during construction coordination meetings.

5. Field test pipelines in which valves and appurtenances have been installed. During these tests, adjust, remove, or replace defective valve or appurtenance, or otherwise make acceptable to Engineer. Test regulating valves, strainers, or other appurtenances to demonstrate conformance with the specified operational capabilities. Correct deficiencies, replace device or otherwise made acceptable to Engineer.

3.4 ATTACHMENTS

A. Attachment 400551-A Table 1: Valve Schedule.

END OF SECTION 400551

SECTION 400551-A
TABLE 1
PROCESS MECHANICAL VALVE SCHEDULE

Tag Number	*Tag Typ*	*Valve Size (Inches)*	*End Connection*	*Working Pressure (psi)*[4]	*Service Fluid* [2]	*Actuator Type*[j]	*Notes*	*Drawing Number*	*Spec Section*
BFV-1325-1	BFV2	12”	FLANGED	20	LPA	MANUAL	BY CONTRACTOR FOR PACKAGE PLANT BLOWERS	DS-IB-1	400564
BFV-1325-2	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-IB-1	400564
BFV-1325-3	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-IB-1	400564
CV-1330-1	DDCV1	12”	FLANGED	20	LPA	MANUAL		DS-IB-1	400565.29
CV-1330-2	DDCV1	12”	FLANGED	20	LPA	MANUAL		DS-IB-1	400565.29
CV-1330-3	DDCV1	12”	FLANGED	20	LPA	MANUAL		DS-IB-1	400565.29
BFV-1330-1	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-IB-1	400564
BFV-1330-2	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-IB-1	400564
BFV-1330-3	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-IB-1	400564
GV-1100-1	GV1	12”	FLANGED	10	INF	MANUAL	PACKAGE PLANT INFLUENT	DS-IB-1	400561
GV-1102-1	GV1	14”	FLANGED	10	CEFF	MANUAL	PACKAGE PLANT CLARIFIER EFFLUENT	DS-IB-1	400561
BV-1214-1	BV3	3”	FLANGED	10	LPA	MANUAL	RAS AIRLIFT AIR SUPPLY	DS-IC-2	400563
BFV-1305-1	BFV2	12”	FLANGED	20	LPA	MANUAL	BY MULTISTAGE BLOWER MANUFACTURER (SECTION 431118)	DS-ID-1	400564
BFV-1305-2	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-ID-1	400564
BFV-1305-3	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-ID-2	400564
BFV-1305-4	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-ID-2	400564
CV-1310-1	DDCV1	12”	FLANGED	20	LPA	MANUAL		DS-ID-1	400565.25
CV-1310-2	DDCV1	12”	FLANGED	20	LPA	MANUAL		DS-ID-1	400565.25
CV-1310-3	DDCV1	12”	FLANGED	20	LPA	MANUAL		DS-ID-2	400565.25
CV-1310-4	DDCV1	12”	FLANGED	20	LPA	MANUAL		DS-ID-2	400565.25
BFV-1310-1	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-ID-1	400564
BFV-1310-2	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-ID-1	400564
BFV-1310-3	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-ID-2	400564
BFV-1310-4	BFV2	12”	FLANGED	20	LPA	MANUAL		DS-ID-2	400564

3

3

NOTES:

(1) Scheduled valves are limited to only process mechanical valves which are manually operated valves 3-inches and larger, and all process mechanical valves that have electric motor, solenoid or pneumatic operators. No fire protection or plumbing valves are included. For Plumbing, Building Mechanical, and Fire Protection valves see Divisions 21, 22, and 23.

(2) Process Fluid Abbreviations: FLT=Filtrate; INF= Raw Influent; CEFF = Clarifier Effluent; LPA=Low Pressure Air.

(3) See Section 400557 for Operator requirements.

(4) See pipe schedule for line test pressures and specifications for valve design pressure requirements. For valves at pump stations, confirm with pump manufacturer for flow and pressure requirements.

END OF SECTION 400551A

SECTION 400553 - IDENTIFICATION FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Requirements:

1. Division 09 for requirements for painting by this Section.
2. Section 400551 “Common Requirements for Process Valves” for basic materials and methods for valves.

1.3 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's catalog literature for each specified product.

B. Shop Drawings:

1. Indicate list of wording, symbols, letter size, spacing of labels, and color-coding for mechanical identification and valve chart and schedule.
2. Indicate valve tag number, location, function, and valve manufacturer's name and model number.

C. Samples: Submit two tags proposed and the manufacturer’s standard color chart and letter styles for each size to be used on Project.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITALLS

A. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

B. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 MAINTENANCE MATERIAL SUBMITTALS

1.7 QUALITY ASSURANCE

A. Piping Color Scheme and Lettering Size: Comply with ASME A13.1.

B. Color coding system and labeling, according to Texas Commission of Environmental Quality Water Hygiene Division: See Division 09 for painting requirements.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 TAGS

A. Metal Tags for All Valves:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.
e. Pipemarker.com (Brimar Industries, Inc.)
f. R&R Identification Co.
g. Seton Identification Products.

2. Description:

a. 19 gauge Brass or 0.025 inch Type 304 Stainless-steel (for corrosive and wet areas) construction; stamped letters or engraved letters.
b. Minimum Tag Size and Configuration: 2 inches diameter with finished edges.
c. Provide with brass hooks suitable for attaching the tag to the valve operator.
d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.

2.2 PIPE MARKERS

A. Plastic Pipe Markers and Directional Arrows for all pipes 3/4 – inch and larger:

1. Manufacturers:

a. Brady ID.
b. Craftmark Pipe Markers.
c. Marking Services, Inc.
d. R&R Identification Co.
e. Seton Identification Products

2. Description:

a. Factory-fabricated, flexible, and semi-rigid plastic.
b. Preformed to fit around pipe or pipe covering.
c. Larger sizes may be of maximum sheet size, with spring fastener.
d. Letters shall bear the full pipe system name as scheduled.
e. Color shall be white or black depending on background color.
f. Letter sizes:

OUTSIDE DIAMETER OF PIPE (INCHES)	LENGTH OF COLOR FIELD (INCHES)	SIZE OF LETTERS (INCHES)
¾ to 1-1/4	8	½
1-1/2 to 2-3/8	8	¾

2-1/2 to 6	12	1-1/2
8 to 10	24	2-1/2
Over 10	32	3

B. Plastic Underground Pipe Markers Used for All Buried Pipes:

1. Manufacturers:

a. Brady ID
b. Craftmark Pipe Makers
c. Kolbi Pipe Marker Co.
d. Marking Services, Inc.
e. Pipemarker.com (Brimar Industries, Inc.)
f. Seton Identification Products.

2. Description:

a. Brightly colored, continuously printed plastic ribbon tape.
b. Minimum Size: 6 inches wide by 4 mils thick.
c. Manufactured for direct burial service.
d. Letter sizes per Paragraph 2.2A.

2.3 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:

a. Brady ID.
b. Master Lock Company, LLC.

2. Description:

a. Material: Anodized aluminum.
b. Furnish hasp with erasable label surface.
c. Minimum Size: 7-1/4 by 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:

a. Brady ID.
b. Master Lock Company, LLC.

2. Description:

a. Material: Plastic.
b. Furnish device to restrict access to valve operator and to accept lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. According to manufacturer instructions.

B. Apply stencil painting.

C. Install identifying devices after completion of coverings and painting.

D. Install nameplates with corrosion-resistant mechanical fasteners or adhesive.

E. Tags:

1. Identify all valves with tags.
2. Install tags using corrosion-resistant chain.
3. Install tags prior to testing and start-up of related equipment.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Piping:

1. Identify piping, concealed or exposed, with plastic pipe markers.
2. Use tags on piping 3/4-inch diameter and smaller.
3. Identify service, flow direction, and pressure.
4. Install in clear view and align with axis of piping.
5. Location: Place labels and directional arrows at a maximum of 15-foot on center at both sides of penetrated walls or floors, adjacent to valves, at connected equipment, at branch fitting and in congested pipe layouts. Contractor to review TCEQ requirements and may need to decrease spacing as required.
    a. Two labels minimum each room, crawl space or compartment, unless otherwise approved.
    b. Arrows indicated direction of flow shall point away from label. If flow may be in both directions, use double-headed arrows.

END OF SECTION 400553

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SECTION 400557 - ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Following types of actuators for linear, multi-turn, and quarter turn valves and gates:

1. Manual actuators.
2. Electric motor actuators.

B. Related Requirements:

1. Section 055000 “Metal Fabrications” for miscellaneous metalwork and fasteners as required.
2. Section 099679 “Atmospheric Protection and Plant Service Areas Coatings” for non-submerged actuators as required.
3. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
4. Section 400551 “Common Requirements for Process Valves” for common product requirements for valves for placement by this Section.

1.3 DEFINITION

A. Where the term “valve” alone is used in this Section, it applies to both valves and gates as the corresponding text context dictates.

1.4 COORDINATION

A. Section 400551 “Common Requirements for Process Valves” for valve schedule requirements.

B. Coordinate Work of this Section with installation of valves, gates, and accessories.

1.5 ACTION SUBMITTALS

A. Product Data: Manufacturer information for actuator with model number and size indicated.

B. Shop Drawings:

1. Parts list, materials, sizes, position indicators, limit switches, control system, actuator mounting, wiring diagrams, control system schematics with external interfaces on assembly drawings.
2. Actuator Shop Drawings with respective valve and gate submittal.

C. Manufacturer's Certificate: Products meet or exceed specified requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer Instructions: Special procedures and placement requirements.

B. Source Quality-Control Submittals: Results of factory tests and inspections and provide required certifications.

C. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

D. Qualifications Statements:

1. Qualifications for manufacturer and installer.
2. Manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Documentation of actual locations and types of actuators.

1.8 QUALITY ASSURANCE

A. Valve Actuators in NEC Class I, Group C and D, Division 1 or 2 Hazardous Locations: Comply with NFPA 70.

B. Minimum NEMA Enclosure Classification:

1. Non-submergence Installations: NEMA 4X.
2. Submergence Installations: NEMA 6P/IP68.

C. Single Source Requirements:

1. Furnish electric motor actuators in the scope of the project by the same manufacturer. Coordinate this requirement with actuated valves and gates included in scope of vender furnished equipment.
2. Furnish actuators, floor stands, stem guides, stems, extensions, and accessories for slide gate assemblies by slide gate manufacturer.

D. Mate actuators to equipment at equipment manufacturers or integrators facility.

1. Test assembled product. Certify ready for installation prior to shipment to job site.
2. For extremely large assemblies requiring disassembly for installation, the actuator may be disassembled for shipment and remounted in the field.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

A. Manufacturer’s Special Warranty: Submit standard written warranty against manufacturing defects for manual pneumatic electric-motor actuators.

1. Warranty Period: 2-Years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to valve and gate schedule for actuator type, accessories, and sizing information.

B. Actuator to move the gate from the full open to full closed position and back again and hold the gate at any position part of the way between full open and closed.

C. Provide clockwise closed actuation unless otherwise noted on the valve and gate schedule.

D. Supply chain actuators for manual valves located 7 feet or higher above finished floor.

2.2 ACCESSORIES

A. Floor Stands:

1. Materials:

   a. Stand: Cast iron.
   b. Stem Bushing: Sintered bronze.
   c. Position Indicator: Bronze.

2. Height to input shaft or handwheel: 36 inch.
3. Base Mounting Requirements:

   a. Concrete Floor Mounting: Type 316 stainless steel anchor bolts.
   b. Face of Basin or Offset Mounting: Heavily reinforced, adjustable wall bracket with required anchor hardware using Type 316 stainless steel.

4. Actuator Mounting Requirements:

   a. Manual Actuator: Cast iron handwheel on top of floor stand with dual ball type thrust bearings, grease fitting on bearing bowl, hardened machined alloy bronze lift nut (for rising stem). Where manual effort is greater than 40 lb rim pull with 2 feet diameter wheel, provide geared actuator with a handwheel or crank.

      1) Handwheel casting to include the word “OPEN” and an arrow indicating the direction of operation.

   b. Gearbox or Direct Powered Actuator: Through bolt holes matched to actuator or gearbox bolting pattern.

5. Non-rising stem position indicator: Mechanical indicator connected to and driven by stem extension and cast position marks on floor stand with the word “OPEN” cast at the top of the travel, and a field mounted aluminum “CLOSED” tag supplied with drive rivets, installed based on number of valve turns.
6. Rising Stem Position Indicator: Permanent markings on transparent stem covers.

B. Stem Covers: Fracture-resistant clear polycarbonate stem covers for rising stems. Closed top with adhesive type position indicator markings.

C. Extension Stems and Stem Guides:

1. Extension stems and couplings to actuate recessed, buried, below slab valves and gates via operating nut or floor stand mounted actuator.
2. Stem Extensions and Stem Couplings: Alloy steel, hardware of Type 316 stainless steel unless specified otherwise in the respective slide gate specification.
3. Stem and Stem Couplings: Rated for five times the maximum input torque capacity of the actuator.
4. Adjustable, Cast Iron Wall Bracket Type Stem Guides: Include two-piece bushing.
5. Spacing: 10 feet spacing or at spacing calculated by manufacturer to prevent buckling with a safety factor of 2 based on design thrust, shaft material and shaft size.

D. Torque Tubes:

1. Supply where shown on the Drawings or Valve and Gate Schedule or as recommended by Manufacturer.
2. Supported by/mated to valve bonnet/yoke.
3. Sized by supplier for the required actuator torque.
4. Drilled specifically for valve and actuator bolt pattern.
5. Internal extension keyed or shaped specifically to mate to valve shaft and fabricated of Type 316 stainless steel.
6. Internal extension designed for axial adjustment for mating purposes.

E. Chain Wheels:

1. Supply for manual valves 3 inch diameter or larger mounted 7 feet and greater above operating floor level.
2. Type: Sprocket rim with chain and floating chain guide.
3. Chain Wheel and Guides Materials: Cast iron with hot-dip galvanized chain.
4. Chain Length: Extend to 5-1/2 feet above operating floor level.
5. Chain Storage: Include where chains may interfere with personnel egress; made with high-strength thermoplastic polymer in safety orange color.
    a. Basis-of-Design: Trumbull, Model ‘Chain Up’ as manufactured by Trumball Manufacturing, Inc., or equal.
6. Chain Wall Hooks: Include where feasible to prevent chain from impeding personnel egress.

2.3 MANUAL ACTUATORS

A. Operating Nuts:

1. 2 inch cast iron AWWA design.
    a. Painted Carbon Steel Tee Handle Operator: 2 inch AWWA nut socket end extension length for nut actuated valves where nuts are recessed in valve boxes.
    b. Tee Extension Length: Determine based on nut height as shown on Drawings with handle height approximately 3 feet above operating surface.
2. Operating Nuts Recessed on Concrete: Cast iron floor box with cover and tee handle operator with 2 inch AWWA nut socket end.
3. Nut Operated Non-Rising Stem Buried Valves: Cast iron bonnet skirts, extension pipes valve box and cover. Stem extensions with AWWA nut end to elevation shown on the Drawings or scheduled.
4. Two tee handles for every ten buried or encased non-rising stem application with 2 inch AWWA operating nut.

B. Gear-Assisted Manual Valve Actuators:

1. Provide:
    a. For manually actuated valves and gates larger than 8 inch nominal diameter and for ball and plug valves 6 inch and larger.
    b. With power actuators where torque requirements dictate.

2. Comply with AWWA C504.
3. Handwheel Diameter: 8 inch
4. Maximum Handwheel Pull: 40 lbs maximum.
5. Housings: Cast or ductile iron.
6. Worm or helical gear type.EIM
7. Gears: Hardened steel, machine cut and mated.
8. Bearings: Permanently lubricated bronze.
9. Input and Output Shafts: Sealed with greased, waterproof machine shaft seals.
10. Filled with waterproof grease and designed for submerged service where scheduled.
11. Handwheel: Removable.
    a. Diameter: 8 inch up to 12 inch valve size.
    b. Diameter: 12 inch diameter up to 16 inch valve size.
    c. Diameter: 18 inch diameter for larger than 16 inch valve size.
    d. Maximum Diameter: 24 inch diameter.
12. Include mechanical top mounted valve position indication, opening direction, and adjustable stops.

C. Direct Manual Slide Gate Actuators:

1. Small Gates not Requiring Gear Reduction to Achieve Rim Pull Requirements: Yoke or floor stand mounted handwheel with dual ball type thrust bearings, grease fitting on bearing bowl, hardened machined alloy bronze lift nut.

D. Gear-Assisted Manual Slide Gate Actuators:

1. Provide manually actuated slide gates where direct mount actuators cannot meet rim pull requirements and design safety factors.
2. Include power actuators where torque requirements dictate.
3. Comply with AWWA C504.
4. Yoke mount for self-contained gates and floor stand mount for non-self-contained gates.
5. Accessories specified hereinabove where pertinent to the application.
6. Handwheel or crank style operator with maximum rim or crank pull of 40 lbs.
    a. Crank operators of cast iron construction with revolving brass grip.
    b. Handwheel casting to include the word “OPEN” and an arrow indicating the direction of operation.
7. Gear Boxes:
    a. Bevel or parallel shaft as required by installation geometry.
    b. Fully enclosed cast or ductile iron housings.
    c. Suitable for pedestal or yoke (bench) mounting.
    d. Mechanical seals on input shafting.
    e. Shafting fully supported with anti-friction ball or roller bearings throughout.
    f. Precision machined high strength bronze lift nuts.
    g. Precision cut steel gears.
    h. Input Shafts: Type 316 stainless steel.
    i. AWWA drive nut for removable crank, wheel or portable power operator to be 2 inches.
    j. Single or compound reduction as required to achieve rim pull requirements.
    k. No damage to gearbox components with 100 lbs rim pull.

l. Coordinate with gate stem design such that catastrophic failure occurs at stem nut prior to stem buckling.

8. Tandem gear drives where indicated on Gate Schedule. Tandem drives include parallel gear boxes, Type 316 stainless steel interconnecting shafting, and flexible couplings furnished by the manufacturer.

2.4 ELECTRIC MOTOR ACTUATORS

A. General:

1. Electric motor, reduction gearling, limit switches, and torque switches.
2. Where specified on the Gate Schedule, or shown on Drawings.
3. Comply with AWWA C542.
4. Actuators for Valves 3 inches and Smaller: 120 Volt, 1 Phase, 60 Hertz power supply.
5. Actuators for Valves Larger than 3 inches and for slide gates and weir gates: 480 Volt, 3 Phase, 60 Hz power supply.
6. Actuators to be designed to match the gate applications for either ¼ turn or multi-turn and for either open/close or modulation operation as noted in the Gate Schedule.

B. 120 Volt Power Actuators:

1. Actuators to have reversing motor, reduction gearing, local position indicator, position limit switches, provision for manual override, 100 to 1000 in-lbs torque range and motor thermal and electronic control protection.
2. Enclosure:
   a. Cast aluminum or steel alloy.
   b. Powder coated or fusion bonded epoxy finish.
   c. NEMA 4X.
3. Power Train:
   a. Self-locking planetary epicyclical gear design.
   b. Hardened steel gears with bronze bearings.
   c. Housing Penetrations: Seal with mechanical seals.
   d. Housing: Equip with space heaters.
   e. Mounting System: ISO 5211.
4. Actuator for Open/Close/Jog Reversing Service: Proportional/modulating service where required in the equipment specifications or Instrumentation Drawings.
5. Motors:
   a. Design for valve actuation service.
   b. Insulation: Class F.
   c. Split phase capacitor protection.
   d. Duty Cycle: 40 percent at 100 degrees F for open/close duty, and 100 percent for modulating duty.
   e. 90-Degree Travel Time: 10 to 20 seconds depending on actuator size.
   f. Actuator Switches: Have two SPDT 15 Amp rated switches for remote open/close valve position indication.

6. Products: Subject to compliance with requirements, provide one of the following or equal:
    a. Series 92 as manufactured by Asahi/America.
    b. P Series as manufactured by Promation Engineering, Inc.
    c. Bettis TorqPlus as manufactured by Emerson Actuation Technologies.

C. 480 Volt Power Actuators:

1. General: 3 phase 60 hz supply rated, self-contained, totally enclosed with motor, integral reversing starters, local controls, reduction gearing, limit switch gearing, limit switches, control power transformer, torque switches, bored and keyed drive sleeve for non-rising stems, declutch lever, auxiliary handwheel, and local position indication.
2. Separately seal motor and control compartments with space heaters in limit switch, motor, and control compartments.
3. Suitable for indoor and outdoor use, fully functional in ambient temperature range from -20 to 140 degrees F at 100 percent relative humidity.
4. Size to guarantee full travel, seating and unseating torque or thrust as specified by the valve or gate manufacturer.
5. Size to provide torque required to operate valve or gate at 90 percent of nominal voltage.
6. Design Travel Rate:
    a. As indicated on valve and gate schedule, and if not so indicated:
        1) Gate Valves and Slide Gates: 12 inches per minute.
7. Enclosure: Cast aluminum construction, 0-ring sealed, watertight to NEMA 4X/6 and submersible to IP 68-8, 20 feet for 72 hours..
    a. Where required on Valve and Gate Schedule, certified explosion proof for Class I, Division 1 and 2, Groups C and D.
    b. External Fasteners: Type 316 stainless steel.
    c. Include anti-condensation heater, suitable for continuous operation.
8. Motors:
    a. High-starting torque; low stall torque, low inertia, designed and built by actuator manufacturer.
    b. Embed thermistor in each motor winding for thermal protection.
    c. Insulation: Class F, with a duty rating of at least 15 minutes at 40 degrees F ambient temperature.
9. Motor Protection:
    a. De-energize without damage in the event of a stall condition when attempting to move a jammed valve.
    b. De-energize in the event of an over-torque condition.
    c. Imbed a minimum of two thermal devices in motor windings to de-energize the motor in case of overheating.
10. Gear Train:
    a. Grease filled, O-ring sealed in cast or ductile iron gear case.
    b. Suitable for operation in any orientation.
    c. Hardened, machine cut steel gears, and precision machined alloy bronze worm gear.

d. Reduction gearboxes as specified in Paragraph "Gear-Assisted Manual Valve Actuators."

11. Manual Operation:
    a. Handwheel which does not rotate during motor operation.
    b. Utilize actuator worm shaft/worm wheel to maintain self-locking gearing and to facilitate changeover from motor to manual operation when the actuator is under load. Do not use designs that bypass actuator worm gear or break valve load at worm gear.
    c. Automatic return from manual to motor operation upon starting motor.
    d. Manual operation capable with seized motor.

12. Position and Torque Calibration:
    a. Torque and travel adjustment parameters:
        1) Position Setting Range: 1 to 500 turns, with resolution of 2.81 degrees and accuracy to 5.0 degrees of actuator output.
        2) Torque Setting: 40 to 100 percent of rated torque.
13. Wiring and Terminals:
    a. Tropical grade insulated stranded cable of appropriate size for the control and 3-phase power.
    b. Include actuators without plug and socket terminal connections having power and control disconnect switches for ease of maintenance and safety.

14. Controls:
    a. Microprocessor: Based with mechanically and electronically interlocked reversing contactors for Open/Close duty and solid-state contactors for modulating duty.
    b. Local/Off /Remote Selector Switch and Open/Stop/Close Pushbuttons: Mount on actuator face with red and green indication lights for open/close, and amber for power On, and red or over torque fault.
    c. Remote On/Off Service: Actuator to accept one remote signal to open and a second remote signal to close.
    d. Modulating Service: When in remote mode, actuator to accept a 4 to 20 mA DC position control signal and position valve 0 to 100 percent of travel in proportion to control signal.
    e. Monitoring Relays: Remotely indicate fault signal for indication of power failure or thermal switch tripped.
    f. Outputs to be provided for position of selector switch.
    g. Gear Actuated Position Transmitter: On modulating duty actuator that is a two-wire device, produce 4 to 20 mA DC signal proportional to 0 to 100 percent travel.
    h. Transmitter: Have easily accessible zero and span adjustment potentiometers.
    i. DC Power Supply: Integral with operator and powered from 110-volt AC internal transformer. Positioner board to provide repeatable accuracy to 0.25 percent of span and have separate trim pots for zero, span, and dead band adjustment.
15. Position Indication: Continuous mechanical dial indication of valve and gate position in step with the actuator at all times in both the hand wheel and motor operation. For modulating applications, graduations on mechanical dial position indicator to be 0 to 100 percent scale.
16. Limit Switches:

a. Adjustable type to trip at any point between fully opened and fully closed.
b. Mid-travel Switches: Provide as noted.
c. Do not allow set position to be lost if over travel occurs in either manual or electric modes of operation.
d. Two independent and fully adjustable rotary type position limit switches each with 10 Amp DPDT contacts for remote open/close position indication.

17. Torque Switches: Actuator with adjustable torque switches and be responsive to load encountered in either direction of travel.
18. Terminal Compartment:
    a. Three threaded cable entries.
    b. Stud-type Terminals: Embed in a terminal block of high tracking-resistance compound.
    c. Three-phase Power Terminals: Shroud from control terminals by means of an insulating cover.

19. Remote Control Stations:

    a. Where indicated, remote control stations for actuators located below the operating floor or located more than 7 feet above the operating floor.
    b. Include a Local/Off/Remote selector switch, Open/Stop/Close pushbuttons and Open/Close indicating lights.

        1) Local/Off/Remote selector to include padlock mount for the Off position.

    c. Include auxiliary contacts for remote indication of switch position.

20. Manufacturers:

    a. EIM M2CP as manufactured by Emerson (EIM)
    b. No equal.

2.5 SOURCE QUALITY CONTROL

A. Factory Testing:

1. Shop inspect and test completed assemblies.
2. Factory performance as specified below for actuators and supply individual test certificates. Submit test certificates prior to shipment of valve actuators. Test equipment to simulate a typical valve and gate load, and record the following parameters:

    a. No load current.
    b. Current at maximum torque setting.
    c. Stall current.
    d. Torque at maximum torque setting.
    e. Stall torque.
    f. Test voltage and frequency.
    g. Actuator output speed.
    h. Factory testing will include 20% of actuators and at least 1 Modulating, and 1 Open/Close unit.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field dimensions are as indicated on Shop Drawings.

3.2 INSTALLATION

A. Install products plumb, square, and true according to manufacturer’s published installation instructions.

B. Securely mount actuators using brackets or hardware specifically designed for attachment to valves/gates. Use 1 or 2 plate adapter mounting. No box brackets or adapters to be used.

C. Extend chain actuators to 5-1/2 feet above operating floor level.

D. Include a removable plug and socket head or termination of all external writing if actuator is located in a vault location or subject to flooding.

E. Contractor shall seal incoming conduit prior to entering into actuator enclosure.

3.3 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Perform adjustments during normal occupancy hours.

3.4 DEMONSTRATIONS

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain actuators.

1. Time Duration: Allow four hours during a single day.

END OF SECTION 400557

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SECTION 400559.23 - STAINLESS STEEL SLIDE GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Stainless steel slide gates.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves” for powered lifting devices.
2. Section 400557 “Actuators for Process Valves and Gates” for the modulating slide gate.

1.3 DEFINITIONS

A. Operating Head: Distance from centerline of gate to maximum water level of channel.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer's product information for system materials and component equipment.

B. Shop Drawings:

1. System materials and component equipment.
2. Description of materials cross-referenced to a sectional drawing listing material by trade name and ASTM reference number.
3. Certified shop and installation drawings showing details of construction, dimensions and anchor bolt locations.
4. Installation and anchoring requirements, fasteners, and other details.
5. Descriptive literature, bulletins and/or catalogs of the equipment.
6. The weight of each component.
7. Description of surface preparation and shop prime painting of gates and accessories.
8. Gate identification number, location, service, type, size, design pressure, operator details, stem details, and loads.
9. Listing of forces transmitted to floor stands if applicable.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Products meet or exceed specified requirements.

B. Manufacturer's Instructions: Detailed instructions on installation requirements, including storage and handling procedures.

C. Source Quality-Control Submittals: Results of factory tests and inspections.

D. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

E. Manufacturer Reports:

1. Certify that equipment has been installed according to manufacturer's instructions.
2. Document activities on Site, adverse findings, and recommendations.

F. Qualifications Statements:

1. Submit qualifications for manufacturer and licensed professional.

1.6 DELEGATED DESIGN SUBMITTALS

A. Submit signed and sealed Shop Drawings with design calculations and assumptions for both seating and unseating pressures.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of installed slide gates and components.

B. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Furnish one set of manufacturer's recommended spare parts.

B. Tools: Furnish special tools and other devices required for Owner to maintain equipment. Provide special tools and spare parts required for normal operation and maintenance of the equipment.

C. O&M Manual: Provide copy of manufacturer's operation and maintenance manuals.

1. Include required cuts, drawings, equipment lists, descriptions, etc. to instruct operating and maintenance personnel unfamiliar with such equipment.
2. Include trouble shooting data and full preventive maintenance schedules.

D. Factory Representative: Provide one day to instruct representatives of the Owner on proper operation and maintenance of the equipment.

1.9 QUALITY ASSURANCE

A. Gate manufacturer to be ISO 9001:2015 certified or provide an alternate quality assurance plan for review and approval by the Engineer.

B. Maintain a copy of each standard affecting Work of this Section on Site.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Licensed Professional: Professional engineer experienced in design of specified Work.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer's instructions.

C. Protect materials from physical damage, moisture and dust by storing in clean, dry location remote from areas involved in construction operations.

1. Provide additional protection according to manufacturer's instructions.

1.12 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Document field measurements on Shop Drawings.

1.13 WARRANTY

A. Furnish 2-years manufacturer's warranty for slide gates from the date of Substantial Completion.

B. Furnish 2-years manufacturer's warranty that clear plastic stem covers will not crack, discolor, or become opaque from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Slide gates shall have the characteristics and dimensions as tabulated in the Gate Schedule included herein.

B. Minimum Vertical Loading: 50 percent of force on the gate from operating head acting on horizontal centerline of gate, multiplied by effective gate area, plus weight of slide and stem.

C. Gate Reinforcement: As required for deflection not greater than 1/360 of span. Slide deflection shall not exceed 1/720 x length or 1/16 inch whichever is less under maximum design head conditions.

D. Operating Head:

1. Safety Factor: Design gate to operate under specified operating head with safety factory of five.

E. Minimum Material Thickness: 1/4 inch.

2.2 STAINLESS STEEL SLIDE GATES

A. Manufacturers:

1. Whipps, Inc. of Athol, MA.
2. RW Gate Company of Troy, NY.

B. Description:

1. Comply with AWWA C561.
2. Self- contained stainless steel slide gate, with extended frame, yoke, lifting stem attached to yoke, lift and lift support, stem, stem guide, and stem block.
3. Non- self-contained stainless steel slide gate, with limited frame, lifting stem, lift and lift support, stem, stem guide, and stem block
4. Size: As indicated in Gate Schedule.
5. Operating Head: As indicated in Gate Schedule.
6. Closure: As indicated in Gate Schedule.
7. Opening: As indicated in Gate Schedule.

C. Gates: Type 316 stainless steel, self-contained or non-self contained, as indicated in Gate Schedule, type with disc arranged to lower or raise to open and with guides designed to mount on the face of or embedded in concrete, as indicated in Gate Schedule.

1. Disc or Sliding Member: Type 316 and the stainless steel plate reinforced stainless steel structural members welded to the plate not more than 16 inch apart.

a. Deflection: 1/720 of span of the gate or 1 /16 -inch, whichever is less, under the design head.
b. Reinforcing Ribs: Extend into guides so they overlap seating surface of the guide.
c. The portion of the disc that engages the guide shall have a minimum thickness of 1/4-inch.
d. A Specially Extruded Resilient Seal:

1) Mounted on the invert member with stainless-steel attachment bolts to provide flush bottom closure.
2) Seal Shape: Produce a seating surface with minimum width of 3/4 inch
3) Vertical Seal Face: In contact with seating surface of guide providing a proper seal at the corners.

e. Reinforcements, Retainer and Bolts: Same material as disc.

2. Configuration: Removable.

D. Guides: Type 316 stainless steel construction, designed for maximum rigidity, weighing a minimum of 13 lbs per foot for face mounted frames and 6.5 lbs per foot for embedded or in-channel mounted frames.

1. The structural members for the guide and guide extensions are to be formed into a one-piece shape for rigidity.
2. Holes for anchor bolts to be provided at a distance of every 18 inches for face mounted units or embedding keyways for embedded units or are to be spaced as required to handle the design pressure for the application, whichever is less.

    a. Bolts to be acceptable on both side of the gusset. Manufacturer to procure holes on either side for mounting constructability.

3. The portion of the face-mounted frame, where the anchor bolts penetrate, will have a minimum thickness of 1/4-inch.
4. Guides to extend beneath opening a sufficient amount to support the disc in fully down or open position for downward opening gates.
5. Guide extensions to be “C” shaped stainless-steel members, or similar, for rigidity, weighing a minimum of 6.5 lbs per foot.

E. Gate Seal:

1. Gate to be sealed with UV stabilized, self-adjusting UHMWPE material with a nitrile compression cord.
2. Seal to be placed in a stainless-steel channel, welded to the guides of the gate.
3. Seals to be provided on the invert and sides of gate, and along the top seal member on gates identified in the Gate Schedule to have top closure.
4. Deflection: Arrange seal to have a minimum deflection of 1/16 -inch.
5. Attachment hardware to be same material as the guides.

F. Yokes (for self-contained): Type 316 stainless steel construction with the yoke supporting the operating benchstand.

1. Formed by welding two “C” channels to the top of the guides to provide a single piece rigid frame.
2. Arrangement: Disc and stem to be removable without disconnecting the yoke.
3. Top of yoke height: Minimum 42”

G. Lifting Nut: Brass

1. Grease fitting on manual operators.
2. Roller bearings or ball bearing above and below lifting nut.

H. Seats: Impacted into dovetail slots and held in position without use of screws or other fasteners.

1. Maximum Clearance between Seating Faces: 0.004 inch when gate is fully closed.

I. Frames: One-piece configuration.

1. Mounting: As indicated in Gate Schedule.

2. Material: Type 316 stainless steel.
3. Furnish continuous embed or mounting flange.
4. Thickness: 1/4 inch.
5. Seats: Ultra-high-molecular-weight polymer.
6. Bottom Flush Closure: Resilient seal securely attached to frame along invert.

J. Lifting Stem: Type 316 stainless steel for the entire length.

1. Tensile Strength: 60,000 psi.
2. Diameter: Of sufficient size at base of thread to lift the weight of the gate, offset the resistance of the gate to the maximum unbalanced head and fully allow for starting impact.
3. Minimum Diameter: 1-1/2 inch to withstand twice the rated output of the operator.
4. Slenderness Ratio (l/r): Less than 200.
5. Non-Rising Stems: Non- rising stems shall have a bronze nut. Equip stems with adjustable bronze stop collars above and below the lift nut preventing over opening or over closing the gate
6. Stem Guides: Type 316 stainless steel, UHMWPE bushed, mounted in a Type 316 stainless-steel bracket. Provide as recommended by manufacturer. Adjustable in two directions and spaced at sufficient intervals to adequately support the stem. Spacing not to exceed 10 feet.
7. For non-rising stems, stem may connect to the downstream side of the slide.
8. Configuration: Removable.
9. Thread: Full depth machine rolled, Acme type, double lead threads.
10. Finish: 16 microinch or better.
11. Stem Covers: Provide rising stem gates with clear fracture resistant polycarbonate covers.

    a. Will not discolor or become opaque for a minimum of 5 years after installation.
    b. Capped, vented, and of a length to allow full travel of gate.
    c. Bottom end mounted in a housing or adapter plate for easy field mounting.
    d. Indicator markings showing gate position.

K. Gate actuator location: Center to be a maximum of 5 feet above finished floor.

2.3 FINISHES

A. Stainless Steel Surfaces: Mill finish.

B. Welds to be sandblasted to remove weld burn and scale.

2.4 ACCESSORIES

A. Hardware: Type 316 stainless steel. Conform to ASTM A276 or ASTM A193/A194 and F593/F594 unless otherwise specified.

B. Attaching Bolts and Anchor Bolts: Type 316 stainless steel. Furnished by slide gate manufacturer.

C. Nameplates: Each gate is to be provided with a nameplate that includes the manufacturer’s name, opening size and maximum head rating, as a minimum. Nameplate to be mounted on the gate yoke or pedestal.

2.5 SOURCE QUALITY CONTROL

A. Shop inspection and testing of completed assemblies.

B. Owner Inspection: Make completed clarifier equipment available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner seven days before inspection is allowed.

C. All welds shall be performed be welders with AWS D1.6 certification.

D. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify facilities are ready to receive slide gates.

3.2 PREPARATION

A. Clean surfaces according to manufacturer's instructions.

3.3 INSTALLATION

A. Install slide gates according to manufacturer's instructions.

B. Ensure products are installed plumb, true, and free of warp or twist.

C. Locate operators to avoid interference with handrails and other Work.

D. Gate Installation: Under the supervision of the gate manufacturer’s factory representative.

E. Manufacturer to provide service until operation is satisfactory.

F. Guides: Surface and Flange Mounted.

1. Install guides with adhesive anchors or expansion anchors. Utilize backing nuts.
2. Position guides at elevation as indicated on Drawings.
3. Grout space between the guides and the mounting surface according to manufacturer’s instructions.

G. Guides: Recessed.

1. Cut slot in concrete to receive guides.
2. Position guides at elevation as indicated on Drawings.
3. Grout guides in place according to manufacturer's instructions.

H. Sealant:

1. Apply 1/8 inch thick layer of elastomeric sealant to back of frame.
2. Tighten nuts snug until sealant begins to flow beyond frame.
3. Remove excess sealant.
4. Cure sealant for minimum seven days.
5. Tighten nuts to their final positions.

I. Lubricants: Oil and grease as required for initial operation.

3.4 FIELD QUALITY CONTROL

A. Inspection: Verify gate and components alignment, smooth operation, with no binding or scraping.

B. Testing per AWWA C561:

1. Maximum slide gate leakage under seating and unseating head: 0.05 gpm/ft. of seating perimeter.
2. After installation, field test slide gates ensuring items of equipment are in compliance with Specifications, including leakage requirements.
3. For units failing to meet specified requirements, make necessary change and retest units. If unit remains unable to meet test requirements to Engineer’s satisfaction, it will be replaced with a satisfactory unit at no additional cost to Owner.

C. Equipment Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and re-inspect.

1. Make final adjustments to equipment under direction of manufacturer's representative.

D. Furnish physical checkout and installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

E. Submit the equipment manufacturer's Certificate of Field Testing.

F. Submit the equipment manufacturer's Certificate of Functional Testing.

3.5 ADJUSTING

A. Adjust slide gates to provide smooth operation.

3.6 MANUFACTURER’S SERVICES

A. Manufacturer shall advise, consult, and instruct the Contractor on:

1. Installation procedures and adjustments and inspect the equipment during installation as a condition of acceptance of the work.
2. Startup and testing of the finished installation.

B. Minimum maintenance training topics:

1. Step-by step, “hands-on” assembly and disassembly procedural instructions.
2. Replacement part identification and ordering procedures.
3. Lubrication procedures, including drain-down and refill procedures.
4. Recommended routine maintenance procedures.
5. Troubleshooting and diagnostic procedures.

C. Man-hour requirements listed below are exclusive of travel time and do not relieve the manufacturer of the obligation to provide sufficient service to place equipment in satisfactory operation. *1

1. Supervise Installation: Trips – 1; Hours/Trip - 8.
2. Inspect and Approve Installation *2: Trips per Facility – 1; Hours/Trip - 8.
3. Instruct Owner’s personnel in proper startup and O&M *3: Trips – 2; Hours/Trip - 8.
4. Supervise and Assist in Testing *4: Trips per Facility – 1; Hours/Trip – 8.
5. Notes:

a. *1 - Manufacturer’s factory representative shall be present at frequent enough intervals to ensure proper installation, testing and initial operation of the equipment. Minimum time on site per trip based on 8-hour working days.
b. *2 - Manufacturer’s factory representative shall submit to the Engineer a written certification that the system has been installed in accordance with the manufacturer’s recommendations.
c. *3 - Instruction may be given upon completion of Item 2, provided that the O&M manuals have been submitted to and accepted by the Engineer.
d. *4 - May be done upon completion of Item 3 if acceptable to the Engineer. The time required for performance testing is in addition to the above specified hours.

3.7 SCHEDULES

A. Slide Gate Schedule: Manufacturer will supply slide gates within the project as indicated in the gate schedule. In the absence of seating and unseating head data, the manufacturer will assume a flooded basin condition from top of concrete to base of gate and assume both a seating and unseating loading condition.

B. Attached.

END OF SECTION 400559.23

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Gate Tag (See Note 2)	Gate Type	Opening Size Width (IN)	Opening Size Height (IN)	Gate Location	Service	Self-Contained Frame (Y/N)	Operator Mounting	Operator Type	Opening Invert Elevation	Gate Invert Elevation (See Note 1)	Operating Floor Elevation	Slide Travel to Full Open Open Pposition (IN)	Seating Head, ft	Unseating head, ft	Guide Frame Mounting Type	Pedestal Mounting Type	Top Seal Required (Y/N)	Direction of Operation
SG-1101-1	Slide	12	12	Headworks	Screened Wastewater	Y	Yoke	Actuator	752.9	752.40	759.45	12	9.15	9.15	Wall Mounted	-	Y	Upward

Notes:

1. Gate Invert Elevation assumed to be 6" below opening invert elevation to allow for sufficient mounting clearance.
2. Contractor to field verify the channel width and invert floor elevation prior to procrument of slide gate

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SECTION 400561 - GATE VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid wedge, resilient-seated gate valves.

B. Related Requirements:
1. Section 400551 “Common Requirements for Process Valves” for basic materials and methods related to valves commonly used for process systems.

1.3 DEFINITIONS

A. Outside screw and yoke (OS&Y) valve: A valve in which the operating screw is driven by a threaded nut that is built into the handle.

1.4 SUBMITTALS

A. As specified in Section 400551 “Common Requirements for Process Valves” for submittal requirements for compliance with this section.

1.5 QUALITY ASSURANCE

A. Test valves in accordance with AWWA C500, C509, C515.

B. Provide Installation Inspection and Operator Training per Section 400551 “Common Requirements for Process Valves”.

C. Provide testing and inspection certificates.

1.6 WARRANTY

A. Furnish manufacturer's warranty for valve and associated components for 2-years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOLID WEDGE, RESILIENT-SEATED GATE VALVES – TAG TYPE GV1

A. Manufacturers:
1. American Flow Control
2. Clow Valve
3. Mueller
4. EJ Flow Master

B. Description:

1. Above grade wastewater or clarifier effluent service.
2. As specified in Section 400551 “Common Requirements for Process Valves”.
3. Comply with AWWA C509 and C515 as applicable to the type of valve specified.
4. Except as otherwise specified, valves shall be rated for a working pressure of 150 psi:
   a. All valve bodies shall be hydrostatically tested to at least twice the rated working water pressure. In addition, valves shall be seat tested, bi directional at the rated working pressure, with seat leakage not to exceed one fluid ounce per inch of valve diameter per hour. Provide certificates of testing.
5. End Connections: ASME B16.1, ASME B16.5, and ASME B16.42, flanged.
6. Gear Actuators for Manual Valves: Comply with AWWA C509 and C515 as applicable to the type of valve specified.
7. Body: no recesses in valve body.

C. Operation:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Stem: Non-rising.
3. Operator: Manual handwheel.
4. Furnish gear operators for valves 8 inches and larger, and chainwheel operators for valves mounted over 6 feet above operating floor.

D. Materials:

1. Wedge: Resilient ASTM A126, cast or ductile iron, fully encapsulated with an approved synthetic rubber material, bonded and vulcanized in accordance with ASTM B429 Method B.
2. Body: ASTM A126, cast iron or ASTM A536, ductile iron
3. Disc: vulcanized rubber bonded and vulcanized in accordance with ASTM B429 Method B.
4. Stem, Stem Nuts, Glands, and Bushings: Type 316 stainless steel.
5. Connecting Hardware: Type 316 stainless steel.
6. Exposed valves shall be furnished with Class 125 flanged ends and provided with outside screw, yoke, and handwheel operator.

E. Finishes:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Body, internal and external, including bonnet: AWWA C550, Epoxy, 4-mil minimum thickness.

3. Gate: ASTM D2000 EPDM encapsulated, ASTM B429 Method B Bonded and vulcanized.

2.2 SOURCE QUALITY CONTROL

A. As specified in Section 400551 “Common Requirements for Process Valves”.
B. Testing: Test gate valves according to AWWA C509.
C. UL and FM approved.

PART 3 - EXECUTION

3.1 INSTALLATION

A. According to AWWA C500 and C509.
B. Dielectric Fitting: Provide between dissimilar metals.

END OF SECTION 400561

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SECTION 400562 - PLUG VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Eccentric plug valves.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves” for basic materials and methods related to valves commonly used for process systems.

1.3 ACTION SUBMITTALS

A. As specified in Section 400551 “Common Requirements for Process Valves” for submittal requirements for compliance with this Section.

B. Submit manufacturer certification confirming that plug valves are capable of passing "pigging" cleaning equipment (using a Girard or similar cleaning pig of full nominal pipeline diameter) in either direction without the use of special equipment.

1.4 INFORMATIONAL SUBMITTALS

A. Source Quality Control: Submit test reports and certification.

1.5 QUALITY ASSURANCE

A. Test valves in accordance with AWWA C517

B. Provide Installation Inspection and Operator Training per Section 400551 “Common Requirements for Process Valves and Piping”.

C. Provide testing and inspection certificates.

1.6 WARRANTY

A. Furnish manufacturer's warranty for valve and associated components for 2-years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ECCENTRIC PLUG VALVES – Tag Type PV1

A. Manufacturers: Provide products by following without substitution nor equal:

1. DeZurik
2. M&H Valve
3. Val-Matic.
4. Henry Pratt

B. Description:

1. As specified in Section 400551 “Common Requirements for Process Valves.”
2. Type:

a. Offset disc type.
b. Non-lubricated.
c. Serviceable (able to be repacked) under full line pressure.
d. Eccentric.
e. Capable of sealing in both directions at the rated pressure.
f. Unobstructed flow path when open.
g. Drop tight shut-off to the full valve rating with pressure on either side of the plug.

3. Body:

a. 30,000-psi tensile strength.
b. Top entry, bolted bonnet.
c. Body shall be cast with integral piping connections.

4. Plug:

a. To be removable without removing the valve from the line.
b. To have an integral upper and lower shaft:

1) Seals on upper and lower journals to prevent entrance of solids into journals.

c. One piece.

5. Bearings:

a. Permanently lubricated.

6. Minimum Design Pressure: At below rated minimum design pressures, certify by manufacturer as permitting zero leakage for a 5-minute duration with full pressure applied in either direction.

    a. Sizes 4-inch through 12-inch: 175 psig.
    b. Sizes 14-inch and Larger: 150 psig.

7. Maximum Process Fluid Temperature: Same as fluid temperature as the pipe they connect to, whichever is higher.

8. Ports:

    a. Configuration: Rectangular.
    b. Minimum Port Area: 100% of nominal pipe area.

9. Seats:

    a. Full 360-degree seating by contact of a resilient seating material on the plug mating with welded-in seating surface in the body.
    b. Screw in body seats not acceptable.
    c. Resilient and of the continuous interface type having consistent opening and closing torques.
    d. Non-jamming in the closed position.

10. Stem Bearings: Self-lubricating.
11. Stem Seals:

    a. Type: V-ring.
    b. Externally adjustable and repackable without removing the bonnet from the valve, or self-adjusting.

12. Packing and Gland: Accessible and externally adjustable.
13. End Connections:

    a. Mechanical Joint: Comply with ANSI/AWWA C111/A21.11.
    b. Flanged: Comply with ASME B16.1 and B16.42.
    c. Grooved: Comply with ANSI/AWWA C606.

C. Operation:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. A suitably sized steel actuator mounting bracket shall be provided to provide an air gap between the actuator and the valve stem seal. Under no circumstance shall the gear box be mounted directly to the top body flange such that leakage could directly enter the gear box.
3. Provide adjustable limit stops for both opening and closing and a clearly marked position indicator.
4. Manually Operated:
    a. 4 Inches and Smaller: Securely attached lever.
    b. Greater Than 4 Inches: Worm gear manual operators with handwheel.

c. Furnish chain wheel operators for valves mounted over 7 feet above operating floor.

D. Materials:

1. Body:

a. Cast iron, AWWA C517 or Ductile iron, ASTM A536.
b. Lining: Epoxy, as specified in Section 400519 “Ductile Iron Process Pipe”.

2. Plug:

a. Ductile iron, ASTM A536, Grade 65-45-12
b. Lining: Resilient coating of Neoprene material or alternate as recommended by valve manufacturer for service conditions.

3. Seats: High Nickel.
4. Stem: Type 316 stainless steel.
5. Stem Bearings: Type 316 Stainless steel.
6. Seals: PTFE, Neoprene, or Buna N.
7. Connecting Hardware: Type 316 stainless steel.

E. Finishes: As specified in Section 400551 “Common Requirements for Process Valves.”

PART 3 - EXECUTION

3.1 GENERAL

A. As specified in Section 400551 “Common Requirements for Process Valves” for submittal requirements for compliance with this Section.

3.2 INSTALLATION

A. According to AWWA C517.

B. Horizontal Piping: Stem horizontal, Plug opening to crown of body.

C. Vertical Piping: Plug at top when closed.

D. Plugs: On top when open and on pressure side when closed.

END OF SECTION 400562

SECTION 400563 - BALL VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Two-piece brass body ball valves.
2. Thermoplastic ball valves.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves” for basic materials and methods related to valves commonly used for process systems.

1.3 SUBMITTALS

A. As specified in Section 400551 “Common Requirements for Process Valves” for submittal requirements for compliance with this Section.

1.4 QUALITY ASSURANCE

A. Test valves in accordance with AWWA C504, API 598, MSS SP61 as applicable for types listed herein.

1.5 WARRANTY

A. Furnish manufacturer's warranty for valve and associated components for 2-years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TWO-PIECE BODY BALL VALVES 3-INCH AND SMALLER- Tag Type BV3

A. Manufacturers:

1. Hammond Valve
2. NIBCO Inc.
3. Milwaukee Valve.
4. Apollo Valve.

B. Description:

1. Standard: MSS SP-110.
2. Temperature Rating: 300 deg F.
3. Pressure Rating: 150 psi
4. Body Design: Two-piece.
5. Body Material: Forged Brass.
6. Ends: Threaded.
7. Seats: Resilient, RPTFE or PTFE.
8. Stem Material: Type 316 Stainless steel.
9. Stem: Blow our proof, soldered ends.
10. Ball Material: Type 316 Stainless steel.
11. Ball: Full port, floating design
12. Packing Material: PTFE.
13. Operator: Steel lever with zinc plating and vinyl grip.
14. Working Pressure: As indicated on the valve schedule or be of the same working pressure as the pipe they connect to, whichever is higher. Working pressure of the pipe is noted on the Pipe Schedule on Drawings.

C. Provide for general water service on metallic piping where not otherwise indicated.

2.2 THERMOPLASTIC BALL VALVES

A. Manufacturers:

1. George Fischer.
2. ASAHI.
3. Spears.

B. Description:

1. Valves shall be verified as completely compatible with intended and specified service; compatibility shall apply to material of valve and internal components, included seals, gaskets, O-rings, and washers; solvents and primers used in valve joint make-up shall be specifically in conformance with written instructions of valve supplier. Service chemicals and service conditions are shown in the Pipe Schedule on the Drawings and Division 40.

2. Working Pressure: As indicated on the valve schedule or be of the same working pressure as the pipe they connect to, whichever is higher. Working pressure of the pipe is noted on the Pipe Schedule on Drawings.
3. Ports: Full size.
4. End Connections:
    a. Union.
    b. Flanged: Comply with ASME B16.1

C. Operator: quarter-turn manual

D. Materials:

1. Body and Ball: PVC, ASTM D1784, made from unplasticized polymer, and generally suitable for service to 120 degrees F.
2. Seats: PTFE.

E. Valves from ½-inch to 2-inches shall have a snap-on fit handle attaching to valve stem to prevent handle from falling off.

2.3 SOURCE QUALITY CONTROL

A. As specified in Section 400551 “Common Requirements for Process Valves.”

B. Testing: Test ball valves according to AWWA C507.

PART 3 - EXECUTION

3.1 INSPECTION

A. As specified in Section 400551 “Common Requirements for Process Valves” for submittal requirements for compliance with this Section.

3.2 INSTALLATION

A. According to AWWA C507.

B. As specified in Section 400551 “Common Requirements for Process Valves.”

END OF SECTION 400563

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SECTION 400564 - BUTTERFLY VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Cartridge seat butterfly valves for low pressure air service

B. Related Requirements:

   1. Section 400551 “Common Requirements for Process Valves” for basic materials and methods related to valves commonly used for process systems.
   2. Section 400523 “Stainless Steel Process Pipe and Tubing”.
   3. Section 431118 “Vertically Split Multistage Centrifugal Blowers”.
   4. Section 465136 “Ceramic Disc Fine Bubble Diffusers”.

C. Van Stone flanges shall not be used with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints; or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

1.3 SUBMITTALS

A. As specified in Section 400551 “Common Requirements for Process Valves” for submittal requirements for compliance with this Section.

1.4 QUALITY ASSURANCE

A. Test valves in accordance with AWWA C504, API 598, MSS SP61 as applicable for types listed herein.

B. Provide Installation Inspection and Operator Training per Section 400551 “Common Requirements for Process Valves”.

C. Provide testing and inspection certificates.

1.5 WARRANTY

A. Furnish manufacturer's warranty for valve and associated components for 2-years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARTRIDGE SEAT BUTTERFLY VALVES FOR AIR SERVICE – Tag Type BFV2

A. Manufacturers:

1. Keystone Series 60
2. Bray Series 30
3. or Engineer Approved Equal

B. Description:

1. Comply with MSS SP 67, API 609, ANSI B16.104, ISO 5211 shaft standard.
2. Minimum Working Pressure: Per Drawing M-1.
3. Maximum Process Fluid Temperature: Per Drawing M-1.
4. Body Style: Wafer
5. Disc: concentric, undercut for air service valves.
6. Shaft: two-piece design, square or double D input to Capable for mechanical separation from disc without damage to shaft or disc.
7. Bearings: Self-lubricating.
8. Shaft Seals/Packing:
   a. Multiple O-rings.
   b. Mechanically retained.
9. Seats:
   a. Cartridge type.
   b. Resilient and replaceable. Field adjustable and replaceable.

C. Actuator:

1. For valves 8 inches and smaller: Ten-position lever handle
2. For valves 10 inches and larger: Geared actuator
3. Gear Actuators for Manual Valves: Comply with AWWA C504.
4. Include mechanical top mounted valve position indication, opening direction, and adjustable stops.

D. Materials:

1. Body: Cast iron ASTM A126, Class B.
2. Stem: Type 416 SS A351 CF8M
3. Disc: Ductile iron, ASTM A536
4. Disc Coating: Manufacturer’s standard
5. Seats:
   a. Elastomer: Fluoroelastomer
6. Bearings: PTFE Gar-Fil reinforced.

E. Finishes:

1. As specified in Section 400551 “- Common Requirements for Process Valves”.
2. Manufacturer’s standard fusion bonded epoxy.
3. Manufacturer’s polyester powder coat.

2.2 SOURCE QUALITY CONTROL

A. As specified in Section 400551 “Common Requirements for Process Valves”.

B. Testing: Test butterfly valves according to AWWA C504.

C. Submit an affidavit of compliance stating that the valves have been manufactured and tested in accordance with AWWA C504 and specifically list all exceptions.

PART 3 - EXECUTION

3.1 Examination:

A. As specified in Section 400551 “Common Requirements for Process Valves” for submittal requirements for compliance with this Section.

3.2 INSTALLATION

A. As specified in Section 400551 “Common Requirements for Process Valves.”

B. According to Manufacturer’s Instructions.

C. Van Stone flanges shall not be used with industrial butterfly valves, or other piping system components having an elastomer liner that is used as a gasket.

END OF SECTION 400564

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SECTION 400565.29 - DOUBLE-DISK CHECK VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Double-disk swing check valves, 2 through 52 inches in size.
   1. Double-disk swing check valves for the Treatment Unit 1 and Treatment Unit 2 Blowers as indicated on DS-ID-1 and DS-ID-2 are to be provided by the Blower Vendor per the details below and Specification section 431118 “Vertically Split Multistage Centrifugal Blowers”.
   2. Double-disk swing check valves for the temporary package plant blowers as indicated on DS-IB-1 are to be provided by the General Contractor.

B. Related Requirements:

   1. Division 09 for coating and touchup of shop-primed surfaces with primer.
   2. Section 400551 “Common Requirements for Process Valves” for basic materials and methods related to valves commonly used for process systems.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections as specified in other Sections.

1.4 SUBMITTALS

A. Section 400551 “Common Requirements for Process Valves”.

B. Product Data: Submit catalog information, indicating materials of construction and compliance with indicated standards.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Source Quality-Control Submittals: Indicate results of factory tests and provide required certifications.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement:

   1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

1.6 QUALITY ASSURANCE

A. Comply with AWWA C518.

B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

C. Provide Installation Inspection and Operator Training Per Section 400551 “Common Requirements for Process Valves”.

D. Provide testing and inspection certificates.

E. Perform Work according to City of Georgetown standards.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect valves and appurtenances by storing off ground.
3. Cover flange faces with 3/4-inch plywood blinds.
4. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

A. Furnish manufacturer's warranty for valve and associated components for 2-years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DOUBLE-DISK CHECK VALVES – Tag Type DDCV

A. Manufacturers:

1. Henry Pratt Company, Series 740.
2. DeZurik/APCO, 9000 Series.
3. Crispin.
4. US Valve, Technocheck.
5. Or approved equal.

B. Description:

1. Blower Discharge Service– Tag Type DDCV1

a. Type: Double-disk, spring-loaded, swing check valves.
b. Size: 2 through 52 inches.
c. Style: Wafer.
d. Body: CF8M Type 316 stainless steel.
e. Disk: Type 316 Stainless steel.
f. Seats: Resilient.
g. Seal: Viton A – blower service.
h. Hinge Pin: Type 316 stainless steel.
i. Spring Material: Type 316 stainless steel.

2. Working Pressure: As indicated in valve schedule or be of the same working pressure as the pipe they connect to, whichever is higher. The working pressure of the pipe is noted on the Pipe Schedule on Drawings.
3. Maximum Process Fluid Temperature: same fluid temperature as the pipe they connect to.

C. Finishes: As specified in Section 400551 “Common Requirements for Process Valves.”

2.2 SOURCE QUALITY CONTROL

A. Testing:

1. Hydrostatically test check valves at twice rated pressure according to AWWA C518.
2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

B. Inspect existing flanges for nonstandard bolt-hole configurations or design and verify that new valve and flange mate properly.

3.2 PREPARATION

A. Thoroughly clean valves before installation.

B. Surface Preparation:

1. Touch up shop-primed surfaces with primer as specified in Division 09.
2. Solvent-clean surfaces that are not shop primed.
3. Clean surfaces to remove loose rust, mill scale, and other foreign substances by power wire brushing.
4. Prime surfaces as specified in Division 09.

3.3 INSTALLATION

A. According to AWWA C518 and manufacturer instructions.

B. Dielectric Fittings: Provide between dissimilar metals.

3.4 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect for damage to valve lining or coating and for other defects that may be detrimental as determined by Engineer/Engineer.
2. Repair damaged valve or provide new, undamaged valve.
3. After installation, inspect for proper supports and interferences.

B. Pressure test valves with piping.

3.5 CLEANING

A. Keep valve interior clean as installation progresses.

B. After installation, clean valve interior of soil, grit, loose mortar, and other debris.

END OF SECTION 400565.29

SECTION 400582 - SOLENOID VALVES FOR PROCESS SERVICE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Solenoid valves for process applications.

B. Related Requirements:

1. Section 400551 “Common Requirements for Process Valves” for basic materials and methods related to valves commonly used for process systems.

1.3 COORDINATION

A. Coordinate Work of this Section with process piping Work as specified in other Sections and as indicated on Drawings. Note that solenoid valves may be shown on Electrical and/or Mechanical Drawings, or may only be specified, but if so specified or shown, shall be provided. Solenoid valves located in hazardous classified areas shall be provided with electrical enclosures which satisfy the electrical classification as specified or shown on the electrical drawings.

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information, indicating materials of construction, wiring diagrams, and compliance with indicated standards.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 SOLENOID VALVES – Tag Type SV

A. Manufacturers:

1. Type L by Magnatrol Valve Corp. Hawthorne, NJ 07507
2. Atkomatic 14500 Series by Circle Valve. Harleysville, PA 19438
3. Or Engineer approved equal as suitable for service required.

B. Description:

1. Working Pressure: 10 psig.
2. Minimum Working Pressure Differential: 0 psig.
3. Maximum Fluid Temperature: 330 degrees F.
4. Coil: Class H.
5. Operation: Fail close, energize to open except for water seal lines to pumps where valves will fail open, energize to close.
6. Enclosures: NEMA 4X rated.
7. Electrical Characteristics: 120VAC.
8. End Connections Less than 2-inches: Threaded or as needed for installation.
9. End Connections Greater than 2-inches: Flanged or as needed for installation.
10. Valves 2” in size or larger shall include a manual override actuated by a handle-levered plunger mounted to the bottom of the valve body. These valves must be mounted in a horizontal run of piping, with the solenoid up in the vertical position.

C. Materials:

1. Body: Brass.
2. Body: Bronze
3. Trim and Spring: Stainless steel with copper coil Class A encapsulated.
4. Seals: Viton or PTFE or as needed for chemical compatibility.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.
3. Submit chemical compatibility tables for diaphragm valve materials and chemical process service. Solenoid valve materials shall exhibit excellent compatibility with respective chemicals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. As specified in Section 400551 “Common Requirements for Process Valves”.

3.2 FIELD QUALITY CONTROL

A. As specified in Section 400551 “Common Requirements for Process Valves”.

END OF SECTION 400582

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SECTION 400593.23 – LOW-VOLTAGE MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single- and three-phase motors for application on process equipment provided under other Sections.

B. The manufacturer of the driven equipment shall provide the associated motor.

C. Related Requirements:

1. Section 260526 “Grounding and Bonding for Electrical Systems”.
2. Section 260553 “Identification for Electrical Systems”.

1.3 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

B. VFC: Variable-frequency motor controller. See VFD.

C. VFD: Variable-frequency drive. Used interchangeably with the term VFC.

1.4 SUBMITTALS

A. Product Data: For each type and rating of motor indicated.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include nameplate data, compliance with specified standards, electrical ratings and characteristics, physical dimensions, frame size, weights, mechanical performance data, support points and the following:

a. Descriptive bulletins, including full description of insulation system.
b. Bearing design data.
c. Efficiency at 1/2, 3/4 and full load.
d. Power factor at 1/2, 3/4 and full load.
e. Conduit entry points and sizes.
f. Special features and accessories (i.e. space heaters, temperature detectors, etc.).

g. Power factor correction capacitor rating and type (when required).

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Qualifications Statements:

1. Submit qualifications for manufacturer and testing agency.

1.5 QUALITY ASSURANCE

A. Electric motors driving identical equipment shall be identical

B. Motors shall be listed under UL recognized component file as applicable.

C. Motor manufacturer to maintain a documented ISO 9001 quality assurance program implementing suitable procedures and controls to monitor all aspects of production and testing.

D. When electrically driven equipment differs from that indicated, adjust the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed.

E. Testing Agency Qualifications: Member company of NETA.

1.6 DELIVERY, STORAGE AND HANDLING

A. Ship motor fully assembled, capable of being lifted in one piece.

B. Inspection: Accept materials on site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Store materials according to manufacturer instructions.
2. Energize motors furnished with space heaters to prevent condensation throughout the storage and construction period. Perform periodic motor insulation resistance tests per manufacturer’s storage recommendations.
3. For extended outdoor storage, remove motors from equipment and store separately.
4. Maintain bearings during storage and construction period, and periodically rotate the motor shaft per manufacturer’s storage recommendations.
5. Lubricate per manufacturer’s recommendations and inspect purged grease for water, rust, or other contaminants.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of motors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three-year(s) from date of Substantial Completion for inverter duty motors.
2. Warranty Period: Five-year(s) from date of Substantial Completion for constant speed severe-duty motors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Nidec (US Motors).
2. ABB (Baldor-Reliance).
3. TECO-Westinghouse.
4. Toshiba.
5. WEG.
6. General Electric.
7. Or equal.

2.2 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.

B. Comply with the latest revision of the following as applicable:

1. NEMA MG 1, “Motors and Generators”.
2. IEEE 841 for TEFC motors where driven equipment specification indicates equipment requires motors to be severe-duty, chemical duty, or mill duty.

C. Unless otherwise noted, all motors 1/2 through 100 horsepower shall be rated 230/460 Volt, three-phase, 60 Hertz A.C.; motors 125 horsepower and above shall be rated 460 Volt, three-phase, 60 Hertz; and motors below 1/2 horsepower shall be rated 115/230 Volt, single phase, 60 Hertz A.C.

D. Duty: Continuous duty at ambient temperature of 40 degrees C and at altitude of 3300 feet above sea level.

E. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

F. Horsepower rating: Size for operation within the full load nameplate rating without applying the service factor, throughout the full range of mechanical or hydraulic operating condition.

G. Specific motor application data such as Hp, rpm, enclosure type, accessories, etc., are specified under the detailed driven mechanical equipment specification.

H. Nameplates: Engrave or emboss on Type 316 stainless steel fastened to the motor frame with stainless steel screws or drive pins with information per NEMA MG 1.

I. Space heater: Include 120-volt space heater for moisture control on all motors rated 50 horsepower and larger.

J. Service Factor: 1.15 service factor on sine wave power and 1.0 service factor on VFD power in a 40 degrees C ambient, unless otherwise noted.

K. Motors and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

L. Enclosures: Conform to one of the NEMA standard enclosure designs as specified under the detailed driven mechanical equipment specification. If no enclosure type is specified, provide TEFC (Totally Enclosed Fan Cooled) enclosures.

M. Motors connected to VFCs: Inverter duty rated and comply with NEMA MG 1, Part 31. First or second torsional critical speed shall be outside the operating speed range for all VFC controlled motors.

N. Three-phase motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Meet or exceed requirements for NEMA MG 1, Part 12 for Premium Efficient motors 1 HP and larger.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.

    a. For motors with 2:1 speed ratio, consequent pole, single winding.
    b. For motors with other than 2:1 speed ratio, separate winding for each speed.

5. Rotor: Random-wound, squirrel cage.
6. Code Letter Designation:

    a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

7. Accessories: Where specified herein, or under process mechanical specification.

O. Class 1 Division 2 locations: Motors in Class 1, Division 2 locations shall be marked with a temperature code label suitable for use in the hazardous area classification where installed. Motors shall also comply with IEEE 841 severe duty requirements, with the following additional requirements:

1. The Class, Group and Temperature Code: Provide one of the following:

    a. Class I Group D – T2B (260 degrees C).
    b. Class I Group D, Class II Groups F and G – T3B (165 degrees C).

c. Class I Groups C and D, Class II Groups F and G – T3C (160 degrees C).

2. Thermostats: Where winding thermostats are used to obtain surface temperature limitation, the thermostats shall be connected in series with the starter holding coil (stop button). Winding temperature detectors and switches shall be UL listed for use in Class 1 Division 2 locations.
3. The exposed surface of motor condensation heaters shall not exceed 80 percent of the nameplate temperature code value.
4. Ventilation fan shall be constructed of corrosion-resistant, non-sparking material such as bronze.

2.3 THREE PHASE MOTOR CONSTRUCTION

A. Enclosure and Frame:

1. NEMA enclosure type as specified in the process equipment specification.
2. NEMA frame for the associated horsepower.
3. Motor frames: Cast iron or welded heavy plate steel construction, stiff enough to withstand the rotating forces and torques generated and designed to limit or avoid any undesirable harmonic resonances.
4. Provide a threaded, forged steel, shouldered eyebolt blind tapped into the motor frame for lifting on all frames 254T and larger.
5. Condensate drain openings: Locate drain holes at the low points in the end brackets to allow removal of accumulated moisture from enclosures. Provide corrosion resistant, breather drain plugs for severe-duty motors.
6. Hardware: Hex head, SAE Grade 5 or better, plated for corrosion protection.
7. Nameplates: Engraved or embossed stainless steel plates fastened to the motor frame with stainless steel screws or drive pins. Clearly indicate all items of information listed in the applicable part of NEMA MG 1.
8. Main terminal box: Fabricated steel or cast iron, sized per the NEC for number and size of conduit connections and conductor bending and terminations as indicated on the Drawings. Split box top to bottom with capability to rotate entry point to any quadrant. Provide gaskets between the box and motor frame and between box and its cover. Include ground lug for equipment grounding conductor termination.
9. Bearing housings: Provide machined surfaces for attaching a magnet mounted accelerometer to monitor the motor vibration in the vertical, horizontal, and axial directions at each bearing housing.
10. Frame grounding: provide motor frame grounding pad or threaded stud where supplemental grounding to frame is indicated on the drawings.
11. Corrosion resistant mill and chemical duty paint.

B. Windings:

1. Copper.
2. Insulation rating: Class F.
3. Temperature rise: Class B at 1.0 SF, Class F at 1.15 SF.
4. Insulation: Non-hygroscopic, epoxy encapsulated windings for enclosure types WP I and WP II. Provide upgraded insulation by additional dips and bakes to increase moisture resistance for totally enclosed designs. Provide vacuum pressure impregnated (VPI) epoxy insulation for moisture resistance for outdoor motors.

5. Provide chemical and humidity resistance insulation system when IEEE 841 motors are specified.
6. Provide winding surge withstand capability per NEMA 1, Part 31 for VFC driven motors.
7. Provide specified temperature sensing devices for VFC driven equipment. If not specified, provide a winding temperature detector per the accessories paragraph.

C. Motor leads: Non-wicking type, minimum Class F temperature rating and permanently numbered for identification.

D. Stator: Built up core using high grade, low loss silicon steel laminations keyed or dovetailed to the stator frame and securely held in place at each end.

E. Rotor:

1. Forged or rolled steel shaft, machined, smooth finished, with sufficient strength for operation including 25 percent overspeed condition.
2. Shaft end coordinated with driven equipment coupling.
3. Entire assembly coated with protective coating.
4. Inpro seals on both ends of the shaft to prevent grease leakage and entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest. Severe duty motors to have improved sealing per IEEE 841.
5. Vertical Motor Shafts:

    a. Provide hollow shaft and P flange mounting to allow driven shaft to extend through provide for vertical pump applications.
    b. Coupling for connecting the motor shaft to the driven shaft is located in the top of the motor.
    c. Where solid shaft is provided couple the driven shaft below the P flange face.

6. Rotor Core:

    a. Solid, built-up stack of fully processed and coated, high-grade, low-loss silicon steel laminations.
    b. Die cast aluminum or fabricated copper bars or their respective alloys.
    c. Rotors on frames 213T and above to be keyed to shaft and rotating assembly dynamically balanced.

7. Rotor Assembly:

    a. Coated with corrosion resistant epoxy insulating varnish or other protective coating, thermally stable, statically and dynamically balanced.
    b. Balance weights securely attached to the rotor resistance ring by welding or similar permanent method.

F. Horizontal Bearings: roller type, grease lubricated.

1. Bearings: Anti-friction open or single-shield, vacuum-degassed steel ball or roller bearings, electric motor quality, designed for 45 degrees C maximum temperature rise. Metric size bearings are not acceptable.

2. Life: L 10 life of 100,000 hours for direct coupled applications and 26,000 hours for belted applications based. IEEE 841 motors, L 10 life increased to 150,000 and 50,000 hours respectively.
3. Shaft seals: Provide to prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest.
4. Shaft currents: Provide mitigation per process equipment specification.
5. Comply with ABMA and refer to process equipment specification for stricter or additional requirements.

G. Vertical Bearings: per manufacturer, thrust type.

1. Bearings: Manufacturer's standard design, constructed with thrust bearings on top to allow inspection and/or replacement without requiring complete disassembly of motor, of type and size to satisfy thrust loading requirements.
2. Life: Rated for an in-service L 10 life of 100,000 hours, designed to support the weight of the rotor plus, if required, the weight of the rotating driven equipment parts and the hydraulic thrust created by the driven equipment, with a 40 degrees C maximum temperature rise. Metric bearings are not acceptable.
3. Shaft seals: Provide to prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest.
4. Shaft currents: Provide mitigation per process equipment specification.
5. Comply with ABMA and refer to process equipment specification for stricter or additional requirements.

2.4 THREE PHASE MOTOR ACCESSORIES

A. Space heaters: Silicone rubber strip type, accessible for inspection, rated 120 Volt, single phase, designed to prevent condensation inside the enclosure when the motor is idle, with leads brought out to a separate terminal box. Emboss the heater wattage and voltage on the motor nameplate.

B. Winding temperature switch: Three embedded bi-metallic temperature thermostat switches with normally closed contacts and leads terminating in the main conduit box.

C. Winding temperature RTDs: Six 100 Ohm platinum (PT 100), three-wire resistance-type temperature detectors (RTDs) embedded in the stator windings, two per phase, symmetrically installed between stator coils where highest temperature will occur. RTD leads brought out to separate terminal box on the motor frame. One RTD set in each phase to be operational and one RTD set to be spare.

D. Bearing temperature sensing: Number, type, and location for motor and driven equipment per process equipment specification.

1. RTD: Replaceable 100 Ohm platinum (PT 100) three-wire RTD's, with spring loaded tip. Mount RTD as close as possible to outer surface of each bearing. RTD includes conduit connection head, terminal block, and cabling brought out to a common terminal box.
2. Dial type thermometer.
3. Temperature relay, furnished with indicating scale.
4. Iron or copper constantan thermocouple.

E. Motor shaft currents: insulate the ODE bearing and provide a shaft grounding strap. Insulate bearing probes to prevent shorting out bearing insulation.

F. Vibration Sensors: Number, type, and location for motor and driven equipment per process equipment specification. Provide machined surfaces at each bearing housing for attaching a magnetic mounted accelerometer in order to monitor motor vibration in vertical, horizontal and axial directions. Coordinate with the supplier of the machine monitoring equipment.

G. Anti-Backspin Device: Provide shaft mounted, mechanical non-reverse ratchet rated at 100 percent of motor full load torque for immediate protection against reversing due to phase reversals or from backspin at shutdown.

H. Encoder for vector drive motors: Provide encoder on opposite drive end to sense rotor speed and provide closed loop feedback (quadrature signal with line driver output) to a control device. Provide sufficient length of encoder cable to connect encoder to variable frequency controller.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Motors 1/20 HP and Smaller: Shaded-pole type.

D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

E. Insulation: Class F or better, with Class B temperature rise of 80 degrees C above ambient, 1.15 service factor. Locked rotor current to be no greater than specified in NEMA MG 1, Design "N".

F. Standard enclosure: Fully gasketed, totally-enclosed air over or fan cooled in conformance with NEMA MG 1.

G. Washdown duty enclosure: Where motor is installed in wet or corrosive areas routinely exposed to washdowns, high humidity or caustic chemicals, provide stainless steel, paint free washdown motors with Inpro bearing isolators, stainless steel T-type condensation drains, nitrile conduit box gasket, and corrosion resistant fans.

H. Bearings: Sealed ball bearings permanently lubricated for 10 years normal use, furnished with shaft slinger.

I. Class 1, Division 1 and 2 locations: Explosion proof, marked with a T3B temperature code label, and UL listed for use in Class 1, Division 1, Groups C & D, and Class II, Groups E, F, & G hazardous location. The temperature code marking to appear on the nameplate.

2.6 SOURCE QUALITY CONTROL

A. Factory Testing: Prior to shipment perform manufacturer’s standard tests in accordance with NEMA MG 1 and IEEE 112.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Upon delivery of motor and prior to unloading, inspect equipment for damage.

B. Comply with DELIVERY, STORAGE, AND HANDLING article within this specification.

3.2 INSTALLATION

A. Prepare rigid foundation or mounting surface to minimize vibration and maintain alignment between motor and load shaft.

B. Install the motors per manufacturer's installation instructions.

C. Anchor motor base to load bearing surface with grade 5 steel bolts or better.

D. Align the motor shaft with driven equipment according to manufacturer’s written instructions. Adjust axial position of motor frame with respect to load shaft.

E. Accurately adjust flexible couplings for direct drive according to machine manufacturer’s guidelines. Check alignment to minimize vibrations. Coupling spacing shall be according to coupling manufacturer guidelines.

F. Install motor branch circuit conduits and conductors in accordance with NEC and local code requirements. Connect motors to rigid conduit system by a short section of liquid-tight flexible conduit to isolate the conduit system from motor vibration. Where motors are installed outdoors, bring conduit into bottom of motor terminal box to avoid standing water at connection point.

G. Terminate the motor leads as shown on the connection diagrams using products intended for vibration applications.

H. Ground equipment according to Section 260526 “Grounding and Bonding for Electrical Systems.”

I. Tighten electrical connections and terminals according to manufacturers' published torque values.

J. Install conduit and wiring between motor auxiliary devices and associated indicators, controllers and protective devices in accordance to installation drawings.

K. Connect devices sensitive to electromagnetic interferes such as RTD's, thermistors, thermal protector switches, vibration sensors with shielded instrumentation wiring per installation drawings.

L. Comply with NECA 1.

M. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

3.3 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems." Identify field-installed conductors, interconnecting wiring, and components.

3.4 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until motors are ready to be energized and placed into service.

B. Lubrication and Shaft Rotation: Lubricate parts and rotate shaft periodically according to manufacturer’s written instructions until motors are ready to be energized and placed into service.

3.5 FIELD QUALITY CONTROL

A. Perform inspections and tests Inspect and test according to the Inspection and Test Procedures for Rotating Machinery state in NETA Acceptance Testing Specification paragraph 7.15.1. Options tests are not required unless called for within the process equipment specification.

B. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Motors will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies the motor and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP AND ADJUSTMENT

A. Complete installation and startup checks according to manufacturer's written instructions. Confirm motor is structurally, mechanically, and electrically ready for start-up. Checks include support system, vibration isolation, alignment, lubrication system, and cleanliness.

B. Start-up motor in accordance with process equipment specification.

C. Verify correct phase rotation at motor with driven equipment uncoupled. Correction for phase rotation to be made in the motor terminal box.

D. Prepare inspection and test reports.

3.7 DEMONSTRATION / SYSTEM FUNCTION TESTS

A. Run motor for system testing as required in motor controller and driven equipment specifications.

B. Confirm correct operation of all protective and metering devices.

C. Measure voltage and motor running current and evaluate relative to load conditions and nameplate full load amperes. Corrective action is required for any current imbalance 10 percent or greater.

D. Prepare driven equipment system testing report. Include results of all tests and check made, meter readings and recordings, and summary adjustments made. Clearly identify any discrepancies and concerns.

END OF SECTION 400593.23

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SECTION 406100 - PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes procurement of the services of a Process Control System Supplier (PCSS) to provide all materials, equipment, labor, and services required to achieve a fully integrated and operational system as specified herein, in "Related Requirements" under this Article, and in related drawings, except for those services and materials specifically noted.

B. Under this contract, the PCSS will also serve as the Applications Engineer System Supplier (AESS).

C. Work includes but is not limited to the following:

1. The PCSS shall perform all Applications Engineering System Supplier (AESS) related work as indicated in Sections 406863 "Configuration of HMI Software" and 406866 "Configuration of Controller Software", unless otherwise indicated in the scope of work section herein including but not limited to all SCADA HMI configuration and PLC programming required for a complete and functional information and control system.

    a. Application Engineering – SCADA HMI configuration, database, and screen additions and modification of the existing SCADA system based on the PLC transition from MOSCAD RTU to DC-PLC and UV system PLC replacement.
    b. PLC programming shall be provided by the PCSS except for vendor-furnished package systems, which will be provided by the respective vendor.

2. Refer to other Division 40 specifications and the drawings for additional scope of work for the PCSS.
3. The following process equipment vendors are responsible for the controls and programming associated with their respective process equipment. These process equipment vendors shall supply as-built software documentation to the Owner as specified herein.
    a. Aeration Blowers (Refer Spec section 431118)
    b. Package Plant Aeration Blowers (Refer Spec section 431117)
    c. UV PLC replacement (Refer Spec Section 466657)

4. Each process equipment vendor shall coordinate with the Process Control Systems Supplier (PCSS) to provide a "memory map" of data registers that are to be exchanged between their respective PLC controller and the SCADA System.

5. Modifications to existing plant Human Machine Interface (HMI) graphics, creating of new HMI graphics using the Contract Documents, and programming of the new and existing PLCs are also part of the contract.
6. Modifications of existing HWKS-PLC to add required Input/output modules with 20% spare for connecting the Headworks effluent flow meter (Existing), Ammonia Analyzer (Existing) and new modulating gate installed in Package Plant.
7. Remove existing MOSCAD RTU and turn over to owner. Transfer all the logic, Input/outputs and network connection associated to MOSCAD RTU to existing DC-PLC for fully functional.
8. Install a new ControlLogix PLC in the space vacated by the MOSCAD RTU to facilitate the new improvements of Dove Springs site under this project.

D. Include auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, whether indicated on the Drawings or not.

E. All equipment and installations to satisfy applicable Federal, State and local codes. Refer to Electrical drawings for area classifications for Class and /Division ratings.

F. Use the equipment, instrument, and loop numbering scheme indicated on the Drawings and in the specifications in the development of the submittals. Do not deviate from or modify the numbering scheme.

G. Related Requirements:

1. Section 406121.20 “Process Control System Testing.”
2. Section 406126 “Process Control System Training.”
3. Section 406196 “Process Control Descriptions.”
4. Section 406263 “Operator Interface Terminals.”
5. Section 406343 “Programmable Logic Controllers.”
6. Section 406613 “Switches and Routers.”
7. Section 406717 “Industrial Enclosures.”
8. Section 406733 “Panel Wiring.”
9. Section 406866 “Configuration of Controller Software.”
10. Section 406866 “Configuration of HMI Software.”
11. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): Entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

C. Maintenance of Plant Operations (MOPO): A construction plan which prevents or limits process disruptions during construction.

1.4 PREINSTALLATION MEETINGS

A. Conduct a project kickoff coordination meeting within two weeks after submitting the Project Plan. The purpose of the meeting is to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to one business day.

B. Conduct a submittal review coordination meeting after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting is to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS and AESS. The meeting will last up to one business day.

C. Attendance at MOPO workshop.

D. Other on-site or conference call coordination meetings with Engineer, Contractor, Vendors, as required prior to any field start-up or activity testing begins.

E. Schedule the mandatory coordination meetings as described herein. Hold the meetings at the Owner's designated location and include attendance by the Owner, the Engineer, the Contractor, the PCSS's Project Engineer. Other Division 40 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Schedule the meeting for a minimum of one week before the requested meeting date.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, mountings, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of control equipment, control panels, and instrumentation as specified herein.

4. Include diagrams for power, signal, and control wiring.

C. Qualifications Submittal:

1. For non-listed PCSS', submit, within 30 calendar days after Notice to Proceed, detailed information on staff and organization to indicate compliance with the Quality Assurance requirements of this Section. Qualification's submittal is required to be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements is grounds for rejection as a PCSS. Qualifications Submittal to contain the following:

    a. Copies of ISA CCST Level 1 certificates for all field technicians or resumes demonstrating field experience.
    b. Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.
    c. Copy of UL-508 certificate for panel fabrication facilities.
    d. Project references for water or wastewater projects as defined in the "Quality Assurance" paragraphs.
    e. Documentation to demonstrate the ability to complete this project including resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.

D. Project Plan, Deviation List, and Schedule Submittal:

1. Submit, within 45 calendar days after Notice to Proceed, a Project plan. Submit for approval the Project Plan before further submittals are accepted. The Project Plan to contain the following:

    a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. Include a general discussion of startup,, approach to testing and training, and other tasks as required by these specifications.
    b. Preliminary list of, PLC software, and PLC hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. The review and approval of software and hardware systems as part of this Project Plan stage does not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer's approval.
    c. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each of these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
    d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, loop drawings, control system architecture and I/O wiring diagrams
    e. Preliminary coordination meeting agendas as specified herein.
    f. Preliminary testing plan.
    g. Preliminary training plan.

2. Define Exceptions to the Specifications or Drawings in a Deviation List consisting of a paragraph-by-paragraph review of the Specifications indicating acceptance or any

proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by Engineer. Specifically state if no exceptions are taken to the specifications or drawings. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

3. PCSS is required to prepare a project schedule in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule is based on the General Contractor schedule and meets all field installation, testing, and start-up milestones in that schedule. The project schedule illustrates I&C related major project milestones including the following:

4. The PCSS must coordinate their work with the General Contractor's overall schedule. PCSS schedule incorporates all PCSS milestones including but not limited to the following:

   a. Schedule for all subsequent project submittals. Include the time required for Contractor's submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
   b. Proposed dates for all project coordination meetings.
   c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
   d. Software purchasing and configuration (following approval of related submittals).
   e. Shipment of instrument and control system equipment.
   f. Installation of instrument and control system equipment.
   g. Testing: Schedule for all testing.
   h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller provided under this Contract.
   i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.

   j. Listing of all major graphics and PLC programs intended to be created or modified for this project. Indicate if graphic or program is new or existing.

5. Component and Wiring Identification and Tagging Plan:

   a. All components provided by PCSS require a tag, label, or nameplate. Review specifications and provide a drawing indicating the tagging and labeling scheme used by the PCSS:

      1) Instruments.
      2) Network Rack Components.
      3) Panel Hardware.
      4) Standalone hardware or communication equipment.
      5) Wires and communication cables.

   b. Provide detailed information so Engineer can review the following characteristics for each type of tag, label, or nameplate for the different types of components provided above:

      1) Size or range of size of the tag, label or nameplate.
      2) Font style.
      3) Material.
      4) Color(s).

E. Input/Output (I/O) List Submittal:

1. Submit, within 60days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
2. Base the I/O list on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.
3. Submit the I/O list in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
4. Reflect all active and spare I/O points on the I/O list. Add points to accommodate spare I/O's as required in the specifications.
5. Arrange the I/O list so that each control panel has a dedicated worksheet, which includes the following information:

    a. TAG NUMBER(S): As indicated on Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, break out the tag loop number to allow for sorting by loop.
    b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
    c. PHYSICAL LOCATION: Control Panel designation of where the I/O point is wired to.
    d. PHYSICAL POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
    e. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.

    f. RANGE/STATE: Range in engineering units corresponding to an analog 4-20 mA signal, or the state at which the value of the discrete points is "1."
    g. ENGINEERING UNITS: Engineering units associated with the Analog I/O.
    h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
    i. P&ID: P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.

    j. LOGICAL POINT ADDRESS: I/O address of each point.
6. Sort the I/O list in order by:

    a. Physical location.
    b. I/O Type.
    c. Loop Number.
    d. Device Tag.

7. Once I/O list is approved, PLC I/O addresses are not be modified without approval by Engineer.
8. For I/O layout requirements, refer to Section 406343 "Programmable Logic Controllers."

F. Field Instruments Submittal:

1. Refer to the Instruments section for submittal requirements.

G. Control System Architecture Hardware and Software Packages Submittal:

1. Refer to Sections below for equipment required as part of the Hardware and Software Packages submittal:

    a. Section 406263 “Operator Interface Terminals”.
    b. Section 406343 “Programmable Logic Controllers”.
    c. Section 406613 “Switches and Routers”.
    d. Section 406717 “Industrial Enclosures”.
    e. Section 406763 “Control Panel Mounted UPS”.
    f. Section 406863 “Configuration of HMI Software”.
    g. Section 406866 “Configuration of Controller Software”.
2. For each hardware and software packages component specified in the sections above, submit a cover page that lists date, specification number, product name, manufacturer, model number, locations, and power required. Preferred format for the cover page is ISA-TR20.00.01-2001 (updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
3. Complete system architecture drawings showing in schematic form the interconnections between major hardware components including, control panels, computers, networking equipment, control panels with PLC systems and I/O modules, local operator interfaces, process equipment vendor panels with PLCs, and networked peripherals such as power monitors, security cameras, etc. The PCSS is required to provide unique network architecture drawings for each facility to the following networks:

    a. SCADA.
4. Develop the system architecture drawings in accordance with the following information and guidelines:

    a. Show power connections to each piece of equipment or grouping of equipment with voltage and power sources noted such as 120VAC UPS battery, 24VDC battery, or 120VAC from LP (lighting panel). Indicate specific UPS number or circuit number whenever possible.
    b. All communication cable types should be uniquely identified with a specific line type and cable characteristics clearly indicated in a key or legend located on drawings. For example, 50/125-micron multimode mode fiber, or CAT6 Ethernet copper cabling. Any multiconductor communication cables will be clearly labeled above each individual communication with a note added to drawing that states if no quantity exists above a linetype, there is only one communication cable between devices. If a multi-conductor cable has multiple colors, legend to clearly indicate which colors are used for which networks (i.e., a multi-pair fiber optic cable used for dedicated networks such as SCADA, Electrical, Security, HVAC, etc.)
    c. All communication cables need to be assigned a unique cable identification label and shown in either a table or above the communication line.
    d. Identify network protocols for each communication path or for system indicated in a key or legend as appropriate. Examples are Allen-Bradley EtherNet/IP, Modbus TCP/IP, or DNP3.
    e. Indicate which port or connection number the communication cable is terminating at any device that has multiple ports or connection points. For multiple devices, this could be shown once in a key or legend and noted on architecture as appropriate.

f. For each PLC control panel or network communication enclosure provided by PCSS, the architecture drawing clearly references other drawings provided by the PCSS for detailed panel wiring diagrams with a note near that PLC panel or communication enclosure indicating referenced drawing numbers. A placeholder is acceptable at the time of submission if these drawings are to be submitted at a later date.
g. Use symbology and/or icons whenever possible to represent a device and differentiate between devices that are different form factors, i.e., tower computer vs. desktop computer vs. rack mounted. Vendor CAD libraries are preferred for symbols.
h. Develop a diagram that will allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature.
i. Use a minimum sheet size of 11-inch x 17-inch and use of more than one sheet is acceptable with a logical breakout between sheets (i.e., head end on one sheet and plant control system on another). Clearly identify line continuations between drawings.

5. Provide a cybersecurity plan discussing configuration protocols and settings for all computers, switches, firewalls, routers, etc. in accordance with the NIST cybersecurity framework. Provide sufficient information in this plan to ensure the system will follow this NIST cybersecurity framework.
6. Provide a software schedule or spreadsheet for project which clearly indicates which software packages and operating systems are loaded onto which computers and servers.

H. Panel Layout Drawings and Wiring Diagrams Submittal:

1. Panel Layout Drawings: Submit Drawings for all panels specified. Draw to scale panel assembly and elevation drawings and detail all equipment in or on the panel. Use 11 inch x17 inch sheet size for panel drawings and include the following:

a. Clearly indicate a legend sheet with all symbols used on drawings and with voltage, color, and size of each wire and in accordance with requirements of Section 406733 “Panel Wiring.”
b. Interior and exterior panel elevation drawings to scale.
c. Nameplate schedule.
d. Conduit access locations.
e. Panel construction details.
f. Cabinet assembly and layout drawings to scale. Include a bill of material on the assembly drawing with each panel component clearly defined. Cross-reference the bill of material to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
g. Fabrication and painting specifications including color (or color samples).
h. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.

i. For every control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Include on calculations the recommended type of equipment required for both heating and cooling.

j. Submit evidence that all control panels are constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application accomplished at the fabrication location or by field inspection by UL inspectors. Costs associated with obtaining the UL seal and any inspections are be borne by Contractor.

2. Wiring Diagrams Submittal:

a. PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. Include drawings in Final O&M submittal. Leaving this information blank on Final Documentation drawings is not acceptable.

b. Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. If ISA Loop Wiring Diagrams are specified below, equipment external to the control panel and related external connections do not need to be shown on the Panel Wiring Diagrams. Panel wiring diagrams include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring includes the device ISA-tag and a unique numeric identifier. Diagrams identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring numbered with rack number, slot number, and point number. Two-wire and four-wire equipment to be clearly identified, and power sources noted. Submit final wire numbering scheme. Provide panel drawings that are 11-inch x 17-inch in size.

c. ISA Loop Wiring Diagrams: Not required.

I. Controller Program Submittal:

1. Refer to Section 406866 “Configuration of Controller Software” for specific submittal requirements.

J. Testing Plan Submittals:

1. Refer to Section 406121.20 “Process Control System Testing” for specific testing submittal requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For any named PCSS, submit a statement on company letterhead indicating that the requirements in the “Quality Assurance” paragraph below are met by the firm.

B. Product Test Reports: Refer to individual instrument, component, or hardware specifications for specific requirements.

C. Evaluation Reports: Refer to individual instrument, component, or hardware specifications for specific requirements.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all PCSS supplied hardware to include in operation and maintenance (O&M) manuals.
   1. Include the following information on the operations and maintenance manuals:

      a. Table of Contents:

         1) Provide a Table of Contents for the entire manual with the specific contents of each volume clearly listed. Include the complete Table of Contents in each volume.

      b. Instrument and Equipment Lists:

         1) Develop the following lists in Microsoft Excel format:
            a) An instrument list or spreadsheet for all instruments supplied including tag number, description, specification section and paragraph number, manufacturer, model number, calibrated range, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
            b) An equipment list or spreadsheet for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

      c. Equipment Operations and Maintenance Information:

         1) Provide ISA-TR20.00.01-2001(updated in 2004-2006) data sheets for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
         2) Provide either new documentation written specifically for this project or modified standard vendor documentation to the vendor O&M documentation for each device, piece of equipment, or OEM software. Indicate with arrows or circles all portions that apply to all standard vendor documentation furnished. Neatly line out or cross out all portions that do not apply. Remove groups of pages or sections that do not apply to the specific model supplied.

3) Provide the record documentation of the completed test forms with signoffs as specified in Section 406121.20 “Process Control System Testing.”
4) Include instrument/equipment calibration and configuration forms developed as specified in Section 406121.20 “Process Control System Testing.”

d. As-Built Drawings:

1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. Include on the drawings all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS. Provide electronic files for all drawings produced. Provide drawings in AutoCAD ".dwg" format and in Adobe Acrobat format.
2) Include on as-built documentation information from submittals, as described in this Specification, updated to reflect the as-built system. Incorporate errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests.

B. Operations and Maintenance Data - Software Maintenance Manual

1. Include these manuals as part of "Final System Documentation."
2. Software Listings and Databases: Submit hard copies of the same information required in the "Controller Program Submittal" except include files updated to reflect the as-built system. Include PDF versions of these files on the DVDs specified below.
3. PID Loop Tuning Parameters: Submit annotated chart recorder traces or computer system trend screen printouts showing tuned control loop response to plus and minus 40 percent of full span step changes of loop setpoint for each individual loop. For cascade loops, submit charts showing response of the secondary loop with secondary setpoint on manual and also response of the entire cascade control loop in automatic mode. Include a description of tuning methodology used.
4. Supply hardcopies of configuration information for the HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract.
5. Machine Readable Documentation: Provide two sets of as-built software documentation on DVDs or USB thumb drives in original electronic format for all PLC, HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract. Incorporate all changes made during or after testing, start-up, and commissioning.
6. Include final version of the system standards and conventions manual reflecting as-programmed conditions.

7. System Configuration Section:

a. Include a printout (or screen capture) of all configuration screens for every device requiring PCSS configuration. This includes, but is not limited to, the hardware firewall, PLC processors, PLC redundancy, EtherNet/IP, and any other communication modules.

C. Operations and Maintenance Data - Operators’ Manual:

1. Provide Operator's Manuals prior to final acceptance of the system.
2. Separately bind and include in the manual all information necessary for the operator to monitor and control the plant from the control system. Write the manuals in non-technical terms and organize for quick access to each detailed description of the operator's procedure. Include the following information:

    a. A comprehensive table of contents of the manual.
    b. A simple overview of the entire system indicating the function and purpose of major control system components described by area or building.
    c. A detailed description of the operation of the HMI and OIT including all appropriate displays. Including a screenshot of each HMI and OIT display screen and annotating each function in text is an acceptable format for presenting this information.
    d. Step-by-step procedures for starting up or shutting down critical component of the control system such as server or a control panel.
    e. Login / logout procedures for the operator interface system(s).
    f. Complete, step-by-step procedures for printing reports and entering manual data.
    g. Complete, step-by-step procedures for performing system or selected file backup and restoration including archiving historical data. Include recommended archiving schedule for historical data and/or frequency system performs an automatic back-up with a listing of all applications that are backed up or need to be backed up.
    h. Operational description for operating HMI computer equipment and peripherals including printers, CD-ROMs, removable bulk storage devices, UPS, etc. Include in the description procedures for typical maintenance and troubleshooting tasks.
    i. A complete glossary of terms and definition of acronyms.
    j. List of personnel to be contacted for warranty and emergency services, including name, address, telephone number, pager or cell phone number, fax number, and email address.

D. Software and Firmware Operational Documentation:

1. Original Licensed Software:

    a. Submit original software licenses and keys for all software provided under this Contract. Submit original paper based and electronic documentation for all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers, and related information. Provide licenses for all software under this Contract to Owner at the time of purchase. Provide media in software sleeves within O&M manual.

E. Electronic O&M Information:

1. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on DVD or USB thumb drive. Supply electronic documents in Adobe Acrobat format.
2. Provide electronic files for all custom-developed manuals including training manuals. Supply text in Microsoft Office and Adobe Acrobat formats.
3. Provide electronic files for all drawings produced. Supply drawings in AutoCAD ".dwg" and in Adobe Acrobat formats. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.

4. If specified in the training section, provide digital copies of all training videos. Format videos so they are readable by standard DVD players and by standard PC DVD drives, a minimum of 800 by 600 pixels, and include sound.

F. Include information on the cover and edge of each volume.

1.8 MAINTENANCE MATERIAL SUBMITTAL

A. Furnish extra materials from the same product run**,** that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Refer to individual specification sections in Division 406343 through 407543 for spare equipment requirements and provide one comprehensive spare parts submittal for project.

B. Pack all spare parts and test equipment in individual cartons and label with indelible markings clearly indicating components inside. Supply with the required spare parts complete ordering information paperwork including manufacturer's contact information (address and phone number), part name, part number, equipment name and tag number(s) for which the part is to be used (if applicable). Deliver and store the spare parts in a location directed by the Owner or Engineer.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: PCSS to hold a valid UL-508 certification for their panel fabrication facility.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

C. Responsible for the technical supervision of the installation by providing on-site supervision to the installers of the various components.

D. Process Control System Supplier (PCSS): “systems integrator” regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a “systems integrator” means an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturer’s training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel to hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel include, as a minimum, the lead field technician.
2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion is defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references for projects where the PCSS's contract was of similar size to this project.

3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

E. Maintain a permanent, fully staffed, and equipped service facility within 200 miles of project site with full-time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. Respond to on-site problems within 12 hours of notice. Provide an on-site response within four hours of notification starting at two months before scheduled startup to two months after startup completion.

F. Listed suppliers will not be required to submit a qualifications proposal (see "Informational Submittals"). Contractors interested in listing an equal to the above listed suppliers to submit PCSS' qualifications for review and approval as specified herein.

G. Select a PCSS from one of the following:

1. Prime Controls
   1725 Lakepointe Drive
   Lewisville, TX 75057
   Phone: (972) 221-4849
   Fax: (972) 420-4842
   Contact: Brian Poarch

2. Control Panels USA Inc.
   2530 Shell Road
   Georgetown, TX 78628
   Phone: (512) 863-3224
   Fax: (512) 868-5446
   Contact: Brian Iguchi.

3. Tesco Controls
   8000 Jetstar Road Ste. 150
   Irving, TX 75063
   Phone: (279) 399-4750
   Contact: Timothy Milberger

H. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

1.10 FIELD CONDITIONS

A. Environmental Requirements: Refer to Electrical Drawings for specific environmental and hazardous area classifications.

B. Elevation: Design equipment to operate at the project ground elevation.

C. Temperature:

1. Outdoor area equipment to operate between -4 to 122 degrees F ambient.
2. Equipment in indoor locations operate between 50 to 95 degrees F degrees ambient minimum.

3. Storage temperatures range from 32 to 122 degrees F degrees ambient minimum.
4. Furnish additional cooling or heating if required by the equipment specified herein.
5. Relative Humidity. Air-conditioned area equipment operate between 20 to 95 percent relative, non-condensing humidity. All other equipment operates between 5 to 100 percent relative, condensing humidity.

D. Do not ship control system equipment located in the control room until the control room areas comply with specified ambient temperature and humidity and free of dust and debris.

1.11 WARRANTY

A. Warranty Period: Two years from date of Substantial Completion unless noted otherwise in individual specification sections.

PART 2 - PRODUCTS

2.1 GENERAL

A. Electrical Requirements for Control System:

1. Operate equipment on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above to be provided between power supply and interconnected instrument loop. Supply constant voltage transformers where equipment requires voltage regulation.
2. With the exception for field device network connected devices, all electronic instrumentation utilizes linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).
3. Outputs of equipment that are not of the standard signals as outlined, have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.
4. All switches have double-pole, double-throw (DPDT) contacts rated at a minimum of 600 VA, unless noted otherwise.
5. Switches and/or signals indicating an alarm, failure or upset condition wired in a fail-safe manner as shown on the P&IDs**,** and as indicated on the instrument list**.** A fail-safe condition is when an open circuit generates an alarm state, i.e., contact opens.
6. Materials and equipment UL approved whenever such approved equipment and materials are available.
7. All equipment furnished designed and constructed so that in the event of power interruption, the systems specified all go through an orderly shutdown with no loss of memory and resume normal operation without manual resetting when power is restored, unless otherwise noted.
8. Surge protection requirements for control system power, signal, and communication lines are specified in Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.” Note that, per city of Georgetown, in addition to stated surge protection

requirements, all 4-20mA signals to and from pumps/PLC are required to have analog surge protection provided.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and Insert other specific conditions and other conditions affecting performance of the Work.

B. Examine instruments and communication controller devices before installation. Reject instrument and communication controller devices that are wet, moisture damaged, or mold damaged.

C. Examine walls, floors, roofs, and process area for suitable conditions where control panels instrumentation or computers will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

A. The shield on each process instrumentation cable to be continuous from source to destination and be grounded at only one ground point for each shield.

B. Provide sunshades for equipment mounted outdoors in direct sunlight. Include sunshades standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North to minimize the impact of glare and ultraviolet exposure on digital readouts.

3.3 IDENTIFICATION

A. Provide identification system for all PCSS provided hardware, instrumentation, and communication cabling.

3.4 FIELD QUALITY CONTROL

A. Refer to individual hardware and instrument specification Sections.

3.5 STARTUP SERVICE

A. Refer to Section 406121.20 “Process Control System Testing.”

B. Refer to Section 406126 “Process Control System Training.”

C. 100 percent checkout of all field components both new and existing.

D. Engage a factory-authorized service representative to perform startup service as specified in individual hardware and instrument specification Sections.

E. Weekly on-site coordination meetings with Engineer, Contractor, and AESS as required during active construction period.

3.6 SOFTWARE SERVICE AGREEMENT

A. Refer to individual hardware and software specifications for specific requirements.

END OF SECTION 406100

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SECTION 406121.20 - PROCESS CONTROL SYSTEM TESTING [CONTRACTOR PERFORMS PROGRAMMING]

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes process control system testing, where Applications Engineering services are performed by Contractor.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406196 “Process Control Descriptions”.
3. Section 406343 “Programmable Logic Controllers”.
4. Section 406613 “Switches and Routers”.
5. Section 406717 “Industrial Enclosures”.
6. Section 406733 “Panel Wiring”.
7. Section 406866 “Configuration of Controller Software”.
8. Section 407000 “Instrumentation for Process Systems”.
9. Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors”.

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): Entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

C. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

D. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Refer to Section 4061000 “Process Control and Enterprise Management Systems General Provisions.”

1.5 ACTION SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Testing Submittals - Submit, in one submittal, the following testing related documents:

1. Status Signoff Forms:

a. Develop and submit project specific I/O Status and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.

1) Example forms are shown in the Appendices.
2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
3) Submit testing forms prior to start of testing.

1. Testing Procedures:

a. Submit detailed procedures proposed to be followed for each of the tests specified herein. The test procedures serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified. At a minimum, provide the following test procedures:

1) Network and Communications Testing.
2) I/O Testing.
3) UPS.
4) Control panel power, indictors, and hardwired logic tests.

b. Structure documents in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
c. Indicate in test procedures all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
d. Structure test procedures in a cause and effect manner where the inputs are indicated, and the outputs are recorded.
e. Include in test procedures the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
f. Do not start testing until all Testing Submittals have been approved.

C. Test Documentation:

1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing is not be considered complete until the signed-

off forms have been submitted and approved. Submittals of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.6 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For Test Documentation of system:

1. Upon completion of each required test, document the test by submitting a copy of the signed-off Testing Status forms. Testing is not considered complete until the signed-off forms are submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.7 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.8 COST OF TRAVEL

A. Scheduled tests will only be attended once by Engineer /Owner. If test is not successful, all subsequent tests will be performed at Contractor's expense. Reimburse Owner for all costs, including labor and expenses, invoiced by Engineer, and incurred by Owner for subsequent retests.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING - GENERAL

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Track results of all testing on a project specific status sign-off form or similar document. The PCSS is responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.

C. Tests the PCSS is required to perform are as follows:

1. Factory Testing:

a. Unwitnessed Factory Test (UFT).
b. Witnessed Factory Test (WFT).

2. Field Testing:

    a. Operational Readiness Test (ORT).
    b. Functional Demonstration Test (FDT).
    c. Site Acceptance Test (SAT).

D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.

E. PCSS to coordinate all required testing with Contractor, affected subcontractors, Engineer, and Owner.

F. Do not ship equipment to jobsite until Engineer or Owner has received all Factory Testing results and approved the system as ready for shipment.

G. Engineer reserves the right to test or re-test any functions.

H. Correction of Deficiencies:

1. Correct deficiencies in workmanship and/or items not meeting specified testing requirements to meet specification requirements at no additional cost to Owner.
2. Repeat testing, as specified herein, after correction of deficiencies is made until specified requirements are met. Perform work at no additional cost to Owner.

3.2 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

A. Purpose of UFT is for PCSS to check system prior to Engineer and/or Owner attending factory testing. This type of testing is part of any quality firm's internal QA/QC procedures.

B. Temporary network connections are required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.

C. Hardware to be tested includes all control system devices shown on System Architecture drawings and provided by PCSS.

D. Perform these tests, but not be limited to the following. Address each of these tests in the Test Procedure submittal.

1. All panels and enclosures provided to undergo a thorough inspection to verify integrity of cabinet enclosures, frame structures, paint work and finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.
2. Perform a system audit to verify all components have been staged for test and have been documented properly with correct model numbers, serial numbers, etc. Prove documentation of audit at factory test and submit as part of O&M Manual Documentation:

    a. For each workstation and server, list of all software installed (including the operating system), with software revision number, software improvement modules

or patches installed, license number and owner registration information, warranty period, vendor and local distributor names and contacts.

b. For each microprocessor-based component connected to control communication backbone in system (PLCs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list firmware revision, vendor and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)

3. Perform panel wire pull tests to ensure all wiring has been connected with appropriate torque to prevent wires from coming loose.
4. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Perform testing of UPS to determine if they have been sized correctly to maintain specified run time during field testing.
5. Perform a 100 percent I/O point checkout to verify proper operation of input/output points from panel terminations to HMI and OIT nodes. At a minimum, I/O checkout consists of four steps.

    a. Jumper discrete input signals at field terminal blocks in control panels to verify proper status in HMI and OIT nodes.
    b. Connect analog input signals to a signal generator at field terminal blocks in control panels to verify proper status in HMI and OIT nodes and verify signals are at zero percent, 50 percent, and 100 percent of full scale.
    c. Test discrete output signals by switching equipment to manual control at HMI and OIT nodes and turning the output on or other means to turn the output on. Then verify the output is on by connecting a digital multimeter to measure continuity at terminations, thus verifying command from PLC has properly executed contact closure.
    d. Test analog output signals by switching the equipment to manual control at HMI and OIT nodes and turning output on or other means to turn the output on. Then verify output by utilizing a digital multimeter to measure current or voltage generated at termination points.

6. Verify all control strategies using simulation or other means to verify logic performs as expected. Verify faults and logical failure conditions for control strategies such instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing (over and under scale) for analog inputs, and all other strategies specified in control strategy document.
7. For each hardware enclosure, include with inspection, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability, i.e., fans, door hinges, keylocks, and other materials.
8. For each subpanel, include with inspection, but not be limited to, I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.
9. All other control panel circuitry.
10. Perform the following systems tests:

    a. Demonstrate ability to share data between operator workstations and servers.
    b. Demonstrate ability of each workstation to print reports on all designated report printers.

c. Demonstrate ability for each workstation to read and write designated files from servers and other workstations on the network.
d. Demonstrate operability of all back-up and mass storage equipment.
e. Demonstrate communication failure and recovering self-healing ring testing.
f. Demonstrate total power failure and recovery. Remove the UPS for this test.
g. Demonstrate capabilities of the historical server.
h. Demonstrate failover capabilities of the redundant HMI servers.
i. Demonstrate failover capabilities of the redundant PLCs.

E. Upon successful completion of UFT, PCSS to submit a record copy of test results as specified in PART 1. As part of this test results submittal, notify Engineer and Owner in writing that system is ready for WFT. No other notice of Factory test will be accepted. Engineer and/or Owner to schedule a test date within 30 days of receipt of this submittal.

3.3 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

A. Purpose of WFT is to allow Engineer or Owner representatives to witness functionality, performance, and stability of entire hardware and software system as a complete integrated system. WFT to be run by PCSS and conducted at PCSS's facility.

B. Required Documents for Test:

1. Clean set of approved panel drawings and wiring diagrams.
2. Set of Contract Documents - all drawings and specifications.
3. All design-change related documentation.
4. Master copy of the PCSS developed factory testing signoff forms.
5. Testing procedures.

C. Operate the system continuously throughout WFT without failure, except where initiated per established test procedures. Unanticipated failures may, at Owner or Engineer's option, result in overall WFT being deemed unsuccessful. Correct and re-test all deficiencies identified during these tests prior to completing WFT or shipment of panels to jobsite as determined by Owner/Engineer.

D. Perform these tests during the WFT, but not be limited to, the following:

1. A repeat of all tests specified in the UFT.

E. Daily schedule during these tests to be as follows:

1. Morning meeting to review the day's test schedule.
2. Scheduled tests and sign-offs.
3. End of day meeting to review day's test results and to review or revise next day's test schedule.
4. Unstructured testing period by witnesses.

F. Upon successful completion of WFT, PCSS to submit a record copy of test results as specified in PART 1.

3.4 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test determines if equipment is ready for operation.

B. This test to take place prior to FDT and startup. Prior to starting this test, install relevant process equipment and mechanically test instruments installed, control panels installed, and field wiring complete.

C. Required Documents for Test:

1. Master copy of the PCSS developed field testing sign-off forms.
2. Testing procedures.
3. Calibration forms.

D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check testing process periodically. All deficiencies found to be corrected by PCSS prior to commencement of Functional Demonstration Test.

E. PCSS to maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.

F. Perform the following tests as part of ORT:

1. Instrument calibration, configuration, and set-up.
2. Input/Output (I/O) Testing to HMI and OITs.
3. Testing of control strategies.

G. Instrument calibration, configuration, and set-up:

1. Calibrate, configure, and set-up all components and instruments to perform specified functions.
2. Calibration form:

    a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this information. These forms provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.
    b. Add this information to Instrument data sheet and to a copy of manufacturer's standard "Configuration Sheet", or create a separate form.

        1) If a separate form, list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.

    c. Some examples of required information are:

        1) For Discrete Devices: Actual trip points and reset points.

2) For Instruments: Any configuration or calibration settings entered into instrument
3) For Controllers: Mode settings (PID).
4) For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).

d. Maintain a copy of these forms in field during testing and make them available for inspection at any time.
e. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection. Submit as part of Final System Documentation as specified in Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

H. I/O Testing:

1. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
2. PCSS in conjunction with Contractor to test signals under process conditions. Preferred test method will always be to execute test wherever possible to end elements. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However, if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation method and make a note on sign-off form.
3. Perform the following I/O tests:

a. Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within loop such as HMI screens, OIT screens, pilot lights, horns, beacons, etc.
b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50 percent, and 100 percent as well as on increasing and decreasing range. Observe results on all indicators within loop such as HMI screens, OIT screens, recorders, digital indicators, etc.
c. Test discrete output signals by switching equipment to manual control at the HMI and OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.
d. Test analog output signals by switching equipment to manual control at HMI and OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.

I. Testing of Automatic Control Strategies:

1. Verify all automatic control strategies using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing for analog inputs, loss of power, and all other strategies specified in control strategy document.

J. Repeat all systems tests specified under factory testing.

K. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Also, test sizing of UPS by switching off-line power to UPS and verify if they maintain specified run time.

L. For all panels with enclosures modified by this Contract, test internal control panel temperature under full running conditions to ensure proper cooling/ventilation is being provided.

M. Upon successful completion of ORT, PCSS to submit a record copy of test results as specified in PART 1 and request scheduling of FDT.

3.5 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

A. After facility is started-up and running treatment process in automatic control to extent possible, perform a Functional Demonstration Test. Purpose of FDT is to allow Engineer or Owner representatives to witness actual functionality, performance, and stability of system while connected to process equipment.

B. Required Documents for Test:

1. Set of panel drawings and wiring diagrams from ORT with corrections noted.
2. Set of Contract Documents - all drawings and specifications.
3. All design-change related documentation.
4. Signed-off master copy of the PCSS developed field testing signoff forms.
5. Testing procedures.
6. Copy of completed calibration forms.
7. One copy of all O & M Manuals for PCSS supplied equipment.

C. Perform a witnessed FDT on each process area. To extent possible, repeat testing performed during ORT.

D. Follow specified daily schedule during factory tests and FDT.

E. After coordinating with Operations, perform a "Black Start" of the plant to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Perform separate tests by recovering the plant while on generator (if a generator is specified) and while on utility power.

F. Document punch list items and resolutions noted during test on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS to perform repairs, replacement, and/or retest within 10 days.

G. Upon successful completion of the FDT, PCSS to submit a record copy of test results as specified in PART 1.

3.6 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

A. After completion of FDT, and system is started-up and running treatment process in automatic control to extent possible, perform a test on the system.

B. While this test is proceeding, Engineer and Owner have full use of system. Only allow plant operating personnel to operate equipment associated with live plant processes. Plant operations remain the responsibility of Owner and decision of plant operators regarding plant operations are final.

C. During this test, PCSS personnel to be present as required to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of hardware and software of system. When PCSS personnel are not on-site, PCSS to provide cell phone/pager numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.

D. PCSS to analyze and correct any malfunctions during test. In event of rejection of any part or function, PCSS to perform repairs or replacement within 5 days.

E. Throughout duration of SAT, do not make software or hardware modifications to the system without prior approval from Owner or Engineer.

3.7 APPENDICES

A. APPENDIX 406121-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

1. An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

B. APPENDIX 406121-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM

1. An example template for Automatic Control Strategies signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

C. Refer to Appendix A and Appendix B on following pages.

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[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Field Testing.
Instrument Alarm Setpoint - Setpoint for any alarms set by PCSS
Wiring Complete - Signal wired from field device to PLC
I/O Tested - Signal tested from field device to SCADA HMI

PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Rack	Slot	Channel	Instrument Alarm Setpoint	Calibrate, config., and Wiring complete	Date	PCSS I/O testing	Date	I/O Testing to the HMI	Date	Notes
PLC-SC	LIT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0								
PLC-SC	LIT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1								
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2								
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3								
PLC-SC	FIT-4102-1	RAS Flow Pumps 1-3	0-1900 GPM	14	AI	2	1	4								
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5								
PLC-SC	N/A	Spare Slot	N/A	N/A	Spare	2	5	N/A								
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0								
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1								
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2								
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5								
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0								
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1								
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2								
PLC-SC	WAHH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3	1	3								
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4								
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5								
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6								
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7	50 GPM	RJM	12/18/2011	JAS	12/22/2011	MIC	12/29/2011	Example completed line
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8								
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9								
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10								
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11								
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12								
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13								
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14								
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15								
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1								
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2								
PLC-SC	HSS-7000-2	Sludge Holding tank Tank Blower No. 2 Start Command	Start	17	DO	4	6	3								
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	5								
PLC-SC	HSS-4105-1	Secondary Scum Pump No. 2 Start/Stop	Start	15	DO	4	6	6								
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7								
PLC-SC	7160-FQI-1	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6	8								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	9								
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6	10								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	11								
PLC-SC	HSO-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12								
PLC-SC	HSC-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13								
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	15								

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[Project Name] Appendix B - Automatic Control Strategies Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Testing

Auto. Control Strategies. - Loop operational in Automatic as defined in Control Stategies

Control Strategies Loop #	Control Strategy Description	P&ID	Auto. Control Strategy	Date	Notes
LOOP 281 - 284	LOW FLOW PUMPS	8			
LOOP 290	LOW EQ CHANNEL FLOW NO.4	8			
LOOP 300	MICROFILTRATION AIR SUPPLY LOW PRESSURE	10			
LOOP 351, 352	SITE LIFT STATION PUMP NO.1 AND NO. 2	12			
LOOP 355	SITE LIFT STATION HIGH AND LOW LEVEL CONTROL	12			
LOOP 371, 372	SLUDGE HOLDING TANK NO.1 AND NO. 2 LEVEL	14			
LOOP 381, 382	SLUDGE TRANSFER PUMPS	14			
LOOP 385	SLUDGE TRANSFER PUMPS REMOTE START/STOP COMMAND	14			
LOOP 700	EFFLUENT PUMPING STATION LEVEL	14			
LOOP 701, 702, 703	EFFLUENT PUMP NO.1	14			
LOOP 840	POST AERATION CHANNEL AIR FLOW CONTROL	15			
LOOP 900	SLUDGE TRANSFER PUMPS DISCHARGE FLOW	8			
LOOP 971	CENTRIFUGE SLUDGE FEED PUMP NO.1	8			
LOOP 1001	CENTRIFUGE NO.1 SLUDGE FEED FLOW CONTROL	8			
LOOP 1411, 1412	SODIUM HYPOCHLORITE STORAGE TANKS LEVEL	8			
LOOP 1421, 1422	SODIUM HYPOCHLORITE PUMPS	8			
LOOP 1430	SODIUM HYPOCHLORITE STORAGE TANKS CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2051, 2052, 2053	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2055	TRANSFER SWITCH STATUS	14			
LOOP 2060	GENERATOR KILOWATTS MONITORING	14			
APPENDIX ONE	EQUIPMENT RESTART DURING A POWER LOSS WITH THE GENERATOR RUNNING	14			
APPENDIX TWO	EQUIPMENT RESTART WITH POWER RESTORED AFTER A POWER LOSS	14			
N/A	SELF-HEALING CAPABILITIES OF NETWORK	N/A			
N/A	REDUNDANT SCADA SERVER FAILOVER AND RECOVERY	N/A			

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END OF SECTION 406121.20

SECTION 406126 - PROCESS CONTROL SYSTEM TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes process control system training for provided devices and systems.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406263 “Operator Interface Terminal.”
3. Section 406343 “Programmable Logic Controllers.”
4. Section 406866 “Configuration of Controller Software.”
5. Section 407000 “Instrumentation for Process Systems.’

1.3 ACTION SUBMITTALS

A. Preliminary Training Plan Submittal:

1. Prior to preparation of Final Training Plans, submit outlines of each training course including course objectives and target audience, resumes of instructors, prerequisite requirements for each class, and samples of handouts for review.

B. Final Training Plan Submittal:

1. Upon receipt of Engineer's comments on preliminary training plan, submit specific proposed training plan with the following:

a. Definitions, objectives, and target audience of each course.
b. Schedule of training courses including proposed dates, duration, and locations of each class.
c. Complete copy of all proposed handouts and training materials bound and logically arranged with all materials reduced to a maximum size of 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion into the binder.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Directly relate the training and instruction to the system being supplied. Training program represents a comprehensive program covering all aspects of the operation and maintenance of the system.

B. Coordinate all training schedules with and at the convenience of Owner, including shift training required to correspond to Owner's working schedule.

C. All onsite instructors must be intimately familiar with the operation and control of Owner's facilities.

D. Provide detailed training manuals to supplement the training courses including specific details of equipment supplied and operations specific to the project. Provide the manuals in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.

E. Make use of teaching aids, manuals, or slide/video presentations as required. After training services, deliver training materials to Owner.

F. Owner reserves the right to videotape all custom training sessions. Training tapes become sole property of Owner.

G. Cost of Travel for off-site training:

1. Cost of Travel for off-site training is paid directly by entity employing the staff doing the traveling.

3.2 TRAINING SUMMARY

A. Provide following training courses listed in the summary table below:

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Control System Overview Seminar	Covered in AESS scope of work			
Operator Control System Training	Covered in AESS scope of work			
Installed Control System	4	4	1	Maintenance, Administrator
PLC Hardware/Software	8	4	1	Maintenance
OIT Hardware/Software	8	4	1	Maintenance
Instrument manufacturer training – Chlorine and Turbidimeter Analyzers	8	4	1	Maintenance
Instruments	16	2	1	Maintenance

Instruments - Operator familiarity	2	8	1	Operations

B. Definitions of Audience Roles:

1. Administrator: Personnel responsible for maintaining the HMI / SCADA system.
2. Maintenance: Personnel responsible for maintaining the field controller hardware and instrumentation system.
3. Operations: Personnel responsible for daily plant operations.
4. Management: Non-daily operations personnel.
5. Include classroom and hands-on instruction such that a student with experience in process instrumentation can configure the HMI with no guidance or with only minimal supervision when attempting complex problems.

3.3 ONSITE TRAINING

A. Training personnel are required to be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel are required to command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Installed Control System Training:

1. Provide training for Owner's personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. Conduct training before Functional Demonstration Test (FDT), but not more than two months before.
2. Provide training and instruction specific to the system that is being supplied.
3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system.
4. Provide detailed training on the actual configuration and implementation for this Contract covering all aspects of the system that will allow Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. Provide training covering the following subjects:

    a. System overview.
    b. System hardware components and specific equipment arrangements.
    c. Periodic maintenance.
    d. Troubleshooting and diagnosis.
    e. Network configuration, communications, and operation.
    f. TCP/IP addressing procedures for all Ethernet devices.

C. Programmable Logic Controller (PLC) Hardware and Software:

1. Provide training for Owner's personnel in operation, maintenance, troubleshooting, etc. with PLC hardware and software system. Conduct the training before FDT, but not more than two months before.
2. Provide training and instruction specific to the system that is being supplied.
3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system. Provide detailed training on the actual configuration and implementation

for this Contract covering all aspects of PLC system that will allow Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to PLC system. Provide training covering the following subjects:

a. PLC system overview.
b. PLC system architecture.
c. PLC system hardware components and specific equipment arrangements.
d. PLC system startup, shut down, load, backup, and PLC failure recovery.
e. Periodic maintenance.
f. Troubleshooting and diagnosis down to the I/O card level.
g. PLC configuration, communications, and operation.

D. Instrument Manufacturer Training:

1. Provide manufacturer instrument training for those instruments where specifically indicated in the Instruments section. This is on-site training provided by an authorized representative of the manufacturer. Manufacturer's representative is required to be fully knowledgeable in equipment operation and maintenance.

E. Instrument Training:

1. Provide instruction on the maintenance of the field and panel instrumentation for Owner's instrumentation technicians. Conduct this training before FDT, but no more than 1 month before and at a time suitable to Owner. This training takes place at Owner's facility. Training program is required to include the following elements:

a. Training in standard hardware maintenance for the instruments provided.
b. Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.
c. Testing, adjustment, and calibration procedures.
d. Troubleshooting and diagnosis.
e. Maintenance and frequency.

F. Instruments - Operator Familiarity:

1. Provide operator level instruction on use of field and panel instrumentation for Owner's operations staff.
2. Conduct training before 30-day site acceptance test, but no more than 1 month before and at a time suitable to Owner.
3. Training Location: Owner's facility.
4. Include hands on demonstration of information each transmitter indicates, and method used to retrieve any operator information from transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.

END OF SECTION 406126

Drawing No.	ISA Tag Name and Loop No.	Type	Description	Destination
DS-IA-1	LI-1005-1	AI	DS WWTP Wetwell No. 1 Level	DS-PLC
DS-IA-1	LAL-1001-1	DI	DS WWTP Wetwell No. 1 Low Level	DS-PLC
DS-IA-1	LAH-1001-1	DI	DS WWTP Wetwell No. 1 High Level	DS-PLC
DS-IA-1	LALL-1001-1	DI	DS WWTP Wetwell No. 1 Low Low Level	DS-PLC
DS-IA-1	LAHH-1001-1	DI	DS WWTP Wetwell No. 1 High High Level	DS-PLC
DS-IA-1	YCI-1001-1A	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 1 In Auto	DS-PLC
DS-IA-1	YRI-1001-1	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 1 Running	DS-PLC
DS-IA-1	XA-1001-1	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 1 Fault	DS-PLC
DS-IA-1	TAH-1001-1	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 1 High Temperature	DS-PLC
DS-IA-1	MAH-1001-1	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 1 Leak	DS-PLC
DS-IA-1	YCI-1001-1B	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 1 LCS In Remote	DS-PLC
DS-IA-1	HSS-1001-1	DO	DS WWTP Wetwell No. 1 Filtrate Pump No. 1 Start/Stop	DS-PLC
DS-IA-1	YCI-1001-2A	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 2 In Auto	DS-PLC
DS-IA-1	YRI-1001-2	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 2 Running	DS-PLC
DS-IA-1	XA-1001-2	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 2 Fault	DS-PLC
DS-IA-1	TAH-1001-2	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 2 High Temperature	DS-PLC
DS-IA-1	MAH-1001-2	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 2 Leak	DS-PLC
DS-IA-1	YCI-1001-2B	DI	DS WWTP Wetwell No. 1 Filtrate Pump No. 2 LCS In Remote	DS-PLC
DS-IA-1	HSS-1001-2	DO	DS WWTP Wetwell No. 1 Filtrate Pump No. 2 Start/Stop	DS-PLC
DS-IA-1	TSH-1001-1	DI	DS WWTP Electrical House Temperature	DS-PLC
DS-IB-1	XA-1101-1	DI	DS WWTP Aeration Basins Inlet Gate Fault	HWKS-PLC
DS-IB-1	ZSO-1101-1	DI	DS WWTP Aeration Basins Inlet Gate Opened	HWKS-PLC
DS-IB-1	ZSC-1101-1	DI	DS WWTP Aeration Basins Inlet Valve Closed	HWKS-PLC
DS-IB-1	YCI-1101-1	DI	DS WWTP Aeration Basins Inlet Gate In Remote	HWKS-PLC
DS-IB-1	ZIC-1101-1	DI	DS WWTP Aeration Basins Inlet Gate Position Feedback	HWKS-PLC
DS-IB-1	ZI-1101-1	DI	DS WWTP Aeration Basins Inlet Gate Position Setpoint	HWKS-PLC
DS-IB-1	FI-1102-1	DI	DS WWTP Aeration Basins Inlet Flow	DS-PLC/DS-RIO1
DS-IB-1	LALL-1401-1	DI	DS WWTP Package Plant Sludge Holding Basins Low Low Level	DS-PLC/DS-RIO1
DS-IB-1	LAL-1401-1	DI	DS WWTP Package Plant Sludge Holding Basins Low Level	DS-PLC/DS-RIO1
DS-IB-1	LAHH-1401-1	DI	DS WWTP Package Plant Sludge Holding Basins High High Level	DS-PLC/DS-RIO1
DS-IB-1	LAH-1401-1	DI	DS WWTP Package Plant Sludge Holding Basins High Level	DS-PLC/DS-RIO1
DS-IB-1	YCI-1401-1A	DI	DS WWTP Package Plant Sludge Transfer Pump In Auto	DS-PLC/DS-RIO1
DS-IB-1	YRI-1401-1	DI	DS WWTP Package Plant Sludge Transfer Pump Running	DS-PLC/DS-RIO1
DS-IB-1	XA-1401-1	DI	DS WWTP Package Plant Sludge Transfer Pump Fault	DS-PLC/DS-RIO1
DS-IB-1	TAH-1401-1	DI	DS WWTP Package Plant Sludge Transfer Pump High Temperature	DS-PLC/DS-RIO1
DS-IB-1	MAH-1401-1	DI	DS WWTP Package Plant Sludge Transfer Pump Leak	DS-PLC/DS-RIO1
DS-IB-1	YCI-1401-1B	DI	DS WWTP Package Plant Sludge Transfer Pump LCS In Remote	DS-PLC/DS-RIO1
DS-IB-1	HSS-1401-1	DO	DS WWTP Package Plant Sludge Transfer Pump Start/Stop	DS-PLC/DS-RIO1
DS-IB-1	YRI-1450-1	DI	DS WWTP Package Plant Clarifier Running	DS-PLC/DS-RIO1
DS-IB-1	XA-1450-1	DI	DS WWTP Package Plant Clarifier Over Torque	DS-PLC/DS-RIO1
DS-IB-1	XA-1300-1A	DI	DS WWTP Package Plant Generator Control Panel Ready	DS-PLC/DS-RIO1

Drawing No.	ISA Tag Name and Loop No.	Type	Description	Destination
DS-IB-1	YRI-1300-1	DI	DS WWTP Package Plant Generator Control Panel Running	DS-PLC/DS-RIO1
DS-IB-1	XA-1300-1B	DI	DS WWTP Package Plant Generator Control Panel Fault	DS-PLC/DS-RIO1
DS-IB-1	XA-1300-1C	DI	DS WWTP Package Plant Generator Control Panel Fuel Low Level	DS-PLC/DS-RIO1
DS-IB-1	CB-1450	DI	DS WWTP Package Plant Main Circuit Breaker Opened	DS-PLC/DS-RIO1
DS-IC-1	XA-1200-1	DI	DS WWTP Clarifier Treatment Structure No. 1 Over Torque Alarm	DC-PLC
DS-IC-1	YRI-1200-1	DI	DS WWTP Clarifier Treatment Structure No. 1 Running	DC-PLC
DS-IC-1	FI-1215-1	AI	DS WWTP Aeration Basin No. 1 Flow	HWKS-PLC
DS-IC-1	AI-1216-1	AI	DS WWTP Aeration Basin No. 1 Ammonia	HWKS-PLC
DS-IC-1	AI-1200-1	AI	DS WWTP Aeration Basin No. 1 Dissolved Oxygen	DC-PLC
DS-IC-2	XA-1200-2	DI	DS WWTP Clarifier Treatment Structure No. 2 Over Torque Alarm	DC-PLC
DS-IC-2	YRI-1200-2	DI	DS WWTP Clarifier Treatment Structure No. 2 Running	DC-PLC
DS-IC-2	FI-1215-2	AI	DS WWTP Aeration Basin No. 2 Flow	HWKS-PLC
DS-IC-2	AI-1200-2	AI	DS WWTP Aeration Basin No. 2 Dissolved Oxygen	DC-PLC
DS-ID-1	PI-1311-1	AI	DS WWTP Treatment No. 1 Aeration Blowers Outlet Pressure	DS-PLC/DS-RIO2
DS-IB-1	XA-1000-1	DI	DS WWTP Treatment Unit No. 1 Generator Control Panel Ready	DS-PLC/DS-RIO2
DS-ID-1	YRI-1000-1	DI	DS WWTP Treatment Unit No. 1 Generator Control Panel Running	DS-PLC/DS-RIO2
DS-ID-1	XA-1000-1B	DI	DS WWTP Treatment Unit No. 1 Generator Control Panel Fault	DS-PLC/DS-RIO2
DS-ID-1	XA-1000-1C	DI	DS WWTP Treatment Unit No. 1 Generator Control Panel Fuel Low Level	DS-PLC/DS-RIO2
DS-ID-2	PI-1311-2	AI	DS WWTP Treatment No. 2 Aeration Blowers Outlet Pressure	DS-PLC/DS-RIO2

SECTION 406193 - PROCESS CONTROL SYSTEM INPUT/OUTPUT LIST

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes process control system Input-Output (I/O) lists.

B. Related Requirements:
   1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for I/O list submittal requirements.
   2. Section 406343 “Programmable Logic Controllers.”

1.3 DEFINITIONS

A. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

B. Programmable Logic Controller (PLC): Ruggedized programmable computer used for industrial automation.

1.4 ACTION SUBMITTALS

A. Process Controller Input/Output (I/O) Schedule
   1. Submit complete I/O schedule as specified in Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
   2. An electronic copy of this I/O list can be requested from the Engineer for use in preparing the I/O list submittal.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

A. Process Controller I/O Schedule.

END OF SECTION 406193

APPENDIX A
PROCESS CONTROLLER I/O SCHEDULE

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SECTION 406196 - PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.2 SUMMARY

A. Applications Engineer System Supplier (AESS) Programming Scope

1. Develop the control system applications to implement the process control descriptions for all new and existing systems. This Section is provided to define control strategies to be used for PLC programming of the system.
2. The Contract Documents are a single integrated document, and as such, all Drawings, Specifications Divisions and Specifications Sections apply. It is the responsibility of the Contractor and Subcontractors to review all Sections to ensure a complete and coordinated project.
3. The PCSS is cautioned to read this Section and all related Sections and their entirety prior to starting any programming. Many general control strategies and requirements are defined once in the body of this Section with the specific requirement called out in the individual control strategy. Implement these general strategies throughout this Contract unless specifically directed otherwise in the individual loop process control descriptions.
4. Follow loop and device tagging criteria shown on the Drawings without exception.
5. SCADA HMI configuration, database, and screen additions for the new process systems and modification of the existing SCADA system based on the PLC transition from MOSCAD RTU to DC-PLC and UV system PLC replacement.
6. Establish programming approach and database/variable identification standards prior to performing any programming work. Review the proposed standards and conventions with the Owner during the coordination workshop required by Section 406863 “Configuration of HMI Software.”

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121.20 “Process Control System Testing”.
3. Section 406126 “Process Control System Training”.
4. Section 406263 “Operator Interface Terminal”.
5. Section 406343 “Programmable Logic Controller”.
6. Section 406866 “Configuration of Controller Software”.
7. Section 407000 “Instrumentation for Process Systems”.

C. This specification section is a performance-based document, and it defines the minimum requirements. The PCSS shall furnish a fully integrated and operational system. Auxiliary and accessory programming structures necessary for proper system operation, performance, and failure contingency, for all new I/O, shall be included whether or not they are shown or described in the Contract Documents.

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Human Machine Interface (HMI): A software-based user interface with supervisory level control of machine level equipment.

C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

D. Operator Interface Terminal (OIT): A hardware component of the SCADA system used for device level control and monitoring.

E. Operator Workstation (OWS): A hardware component of the SCADA system used for supervisory level control and monitoring.

F. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

G. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

H. Supervisor Control and Data Acquisition (SCADA): Hardware and software components used for high-level supervisory monitoring of industrial processes. Typical devices that are part of the SCADA network include computers (OWS), PLCs, Ethernet switches, OITs, and HMIs.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Control System Hierarchy:

1. The control descriptions are broken into a hierarchical layer concept. There may be one layer or multiple layers per loop, depending upon that loop. An example of multiple layered loop is shown in Figure 1.

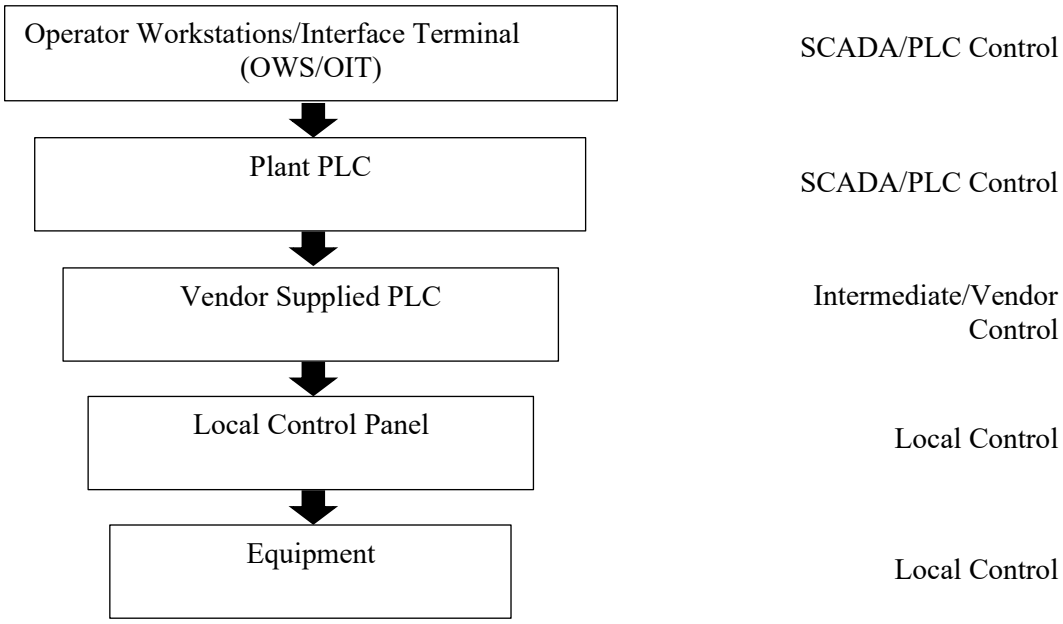

Figure 1. Control System Hierarchy

As shown in Figure 1, the lowest layer of control, local control, is at that piece of equipment or that piece of equipment's panel or drive. The second layer of control is at an intermediate control panel between the equipment and the SCADA I/O or vendor's PLC I/O. The third layer would be at the vendor's PLC or microprocessor touchscreen station. The highest layer of control is by the SCADA PLC System with its associated operator workstations (OWS) in the main control room, remote office locations, and satellite locations operator interface terminals (OITs). The SCADA PLC/ OWS refers to both the SCADA PLC, which does the actual monitoring and control logic for the process equipment and the SCADA operator workstation (OWS), which are computers that have graphical software that interface to the PLC software for monitoring and implementing all operator-required tasks to control that process equipment. Any functions done in the operator workstations also take place at all the SCADA OITs.

B. Loop Numbering:

1. The following is a list of areas and the loop numbers associated with each area for Dove Springs WWTP:

2

Filtrate Lift Station (DS-IA-1), Electrical House, and Generator	1000-1099
Package Plant Influent and Slide Gate (DS-IB-1)	1100-1199
Treatment Structure No. 1 and 2 (DS-IC-1 and DS-IC-2)	1200-1299
Aeration Blowers (DS-ID-1, DS-ID-2, DS-IB-1, DS-IB-2) and Generator	1300-1399
Package Plant Clarifier, Sludge Transfer Pumps, and Circuit Breaker	1400-1499

3.2 GENERAL CONTROLS AND MONITORING

A. Overview:

1. The hardware and/or software functions noted by this paragraph reference are to be implemented in the PLC control system.
2. Setpoints, as defined by this section, refer to numerical values adjustable from the HMI.
3. The PLC is responsible for resetting command bits sent from the HMI to the PLC. If the commanded state cannot be achieved for any reason, the PLC resets the bit to allow the operator to set the command bit again. For example, when pressing the AUTO button on the HMI, the PLC resets the AUTO command from the HMI after the device is in the AUTO Mode. If the AUTO Mode is not available for any reason, the PLC resets the bit, so the AUTO button can be selected at the HMI once AUTO control is available.

B. Interlocks:

1. Hardwired interlocks will interlock the controls locally, at the vendor PLC, and at the plant PLC. If the interlock occurs, the shutdown will cause the equipment to be inoperable at all levels of control.
2. Software interlocks are represented in a particular layer of the operation description and interlock the controls in that layer and the layers above it. However, the interlock does not interlock the commands in the layer before it. For example, a software interlock implemented at the SCADA/PLC level will not stop equipment from being controlled locally.
3. Interlocks that shutdown (stop a piece of equipment and prevent it from being restarted or moved) are displayed on the faceplate pop-up graphic for that piece of equipment.

C. Motors:

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.
3. Motors can be started manually by the operator at the HMI, or automatically by the control strategy.
4. Automatic control strategies are defined in individual loop descriptions.
5. The SCADA system stops a motor or drive, if it does not receive the AUTO or REMOTE status or one of its software interlocks trips. If the drive or motor is in HAND or LOCAL, it will continue to run but the SCADA start/stop output will be open.
6. If a motor stops for any reason, it cannot be restarted automatically once the problem with the motor has been resolved. A manual reset from the OWS or OIT is required to resume operation.
7. Motors that have a HAND-OFF-AUTO (HOA) selector, indicate to the operator that the pump is being run in the HAND position. A motor is being run in HAND when the AUTO position is not true and the run confirm status is true. If not in AUTO, the SCADA PLC output contact will open and stop (shutdown) the pump.

D. Valves:

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.
3. Valves with only full travel capability can be opened or closed manually by the operator at the HMI, or automatically by the control strategy.
4. Modulating valves with position feedback can be positioned between 0% and 100% open manually by the operator at the HMI, or automatically by the control strategy.
5. Automatic control strategies are defined in individual loop descriptions with their corresponding process variable used for control.

E. Analog Instruments:

1. Analog instruments refer to indicating devices capable of providing a continuous output relative to time.
2. Provide monitoring of the analog signals shown on the P&IDs.
3. Analog signals may be a continuous voltage (-10V to 10V, 0V to 5V, 0V to 10V) or current (0 mA to 20mA, 4mA to 20mA) as determined by the output of the field instrument. The output range corresponds to the minimum and maximum full-scale measurement.
4. The PLC will linearly scale the output range (voltage or current) to the equivalent values in engineering units.
5. Provide cutoff deadbands for when the analog signal is approaching the minimum or maximum full-scale measurement.

    a. An analog signal measuring less than or equal to 2 percent of full-scale will be forced to zero after an adjustable time delay.
    b. An analog signal measuring greater than 100 percent of full-scale will be clamped at 100 percent.

6. Provide a CALIBRATION mode with an adjustable time setpoint (in hours).

    a. When entering CALIBRATION mode, the last good value is held prior to CALIBRATION mode being activated. The value is held until the calibration time setpoint expires.
    b. The Operator may enter a calibration value, which will be the value held until the calibration time setpoint expires.
    c. When active, clearly indicate the instrument is in CALIBRATION mode on any local OITs and in the HMI system.

F. Discrete Instruments:

1. Discrete instruments refer to indicating devices with any number of non-continuous defined states (e.g., ON/OFF, 0 or 1)
2. Provide monitoring of the discrete signals shown on the P&IDs.

    a. When a contact or status from the instrument is true, the PLC will receive power to its input channel. The PLC registers this as a binary bit of 1.
    b. When a contact or status from the instrument is false, the PLC will receive no power (open circuit) to its input channel. The PLC registers this as a binary bit of 0.

G. PLC Hardware:

1. Monitor status and communication faults at the HMI.

    a. Implement watchdog timers to monitor CPU and I/O module health, and execution time for PLC routines.
    b. Generate an alarm at the HMI if any watchdog timer expires.

2. Program the system time for all PLCs to synchronize with a Network Time Protocol (NTP) server once every 24 hours.

H. Input Validation:

1. Provide input validation for setpoints used in process control (e.g., chemical dosage setpoints, pump flow setpoints).
2. The PLC will verify that the HMI setpoint is within an acceptable predefined range.
3. Out of range values will be rejected by the PLC and the current value will be retained.

3.3 HISTORICAL DATA COLLECTION

A. Provide historical data collection for all analog inputs, process control setpoints, flow totals, equipment runtimes, and discrete equipment statuses (ON/OFF), unless otherwise stated in the individual loop descriptions. Historical data collection is as follows:

Collection Options	
Collection Type:	Polled
Collection Interval:	1 minute
Collection Offset:	0 seconds
Time Resolution:	Milliseconds
Compression:	Enabled
Collector Deadband:	0.5 Percent Range
Collector Compression Timeout:	15 minutes

3.4 ACCUMULATORS AND TOTALIZERS

A. Accumulators:

1. Display accumulated run time for all equipment with a RUNNING status. Each run time accumulation is resettable from the HMI with a reset push button.
2. The PLC will update the flow totals at 12:00 a.m. local time.

Runtime	Display Format
Current Day:	XX.XX Hrs.
Yesterday:	XX.XX Hrs.
Current Month:	XXX.X Hrs.
Previous Month:	XXX.X Hrs.
Accumulated Total:	XXXXXX Hrs.

B. Flow Totalizers:

1. Totalize all flow indications.

   a. If the flowmeter provided has a configurable pulse output for totalized flow, perform flow totalization using the pulse output. The PLC calculates totalized flow by multiplying the number of pulses by the volume per pulse.
   b. If the flowmeter provided does not have a configurable pulse output for totalized flow, perform flow totalization using the analog 4-20mA signal.

      1) Do not totalize if the analog signal is outside the 4-20 mA range.
      2) Do not totalize if the value of the flow input is less than 2% of the full range of the input.

3) Do not totalize if a discrete status exists that can be used to determine if flow is present (for example, no flow can be present unless a pump is running).

2. Each flow totalization is resettable from the HMI/OIT with a reset push button.
3. Display totalized flow in million gallons (MG), thousands of gallons (kGal), or Gallons (Gal) in accordance with the following:

Totalizer	MG Format	kGal Format	Gal Format
Current Day:	X.XXX	XXX.XX	XXXX.X
Yesterday:	X.XXX	XXX.XX	XXXX.X
Current Month:	XXX.X	XXX.X	XXXX
Previous Month:	XXX.X	XXX.X	XXXX
Accumulated Total:	XXXX	XXXX	XXXX

4. Use appropriate flow totalizer units for the total volume anticipated for the time period. Unless requested by the Owner, water process flows are totalized in million gallons (MG) and chemical flows are totalized in gallons (Gal). Auxiliary flow (e.g., backwash) units are determined based on the total flow for the day.
5. Chemical systems which do not have flowmeters will calculate usage based on the chemical tank volume. The PLC will calculate tank volume based on the measured level and the vessel geometry or the measured weight and the specific weight of the chemical.
6. The PLC will update the flow totals at 12:00 a.m. local time.

3.5 ALARMING AND EQUIPMENT FAILURES

A. Analog Alarms:

1. Provide analog alarming capability for all analog signals monitored by the PLC.
2. Supervisor level users can set a common time setpoint (initially set to 5 seconds) that is used to generate alarms. The following alarms (setpoints to be Supervisor adjustable) are generated based on the analog feedback value. Each alarm includes the ability for individual enabling and disabling.

   a. High-High.
   b. High.
   c. Low.
   d. Low-Low.
   e. Loss of Signal.

3. LOSS OF SIGNAL alarm is generated when an analog signal goes outside the 4-20 mA range due to a failure at the instrument or PLC card. The following SCADA programming occurs:

   a. If the analog signal is used in a control loop or ratio control loop, that loop is placed into MANUAL.
   b. If the analog signal is used in a calculation, that calculation uses the last good analog signal. If the calculation is used in a control loop, that loop is placed into MANUAL.

4. SETPOINT REJECTED alarm is generated at the HMI when an analog setpoint is out of range and rejected by the PLC.

B. Discrete Alarms:

1. Program all discrete alarm signals wired to the PLC (float switches, pressure switches, overload alarms) to alarm after an HMI adjustable time delay expires.
2. The maximum alarm delay for Safety related alarms (e.g., E-stop) is 500ms. Set each alarm timer during startup.

C. Motor Failure Alarms:

1. Supervisor level users can set a common elapsed time setpoint for each scenario below:

a. Motors being remotely controlled generate a FAIL-TO-START alarm when the PLC sends the START command to the motor and it does not receive a RUNNING status from the motor after a supervisor adjustable time setpoint. When a FAIL-TO-START alarm is generated, the START output command from the PLC is deenergized and the motor is prevented from starting until a reset is issued from the HMI.
b. Motors being remotely controlled generate a FAIL-TO-STOP alarm when the PLC sends the STOP command to the motor and it continues to run after a supervisor adjustable time setpoint.
c. Motors with adjustable speed control generate a SPEED DEVIATION alarm when the motor is running and the PLC sends a speed setpoint to the motor and it does not reach the correct speed (within a deadband, initially set to 10%) within a supervisor adjustable time setpoint. The motor remains running if the SPEED DEVIATION alarm is activated.

D. Valve Failures:

1. Supervisor level users can set a common time setpoint that is used to generate the following alarms. When a valve position alarm is active, the PLC output is maintained unless explicitly stated in the individual loop descriptions (e.g., a fail to open alarm does not trigger the PLC to close the valve).

a. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-OPEN alarm when the PLC sends the OPEN command to the valve and it does not reach the OPENED limit within a supervisor adjustable time setpoint.
b. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-CLOSE alarm when the PLC sends the CLOSE command to the valve and it does not reach the CLOSED limit within a supervisor adjustable time setpoint.
c. All modulating valves (POSITIONING) being remotely controlled generate a FAIL-TO-POSITION alarm when the valve feedback does not match the PLC commanded position within a supervisor adjustable time setpoint.

3.6 AUTOMATIC CONTROLS

A. Lead/Lag and Duty/Standby Strategy:

1. Pump Priority:

a. When pumps are called to operate by the automatic sequence, the order of their priority is determined by the following mode selection.
   1) Operator Mode: The operator manually selects the priority of each pump (LEAD/LAG/STANDBY/OFFLINE) using radio buttons on a popup display. The order can be changed at any time, but no two pumps can be selected to have the same priority. The pump cannot run in automatic mode or be used in any of the following automatic sequences if placed OFFLINE.
   2) Alternation Mode: Used for pumps operating in a DUTY/STANDBY configuration. The pump priorities are rotated each time the DUTY pump is stopped by the control strategy.
   3) Sequential Mode: Used for groups of three or more pumps (e.g., LEAD/LAG/STANDBY). The pumps are inserted into the sequence in ascending numerical order and the PLC rotates the pumps using a revolving queue. After an adjustable time setpoint expires, the LEAD pump becomes the STANDBY and the previous LAG pump becoming the new LEAD.

2. Automatic Operation:

   a. If the individual loop description requires that the pumps operate in the LEAD/LAG/STANDBY mode, the LAG is called to start when the following conditions are met after a time delay. If more than one LAG pump is included in the strategy (LEAD/LAG1/LAG2/STANDBY), the sequence repeats.

      1) The LEAD pump is running at maximum speed for an adjustable length of time.
      2) The process variable being controlled is more than 5% from the target value. For example, in flow control, the flow must be 5% below the target.

   b. If multiple pumps are called to run by the automatic logic, the pumps will run at the same speed.
   c. If the automatic strategy determines that a pump is needed and the pump for the required sequence position is unavailable, the pump with the next highest position immediately starts.
   d. If the individual loop description requires the pumps to operate in the DUTY/STANDBY mode, the STANDBY pump only starts if the DUTY pump is not available to run when called to start by the automatic strategy.

B. PID Control:

1. When individual control loops require PID control, use the PLC manufacturer's standard PID control functions. Provide a PID faceplate with the following parameters:

   a. Setpoint (SP): Reference to the setpoint. This is the setpoint entered (either manually from the HMI or via program logic, as required by the individual loop description) and is maintained by the PID controller.
   b. Process Variable (PV): Reference to the process variable. The process variable is the feedback from a field device or instrument for comparison to the SP by the PID controller.
   c. Output (CV): Reference to the controlled variable. This is the signal varied by the PID controller in order to maintain the PV at the desired SP.

2. PID controller accepts inputs for proportional (P), integral (I), and derivative (D) setpoints used to tune the controller response. PID tuning parameters can be entered manually by the Operator at the HMI or calculated automatically if the PID controller supports autotuning functionality.
3. Operator can place the PID controller in MANUAL or AUTOMATIC mode.

    a. In MANUAL, the Operator will enter the desired output (CV). The PID controller will use setpoint tracking to write the process variable (PV) to the controller setpoint (SP) to ensure bumpless transfer when the controller is switched from MANUAL to AUTO.
    b. In AUTO, the PID controller adjusts the output (CV) to hold the process variable (PV) at the setpoint (SP).

4. Configure PID controller to prevent reset windup when operating in MANUAL mode or when the output (CV) has reached maximum limit.

C. Chemical Flow Pacing:

1. Provide the following control for individual loops referencing automatic flow pacing.
2. The individual loop description defines the process flow meter used for flow pacing.
3. Control the speed of the chemical feed pump proportionally to the flow rate. An adjustable DOSAGE SETPOINT (mg/L) and CHEMICAL WEIGHT (lb/gal) are entered from the HMI. The feed rate calculation is based on the following equation (**Eq.1**):

$FR = Chemical\ Feed\ Rate\ \left(\frac{Gal}{hr}\right)$[Calculated in **Eq. 1**]
$Dose = Dosage\ Setpoint\ \left(\frac{mg}{L}\right)$ [Operator Adjustable Setpoint from HMI]
$Flow = Process\ Flow\ Rate(MGD)$ [Feedback from flow meter defined in individual loop description]
$Weight = Chemical\ Weight\ \left(\frac{lb}{gal}\right)$ [Operator Adjustable Setpoint from HMI]

Eq. 1

$$FR = Dose * Flow * \frac{8.34}{24 * Weight}$$

An HMI adjustable setpoint allows the operator to enter the PUMP CAPACITY (gal/hr). The PUMP SPEED OUTPUT is calculated as follows (**Eq. 2**):

$OP = Pump\ Speed\ Output$ (%) [Calculated in **Eq. 2**]
$FR = Chemical\ Feed\ Rate\ \left(\frac{Gal}{hr}\right)$ [Calculated in **Eq. 1**]
$PC = Pump\ Capacity\ \left(\frac{gal}{hr}\right)$ [Operator Adjustable Setpoint from HMI]
$PS = Pump\ Stroke$ (%) [Operator Adjustable Setpoint from HMI, initially set at 100%]

Eq. 2

$$OP = \frac{FR}{PC * \left(\frac{PS}{100}\right)} * 100\%$$

3.7 EXISTING PLC INFORMATION

A. Remove the existing MOSCAD RTU hardware components and transfer all the Input/output associated with the existing equipment/devices to the existing Data concentrator DC-PLC in accordance with the Specifications and Drawings. Re-create that logic in DC-PLC and re-map existing SCADA HMI tags as required. Refer below table for relevant signals based on existing panel drawings.

B. Install a new ControlLogix PLC in the space vacated due to removal of MOSCAD RTU for the new equipment/devices in accordance with the Specifications and Drawings.

Existing Tag Name	New Tag Name	Description	From	To	Status
140-01	CF-1200-1	Clarifier No. 1 Run	MOSCAD	DC-PLC	Transfer
140-01	CF-1200-1	Clarifier No. 1 Over Torque/ Common Alarm	MOSCAD	DC-PLC	Transfer
140-02	CF-1200-2	Clarifier No. 2 Run	MOSCAD	DC-PLC	Transfer
140-02	CF-1200-2	Clarifier No. 2 Over Torque/ Common Alarm	MOSCAD	DC-PLC	Transfer
200-01	-	Filtrate LS Pump No.1 Run	MOSCAD	-	Demo
200-01	-	Filtrate LS Pump No.1 Fail	MOSCAD	-	Demo
200-01	-	Filtrate LS Pump No.1 On/Off	MOSCAD	-	Demo
200-02	-	Filtrate LS Pump No.2 Run	MOSCAD	-	Demo
200-02	-	Filtrate LS Pump No.2 Fail	MOSCAD	-	Demo
200-02	-	Filtrate LS Pump No.2 On/Off	MOSCAD	-	Demo
200-02	-	Filtrate Ls High Level	MOSCAD	-	Demo
-	BLR-1330-1	Blower C-01 Run	MOSCAD	-	Demo
-	BLR-1330-1	Blower C-01 Fail	MOSCAD	-	Demo
-	BLR-1330-1	Blower C-01 On/Off	MOSCAD	-	Demo
-	BLR-1330-2	Blower C-02 Run	MOSCAD	-	Demo
-	BLR-1330-2	Blower C-02 Fail	MOSCAD	-	Demo
-	BLR-1330-2	Blower C-02 On/Off	MOSCAD	-	Demo
-	BLR-1330-3	Blower C-03 Run	MOSCAD	-	Demo
-	BLR-1330-3	Blower C-03 Fail	MOSCAD	-	Demo
-	BLR-1330-3	Blower C-03 On/Off	MOSCAD	-	Demo

Existing Tag Name	New Tag Name	Description	From	To	Status
-	-	Blower PD-01 Run	MOSCAD	-	Demo
-	-	Blower PD-01 Malfunction	MOSCAD	-	Demo
-	-	Blower PD-01 On/Off	MOSCAD	-	Demo
-	-	Blower PD-02 Run	MOSCAD	-	Demo
-	-	Blower PD-02 Malfunction	MOSCAD	-	Demo
AI-120-01	AIT-1200-1	Aeration Basin No. 1 Dissolved Oxygen	MOSCAD	DC-PLC	Transfer
AI-120-02	AIT-1200-2	Aeration Basin No. 2 Dissolved Oxygen	MOSCAD	DC-PLC	Transfer
FIR-180		Plant Effluent Flow	MOSCAD	DC-PLC	Transfer
LIT-300	-	Aeration Sludge Holding Tank No. 1 Level	MOSCAD	DC-PLC	Transfer
-	-	Chemical Tank level	MOSCAD		Demo
RL-010-02	-	Smith Branch LS Pump No. 2 Run	MOSCAD	DC-PLC	Transfer
YL-010-02	-	Smith Branch LS Pump No. 2 HOA Status	MOSCAD	DC-PLC	Transfer
XA-010-02	-	Smith Branch LS Pump No. 2 Common Alarm	MOSCAD	DC-PLC	Transfer
YL-020	-	Smith Branch LS Pump No. 1 VFD	MOSCAD	DC-PLC	Transfer
YL-020	-	Smith Branch LS Pump No. 1 VFD Mode	MOSCAD	DC-PLC	Transfer

3.8 INDIVIDUAL CONTROL DESCRIPTIONS AND CONTROL SEQUENCES

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2

LOOP 1005-1 DOVE SPRINGS – FILTRATE LIFT STATION LEVEL

PLC: DS-PLC
P&ID: DS-IA-1.

A. General:

1. The filtrate lift station shall be fitted with a Radar level transmitter (LE/LIT-1005-1) to provide continuous level measurement to SCADA. This level shall be utilized for filtrate pumps operation.

2. Upon failure of the PLC, the float switches shall take over the control locally at the MCC via relay logic.

3. Method of control via the SCADA HMI is that the pumps start and stop based on the wet well level (as indicated by the transmitter in the wet well).

B. Control:

1. Local:

None.

2. SCADA PLC/OWS:

The filtrate pumps shall be controlled based on the influent level value. The operator shall enter a level setpoint at the SCADA PLC/OWS.

C. Alarms/Monitoring:

1. Local:

Level indication (LI-1005-1)

2. SCADA PLC/OWS:

Level Indication (LI-1005-1)
Calculated Level High Alarm (LAH-1005-1)
Calculated Level High-High Alarm (LAHH-1005-1)
Calculated Level Low Alarm (LAL-1005-1)
Calculated Level Low-Low Alarm (LALL-1005-1)

LOOP 1001-1 DOVE SPRINGS – FILTRATE LIFT STATION LEVEL SWITCHES

PLC: DS-PLC
P&ID: DS-IA-1.

A. General:

1. Filtrate Lift station shall be fitted with four float switches intended to provide a backup means of pump control if LIT or PLC fails and installed at the following elevations:
   a. LSHH (LSHH-1001-1) installed at XX feet (refer mechanical drawings)
   b. LSH (LSH-1001-1) installed at XX feet (refer mechanical drawings)
   c. LSL (LSL-1001-1) installed at XX feet (refer mechanical drawings)
   d. LSLL (LSLL-1001-1) installed at XX feet (refer mechanical drawings)

B. Control:

1. Local:

   None.

2. SCADA PLC/OWS:

   a. In case of Level transmitter failure, the float switches (LSL & LSH) shall be utilized as a backup for filtrate pump operations from DS-PLC. These floats shall be only for alarming purpose at SCADA if the level transmitter healthy.

   b. Low Low-level switch interlocks to the motor starter to trip the influent pumps regardless of operation mode.

   c. Low level and High-Level switches also interlock to the motor starter. In case of PLC failure, these floats shall be utilized to operate the filtrate pumps at the MCC.

C. Alarms/Monitoring:

1. Local:

   None.

2. SCADA PLC/OWS:

   Level Low-Low Alarm (LALL-1001-1)
   Level Low Alarm (LAL-1001-1)
   Level High Alarm (LAH-1001-1)
   Level High-High Alarm (LAHH-1001-1)

LOOP 1001-X DOVE SPRINGS – FILTRATE PUMPS
PLC: DS-PLC
P&ID: DS-IA-1

A. General:

1. There are two filtrate pumps (PMP-1001-X). These pumps deliver raw influent from the lift station to the headworks. The influent pumps operate in Duty/Standby configuration and operate based on lift station level Transmitter (LIT-1005-1) along with float switches (LSH/LSL-1001-1) as a backup. The operator can select which pump is duty and which pump is standby at SCADA PLC/OWS or automatically alternated based on a Pumps Alternate Timer (Operator adjustable, 0-XX hours). X denotes the pump number 1/2.

B. Control:

Hardwired Interlocks:

- The high motor winding temperature (TSH-1001-X), leak detection (MSH-1001-X), E-STOP shall be wired to the motor starter. If any one of the switches is tripped, then the motor shall stop.

- A Low-Low cutoff level float (LSLL) will be set at elevation defined above and the mechanical drawings. The low-low alarm shall stop all operating pumps upon activation on falling level regardless of Hand or Auto operation.

- Low level (LSL) and High-Level (LSH) floats are also set at elevation defined above and the mechanical drawings. These floats interlock to the motor starter for pump operations at MCC. In case of PLC failure, these floats shall be utilized to operate the influent pumps at the MCC in Hand mode.

<u>Local Control Station:</u>

Local: When the Local/Off/Remote selector switch (HS) is in the "Local" position, the pump can be started or stopped through the pushbuttons.

Off: When the Local/Off/Remote selector switch (HS) is in the "Off" position, the pump cannot be operated from locally or remotely.

Remote: When the Local/Off/Remote selector switch (HS) is in the "Remote" position, pump control is transferred to the Motor starter at MCC.

<u>MCC:</u>

Hand: When the Hand/Off/Auto selector switch (HS) is in the "Hand" position, the pump can be started or stopped through the pushbuttons of the motor starter at MCC.

Off: When the Hand/Off/Auto selector switch (HS) is in the "Off" position, the pump cannot be operated from the locally or remotely.

Auto: When the Hand/Off/Auto selector switch (HS) is in the "Auto" position, pump control is transferred to the SCADA PLC/OWS.

SCADA PLC/OWS:

The operator shall enter Lift station filtrate pumps START LEVEL SETPOINT and STOP LEVEL SETPOINT based upon the Lift station level. These setpoints shall be common for all Filtrate Lift Station Pumps.

Software Interlock:

If the high motor winding temperature (TAH) or Leak (MAH) are detected at the SCADA PLC/OWS system, the pump shall stop.

If the Lift station low-low level (LALL) is detected at the SCADA PLC/OWS system, the running pump shall stop irrespective any operational modes.

On/Off Features:

Manual: The pump can be manually started or stopped (HSS) by the operator at the SCADA PLC/OWS.

Auto: Pump Control is primarily based on the wet well level transmitter (LIT) and secondarily on level floats (LSL/LSH). The float switches are only intended as backup to the Level transmitter(LIT) and all floats except the LSLL will not override the LIT.

The pumps shall operate in a Duty/Standby sequence. The operator shall enter the level setpoints for the Duty pump to start and stop.

The operator shall select which pump is Duty or standby when all pumps are placed in Auto or automatically alternated based on a Pumps Alternate Timer (Operator adjustable, 0-XX hours). Provide alteration sequence based on articles of section 3.6 “Automatic Controls,” “Duty/Standby Strategy”.

Duty: When the level in lift station rises above the START LEVEL SETPOINT for an adjustable amount of time, the Duty pump will be called to start. The pump will run until the level in the wet well drops below the STOP LEVEL SETPOINT, at which the pump will stop.

Standby: The standby pump shall automatically start when a duty pump fails and is not stopped by the operator.

Failover: When the pump is chosen as the standby pump, it shall automatically assume the duty role when original duty pump fails or is stopped by an interlock but is not stopped by the operator.

C. Alarms/Monitoring:

Local Control Station:

Filtrate Pump No. 1 Run Light (YRL-1001-1A)
Filtrate Pump No. 1 Fault Light (XL-1001-1A)
Filtrate Pump No. 2 Run Light (YRL-1001-2A)
Filtrate Pump No. 2 Fault Light (XL-1001-2A)

MS Control Panel:

Filtrate Pump No. 1 Run Light (YRL-1001-1B)
Filtrate Pump No. 1 Fault Light (XL-1001-1B)
Filtrate Pump No. 1 LCS Remote Light (YCL-1001-1A)
Filtrate Pump No. 1 Auto Light (YCL-1001-1B)
Filtrate Pump No. 2 Run Light (YRL-1001-2B)
Filtrate Pump No. 2 Fault Light (XL-1001-2B)
Filtrate Pump No. 2 LCS Remote Light (YCL-1001-2A)
Filtrate Pump No. 2 Auto Light (YCL-1001-2B)

SCADA PLC/OWS:

Filtrate Pump No. 1 In Auto Indication (YCI-1001-1A)
Filtrate Pump No. 1 Running Indication (YRI-1001-1)
Filtrate Pump No. 1 Fault Alarm (YFI-1001-1)
Filtrate Pump No. 1 Motor High Temperature Alarm (TAH-1001-1)
Filtrate Pump No. 1 Leak Alarm (MAH-1001-1)
Filtrate Pump No. 1 LCS In Remote Indication (YCI-1001-1B)
Filtrate Pump No. 1 Start/Stop Command (HSS-1001-1)
Filtrate Pump No. 2 In Auto Indication (YCI-1001-2A)
Filtrate Pump No. 2 Running Indication (YRI-1001-2)
Filtrate Pump No. 2 Fault Alarm (YFI-1001-2)
Filtrate Pump No. 2 Motor High Temperature Alarm (TAH-1001-2)
Filtrate Pump No. 2 Leak Alarm (MAH-1001-2)
Filtrate Pump No. 2 LCS In Remote Indication (YCI-1001-2B)
Filtrate Pump No. 2 Start/Stop Command (HSS-1001-2)

LOOP 1001-1 DOVE SPRINGS – ELECTRICAL HOUSE HIGH TEMPERATURE
PLC: DS-PLC
P&ID: DS-IA-1

General: The electrical house high temperature status is monitored by SCADA PLC/OWS.

Control:

Local:

None.

SCADA PLC/OWS:

None.

Alarms / Monitoring:

Local:

None.

SCADA PLC/OWS:

High Temperature (TAH-1001-1)

LOOP 1450-1 DOVE SPRINGS – MAIN CIRCUIT BREAKER OPENED STATUS
PLC: DS-PLC
P&ID: DS-IB-1

General: The MCC-3 main circuit breaker open status is monitored by SCADA PLC/OWS.

Control:

Local:

None.

SCADA PLC/OWS:

None.

Alarms / Monitoring:

Local:

None.

SCADA PLC/OWS:

Breaker Opened (XA-1450-1)

LOOP 1330-X DOVE SPRINGS – PACKAGE PLANT AERATION BASIN BLOWERS
PLC: DS-PLC
P&ID: DS-IB-1/DS-IB-2

A. General:

2

1. There are three aeration blowers (BLR-1330-X). These blowers supply low-pressure air to the package plant treatment units. X denotes the blower number 1/2/3.

2

2. Refer to section 431117 for additional PCSS scope to remove the package plant blower LCP and configure the relocation of existing blower LCP into the plant control system.

B. Control:

Hardwired Interlocks:

The motor DE and NDE temperatures (TIT) shall be wired to the vendor provided Local control panel and when the temperature high alarm shall trip the motor. The motor DE and NDE vibration transmitters (VIT) shall be wired to the vendor provided local control panel and if the vibration reaches the trip setpoint the motor shall stop. When the E-stop push button is pressed, the blower shall stop.

Local Control Panel (**Vendor PLC**):

Hand: When the Hand/Off/Auto selector switch (HS) is in the "Hand" position, the blower can be started or stopped through the pushbuttons or OIT at LCP.

Off: When the Hand/Off/Auto selector switch (HS) is in the "Off" position, the blower cannot be operated from the Vendor LCP or remotely.

Auto: When the Hand/Off/Auto selector switch (HS) is in the "Auto" position, blower control is transferred to the SCADA PLC.

2

Refer to Sections 431117 for any additional controls at vendor local control panel.

SCADA PLC/OWS:

On/Off Features at DS-PLC

Manual: The blower can be manually started or stopped (HSS) by the operator at the SCADA PLC/OWS.

Auto: At a time, two blowers will be in duty and one blower will be in standby mode. The operator shall select which blower is duty or standby when all the blowers are placed in Auto.

Duty: Two of the blowers shall start once placed on duty.

Standby: When the blower is chosen as the standby blower, it shall automatically start when one of the duty blower fails.

The operator shall select which blower is Duty or standby when all blowers are placed in Auto or automatically alternated based on a blowers Alternate Timer (Operator adjustable, 0-XX hours). Provide alteration sequence based on articles of section 3.6 "Automatic Controls," "Duty/Standby Strategy".

Refer to Sections 431117 for any additional controls.

C. Alarms/Monitoring:

Vendor Local Control Panel:

PP Aeration Blower No. 1 Run Light (YRL-1330-1D)
PP Aeration Blower No. 1 Fault Light (XL-1330-1E)
PP Aeration Blower No. 1 In Auto Light (YCL-1330-1B)
PP Aeration Blower No. 1 Current (II-1330-1)
PP Aeration Blower No. 2 Run Light (YRL-1330-2D)
PP Aeration Blower No. 2 Fault Light (XL-1330-2E)
PP Aeration Blower No. 2 In Auto Light (YCL-1330-2B)
PP Aeration Blower No. 2 Current Indication (II-1330-2)
PP Aeration Blower No. 3 Run Light (YRL-1330-3D)
PP Aeration Blower No. 3 Fault Light (XL-1330-3E)
PP Aeration Blower No. 3 In Auto Light (YCL-1330-3B)
PP Aeration Blower No. 3 Current Indication (II-1330-3)

SCADA PLC/OWS:

PP Aeration Blower No. 1 In Auto Indication (YCI-1330-1)
PP Aeration Blower No. 1 Running Indication (YRI-1330-1)
PP Aeration Blower No. 1 Fault Alarm (YFI-1330-1)
PP Aeration Blower No. 1 Start/Stop Command (HSS-1330-1)
PP Aeration Blower No. 1 Amps Indication (II-1330-1)
PP Aeration Blower No. 1 Motor DE Vibration Indication (VI-1330-1A)
PP Aeration Blower No. 1 Motor NDE Vibration Indication (VI-1330-1B)
PP Aeration Blower No. 1 Motor DE Temp Indication (TI-1330-1A)
PP Aeration Blower No. 1 Motor NDE Temp Indication (TI-1330-1B)
PP Aeration Blower No. 1 KWH Indication (JI-1330-1)
PP Aeration Blower No. 2 In Auto Indication (YCI-1330-2B)
PP Aeration Blower No. 2 Running Indication (YRI-1330-2)
PP Aeration Blower No. 2 Fault Alarm (YFI-1330-2)
PP Aeration Blower No. 2 Start/Stop Command (HSS-1330-2)
PP Aeration Blower No. 2 Amps Indication (II-1330-2)
PP Aeration Blower No. 2 Motor DE Vibration Indication (VI-1330-2A)
PP Aeration Blower No. 2 Motor NDE Vibration Indication (VI-1330-2B)
PP Aeration Blower No. 2 Motor DE Temp Indication (TI-1330-2A)
PP Aeration Blower No. 2 Motor NDE Temp Indication (TI-1330-2B)

PP Aeration Blower No. 2 KWH Indication (JI-1330-2)
PP Aeration Blower No. 3 In Auto Indication (YCI-1330-3B)
PP Aeration Blower No. 3 Running Indication (YRI-1330-3)
PP Aeration Blower No. 3 Fault Alarm (YFI-1330-3)
PP Aeration Blower No. 3 Start/Stop Command (HSS-1330-3)
PP Aeration Blower No. 3 Amps Indication (II-1330-3)
PP Aeration Blower No. 3 Motor DE Vibration Indication (VI-1330-3A)
PP Aeration Blower No. 3 Motor NDE Vibration Indication (VI-1330-3B)
PP Aeration Blower No. 3 Motor DE Temp Indication (TI-1330-3A)
PP Aeration Blower No. 3 Motor NDE Temp Indication (TI-1330-3B)

2

LOOP 1101-1 DOVE SPRINGS – PACKAGE PLANT INFLUENT SLIDE GATE
PLC: HWKS-PLC
P&ID: DS-IB-1

A. General:

2

1. The plant influent flow control slide gate (SG-1101-1) is used to control the package plant influent wastewater flow in relation to the online permanent treatment units. The operation of the modulating gate is either at the gate or on the SCADA PLC/OWS.

B. Control:

Local:

Hardwired Interlock:

None.

Local: When the Local/Off/Remote selector switch (HS) is in the "Local" position, the gate can be opened, stopped in mid-travel, or closed through the selector switch (HS). The Position of the valve can be varied through ZC at the actuator.

Off: When the Local/Off/Remote selector switch (HS) is in the "Off" position, the gate cannot be operated locally or remotely.

Remote: When the Local/Off/Remote selector switch (HS) is in the "Remote" position, gate control is transferred to the SCADA PLC/OWS.

SCADA PLC/OWS:

2

The operator shall enter the treatment unit FLOW SETPOINT (X mgd) and Package Plant MINIMUM TIME SETPOINT.

Software Interlock:

None

Open/Close Features

Manual: The gate can be manually set to any position (ZC) by the Operator using the feedback position (ZI) as a guide.

Auto: The influent flow control gate shall be opened with 40% of opening initially and continue to be opened during normal operation. When one of the treatment unit flows (FIT-1215-1 or FIT-1215-2) exceeds the FLOW SETPOINT, the influent flow control gate shall be 100% fully opened for 60 minutes.

After then influent slide gate shall be 40% opened for the MINIMUM TIME SETPOINT irrespective of the treatment unit flow.

Local:

Open Limit Switch Light (ZLO-1101-1)
Close Limit Switch Light (ZLC-1101-1)
Position Indication (ZI-1101-1)

SCADA PLC/OWS:

Open Limit Switch Indication (ZSO-1101-1)
Close Limit Switch Indication (ZSC-1101-1)
Fault Alarm (XA-1101-1)
In Remote Indication (YCI-1101-1)
Position Indication (ZI-1101-1)

LOOP 1102-1 DOVE SPRINGS – PACKAGE PLANT INFLUENT FLOW
PLC: DS-PLC
P&ID: DS-IB-1

A. General:

1. Continuous flow measurement of the package plant influent using a magnetic flow meter.

B. Control:

1. Local:

a. None.

2. SCADA PLC/OWS:

2

a. The flow measured (FIT-1102-1) is for operational knowledge and monitoring purposes so that operators may manually adjust the set points for gate operation.

C. Alarms/Monitoring:

1. Local:

   a. None.

2. SCADA PLC/OWS:

   Flow Indication (FI-1102-1)
   Calculated Flow High Alarm (FAH-1102-1)
   Calculated Flow High-High Alarm (FAHH-1102-1)
   Calculated Flow Low Alarm (FAL-1102-1)
   Calculated Flow Low-Low Alarm (FALL-1102-1)

LOOP 1450-1 DOVE SPRINGS – PACKAGE PLANT CLARIFIER DRIVE
PLC: DS-PLC
P&ID: DS-IB-1 & DS-IB-2

2

General: The clarifier drive (CF-1450-1) will be supplied by Package Plant Manufacturer under separate City solicitation.

Control:

Local:

None.

SCADA PLC/OWS:

None.

Alarms / Monitoring:

Local:

None.

SCADA PLC/OWS:

Packing Plant Clarifier Drive Over Torque Alarm (WAH-1450-1)
Packing Plant Clarifier Drive Running (YRI-1450-1)

LOOP 1401-1 DOVE SPRINGS – PACKAGE PLANT SLUDGE HOLDING BASIN LEVEL SWITCHES

PLC: DS-PLC
P&ID: DS-IB-1.

A. General:

1. Sludge holding basin shall be fitted with four float switches intended to provide pump control and installed at the following elevations:
    a. LSHH (LSHH-1401-1) installed at XX feet (refer mechanical drawing)
    b. LSH (LSH-1401-1) installed at XX feet (refer mechanical drawing)
    c. LSL (LSL-1401-1) installed at XX feet (refer mechanical drawing)
    d. LSLL (LSLL-1401-1) installed at XX feet (refer mechanical drawing)

B. Control:

1. Local:

None.

2. SCADA PLC/OWS:

a. The float switches (LSL & LSH) shall be utilized for transfer pump operations from DS-PLC.

b. Low Low-level switch interlocks to the motor starter to trip the influent pumps regardless of operation mode.

c. Low level and High-Level switches also interlock to the motor starter. In case of PLC failure, these floats shall be utilized to operate the filtrate pumps at the MCC.

C. Alarms/Monitoring:

1. Local:

None.

2. SCADA PLC/OWS:

Level High High Alarm (LAHH-1401-1)
Level High Alarm (LAH-1401-1)
Level Low Alarm (LAL-1401-1)
Level Low Low Alarm (LALL-1401-1)

LOOP 1401-1 DOVE SPRINGS – SLUDGE TRANSFER PUMP
PLC: DS-PLC
P&ID: DS-IB-1

A. General:

2

1. There is a transfer pump (PMP-1401-1). The pump deliver sludge from the package plant sludge holding basin to aerated sludge holding tank No. 2.

B. Control:

Hardwired Interlocks:

- The high motor winding temperature (TSH-1401-X), leak detection (MSH-1401-X), E-STOP shall be wired to the motor starter. If any one of the switches is tripped, then the motor shall stop.
- A Low-Low cutoff level float (LSL) will be set at elevation defined above and the mechanical drawings. The low alarm shall stop all operating pumps upon activation on falling level regardless of Hand or Auto operation.

Local Control Station:

Local: When the Local/Off/Remote selector switch (HS) is in the "Local" position, the pump can be started or stopped through the pushbuttons.

Off: When the Local/Off/Remote selector switch (HS) is in the "Off" position, the pump cannot be operated from locally or remotely.

Remote: When the Local/Off/Remote selector switch (HS) is in the "Remote" position, pump control is transferred to the Motor starter at MCC.

MCC:

Hand: When the Hand/Off/Auto selector switch (HS) is in the "Hand" position, the pump can be started or stopped through the pushbuttons of the motor starter at MCC.

Off: When the Hand/Off/Auto selector switch (HS) is in the "Off" position, the pump cannot be operated from the locally or remotely.

Auto: When the Hand/Off/Auto selector switch (HS) is in the "Auto" position, pump control is transferred to the SCADA PLC/OWS.

SCADA PLC/OWS:

Software Interlock:

If the high motor winding temperature (TAH) or Leak (MAH) are detected at the SCADA PLC/OWS system, the pump shall stop.

If the low low level alarm (LAL) is detected at the SCADA PLC/OWS, the pumps shall stop regardless of Hand or Auto operation.

On/Off Features:

Manual: The pump can be manually started or stopped (HSS) by the operator at the SCADA PLC/OWS.

Auto: None

C. Alarms/Monitoring:

Local Control Station:

PP Sludge Transfer Pump Run Light (YRL-1401-1A)
PP Sludge Transfer Pump Fault Light (XL-1401-1A)

MS Control Panel:

PP Sludge Transfer Pump Run Light (YRL-1401-1B)
PP Sludge Transfer Pump Fault Light (XL-1401-1B)
PP Sludge Transfer Pump LCS Remote Light (YCL-1401-1A)
PP Sludge Transfer Pump Auto Light (YCL-1401-1B)

SCADA PLC/OWS:

PP Sludge Transfer Pump In Auto Indication (YCI-1401-1A)
PP Sludge Transfer Pump Running Indication (YRI-1401-1)
PP Sludge Transfer Pump Fault Alarm (YFI-1401-1)
PP Sludge Transfer Pump Motor High Temperature Alarm (TAH-1401-1)
PP Sludge Transfer Pump Leak Alarm (MAH-1401-1)
PP Sludge Transfer Pump LCS In Remote Indication (YCI-1401-1B)
PP Sludge Transfer Pump Start/Stop Command (HSS-1401-1)

LOOP 1300-1 DOVE SPRINGS – 350KW PACKAGE PLANT GENERATOR
PLC: DS-PLC
P&ID: DS-IB-1

General: The Package plant shall be equipped with a new generator and monitored by SCADA PLC/OWS.

Control:

Local:

None.

SCADA PLC/OWS:

None.

Alarms / Monitoring:

Local:

None.

SCADA PLC/OWS:

Generator Ready (YCI-1300-1)
Generator Running (YRI-1300-1)
Generator Fault (YFI-1300-1)
Generator Fuel Low level (LAL-1300-1)

LOOP 1000-1 DOVE SPRINGS – 750KW WWTP GENERATOR
PLC: DS-PLC
P&ID: DS-ID-1

General: The treatment plant shall be equipped with a new generator and monitored by SCADA PLC/OWS.

Control:

Local:

None.

SCADA PLC/OWS:

None.

Alarms / Monitoring:

Local:

None.

SCADA PLC/OWS:

Generator Ready (YCI-1000-1)
Generator Running (YRI-1000-1)
Generator Fault (YFI-1000-1)
Generator Fuel Low level (LAL-1000-1)

LOOP 1200-X DOVE SPRINGS – TREATMENT STRUCTURE CLARIFIER DRIVE
PLC: DC-PLC(Existing)
P&ID: DS-IC-1 & DS-IC-2

General: There are two existing clarifier drives (CF-1200-X). X denotes the clarifier drives 1/2.

Control:

Local:

None.

SCADA PLC/OWS:

None.

Alarms / Monitoring:

Local:

None.

SCADA PLC/OWS:

Treatment Structure No. 1 Clarifier Drive Over Torque Alarm (WAH-1200-1)
Treatment Structure No. 1 Clarifier Drive Running (YRI-1200-1)
Treatment Structure No. 2 Clarifier Drive Over Torque Alarm (WAH-1200-2)
Treatment Structure No. 2 Clarifier Drive Running (YRI-1200-2)

LOOP 1250-1 DOVE SPRINGS – TREATMENT STRUCTURE INFLUENT FLOW
PLC: HWKS-PLC(Existing)
P&ID: DS-IC-1 & DS-IC-2

A. General:

1. Continuous flow measurement of the Treatment Structure 1 plant influent using a magnetic flow meter. There are two existing flow meters (FIT-1215-X). X denotes the flow meters 1/2.

B. Control:

1. Local:

a. None.

2. SCADA PLC/OWS:

a. None.

C. Alarms/Monitoring:

1. Local:

a. None.

2. SCADA PLC/OWS:

Flow Indication (FI-1215-X)
Calculated Flow High Alarm (FAH-1215-X)
Calculated Flow High-High Alarm (FAHH-1215-X)
Calculated Flow Low Alarm (FAL-1215-X)
Calculated Flow Low-Low Alarm (FALL-1215-X)

LOOP 1216-1 DOVE SPRINGS – TREATMENT STRUCTURE AMMONIA
PLC: HWKS-PLC(Existing)
P&ID: DS-IC-1

A. General:

2

1. The headworks is equipped with an existing Ammonia Analyzer and shall be monitored by SCADA PLC/OWS under this contract.

B. Control:

1. Local:

a. None.

2. SCADA PLC/OWS:

a. None.

C. Alarms/Monitoring:

1. Local:

a. None.

2. SCADA PLC/OWS:

Ammonia Indication (AI-1216-1)
Calculated Ammonia High Alarm (AAH-1216-1)
Calculated Ammonia High-High Alarm (AAHH-1216-1)
Calculated Ammonia Low Alarm (AAL-1216-1)
Calculated Ammonia Low-Low Alarm (AALL-1216-1)

LOOP 1200-X DOVE SPRINGS – TREATMENT UNITS DISSOLVED OXYGEN
PLC: DC-PLC

P&ID: DS-IC-1 & DS-IC-2

A. General:

1. Continuous dissolved oxygen measurement of the treatment units are done through dissolved oxygen analyzer (AIT-1200-X) in each unit. X denotes the treatment units 1/2.

B. Control:

1. Local:

a. None.

2. SCADA PLC/OWS:

a. None.

C. Alarms/Monitoring:

1. Local:

a. Dissolved Oxygen Indication (AIT-1200-X)

2. SCADA PLC/OWS:

Dissolved Oxygen Indication (AI-1200-X)
Calculated Dissolved Oxygen High Alarm (AAH-1200-X)
Calculated Dissolved Oxygen High-High Alarm (AAHH-1200-X)
Calculated Dissolved Oxygen Low Alarm (AAL-1200-X)
Calculated Dissolved Oxygen Low-Low Alarm (AALL-1200-X)

LOOP 1310-X DOVE SPRINGS – TREATMENT UNIT NO. 1 AERATION BLOWERS
PLC: DS-PLC
P&ID: DS-ID-1

A. General:

1. There are two aeration blowers (BLR-1310-X). These blowers supply low-pressure air to the Treatment unit No. 1. X denotes the blower number 1/2.

B. Control:

Hardwired Interlocks:

The motor DE and NDE temperatures (TIT) shall be wired to the vendor provided Local control panel and when the temperature high alarm shall trip the motor. The motor DE and NDE vibration transmitters (VIT) shall be wired to the vendor provided local control panel and if the vibration reaches the trip setpoint the motor shall stop. When the E-stop push button is pressed, the blower shall stop.

MS Control Panel:

Local: When the Local/Off/Remote selector switch (HS) is in the "Local" position, the blower can be started or stopped through the pushbuttons.

Off: When the Local/Off/Remote selector switch (HS) is in the "Off" position, the blower cannot be operated from the MS panel, Vendor LCP or remotely.

Remote: When the Local/Off/Remote selector switch (HS) is in the "Remote" position, blower control is transferred to the Vendor LCP.

Local Control Panel (**Vendor PLC**):

Hand: When the Hand/Off/Auto selector switch (HS) is in the "Hand" position, the blower can be started or stopped through the pushbuttons or OIT at LCP.

Off: When the Hand/Off/Auto selector switch (HS) is in the "Off" position, the blower cannot be operated from the Vendor LCP or remotely.

Auto: When the Hand/Off/Auto selector switch (HS) is in the "Auto" position, blower control is transferred to the SCADA PLC.

Refer to Sections 431118 for any additional controls at vendor local control panel.

SCADA PLC/OWS:

On/Off Features at DS-PLC

Manual: The blower can be manually started or stopped (HSS) by the operator at the SCADA PLC/OWS.

Auto: The operator shall select which blower is duty or standby when both blowers are placed in Auto.

Duty: The blower shall start once placed on duty.

Standby: When the blower is chosen as the standby blower, it shall automatically start when the duty blower, fails.

The operator shall select which blower is Duty or standby when all blowers are placed in Auto or automatically alternated based on a blowers Alternate Timer (Operator adjustable, 0-XX hours). Provide alteration sequence based on articles of section 3.6 "Automatic Controls," "Duty/Standby Strategy".

Refer to Sections 431118 for any additional controls.

C. Alarms/Monitoring:

MS Control Panel:

Aeration Blower No. 1 Run Light (YRL-1310-1A)
Aeration Blower No. 1 Fault Light (XL-1310-1B)
Aeration Blower No. 2 Run Light (YRL-1310-2A)
Aeration Blower No. 2 Fault Light (XL-1310-2B)

Vendor Local Control Panel:

Aeration Blower No. 1 Run Light (YRL-1310-1D)
Aeration Blower No. 1 Fault Light (XL-1310-1E)
Aeration Blower No. 1 In Auto Light (YCL-1310-1B)
Aeration Blower No. 2 Run Light (YRL-1310-2D)
Aeration Blower No. 2 Fault Light (XL-1310-2E)
Aeration Blower No. 2 In Auto Light (YCL-1310-2B)

SCADA PLC/OWS:

Aeration Blower No. 1 In Auto Indication (YCI-1310-1)
Aeration Blower No. 1 Running Indication (YRI-1310-1)
Aeration Blower No. 1 Fault Alarm (YFI-1310-1)
Aeration Blower No. 1 Motor High Temperature Alarm (TAH-1310-1)
Aeration Blower No. 1 Start/Stop Command (HSS-1310-1)
Aeration Blower No. 1 Amps Indication (II-1310-1)
Aeration Blower No. 1 Inlet Bearing Vibration Indication (VI-1310-1A)
Aeration Blower No. 1 Outlet Bearing Vibration Indication (VI-1310-1B)
Aeration Blower No. 1 KWH Indication (JI-1310-1)
Aeration Blower No. 2 In Auto Indication (YCI-1310-2B)
Aeration Blower No. 2 Running Indication (YRI-1310-2)

Aeration Blower No. 2 Fault Alarm (YFI-1310-2)
Aeration Blower No. 2 Motor High Temperature Alarm (TAH-1310-2)
Aeration Blower No. 2 Start/Stop Command (HSS-1310-2)
Aeration Blower No. 2 Amps Indication (II-1310-2)
Aeration Blower No. 2 Inlet Bearing Vibration Indication (VI-1310-2A)
Aeration Blower No. 2 Outlet Bearing Vibration Indication (VI-1310-2B)
Aeration Blower No. 2 KWH Indication (JI-1310-2)

LOOP 1311-1 DOVE SPRINGS – TREATMENT UNIT NO. 1 AERATION BLOWERS DISCHARGE PRESSURE
PLC: DS-PLC
P&ID: DS-ID-1

A. General:

1. The aeration blowers discharge pressure is monitored and displayed on SCADA.

B. Control:

1. Local:

a. None.

2. SCADA PLC/OWS:

a. None.

C. Alarms/Monitoring:

1. Local:

a. Pressure Indication (PI-1311-1)

2. SCADA PLC/OWS:

Pressure Indication (PI-1311-1)
Calculated Pressure High Alarm (PAH-1311-1)
Calculated Pressure High-High Alarm (PAHH-1311-1)
Calculated Pressure Low Alarm (PAL-1311-1)
Calculated Pressure Low-Low Alarm (PALL-1311-1)

LOOP 1310-X DOVE SPRINGS – TREATMENT UNIT NO. 2 AERATION BLOWERS
PLC: DS-PLC
P&ID: DS-ID-2

A. General:

1. There are two aeration blowers (BLR-1310-X). These blowers supply low-pressure air to the Treatment unit No. 2. X denotes the blower number 3/4.

B. Control:

Hardwired Interlocks:

The motor DE and NDE temperatures (TIT) shall be wired to the vendor provided Local control panel and when the temperature high alarm shall trip the motor. The motor DE and NDE vibration transmitters (VIT) shall be wired to the vendor provided local control panel and if the vibration reaches the trip setpoint the motor shall stop. When the E-stop push button is pressed, the blower shall stop.

MS Control Panel:

Local: When the Local/Off/Remote selector switch (HS) is in the "Local" position, the blower can be started or stopped through the pushbuttons.

Off: When the Local/Off/Remote selector switch (HS) is in the "Off" position, the blower cannot be operated from the MS panel, Vendor LCP or remotely.

Remote: When the Local/Off/Remote selector switch (HS) is in the "Remote" position, blower control is transferred to the Vendor LCP.

Local Control Panel (**Vendor PLC**):

Hand: When the Hand/Off/Auto selector switch (HS) is in the "Hand" position, the blower can be started or stopped through the pushbuttons or OIT at LCP.

Off: When the Hand/Off/Auto selector switch (HS) is in the "Off" position, the blower cannot be operated from the Vendor LCP or remotely.

Auto: When the Hand/Off/Auto selector switch (HS) is in the "Auto" position, blower control is transferred to the SCADA PLC.

Refer to Sections 431118 for any additional controls at vendor local control panel.

SCADA PLC/OWS:

On/Off Features at DS-PLC

Manual: The blower can be manually started or stopped (HSS) by the operator at the SCADA PLC/OWS.

Auto: The operator shall select which blower is duty or standby when both blowers are placed in Auto.

Duty: The blower shall start once placed on duty.

Standby: When the blower is chosen as the standby blower, it shall automatically start when the duty blower, fails.

The operator shall select which blower is Duty or standby when all blowers are placed in Auto or automatically alternated based on a blowers Alternate Timer (Operator adjustable, 0-XX hours). Provide alteration sequence based on articles of section 3.6 "Automatic Controls," "Duty/Standby Strategy".

Refer to Sections 431118 for any additional controls.

C. Alarms/Monitoring:

MS Control Panel:

Aeration Blower No. 3 Run Light (YRL-1310-3A)
Aeration Blower No. 3 Fault Light (XL-1310-3B)
Aeration Blower No. 4 Run Light (YRL-1310-4A)
Aeration Blower No. 4 Fault Light (XL-1310-4B)

Vendor Local Control Panel:

Aeration Blower No. 3 Run Light (YRL-1310-3D)
Aeration Blower No. 3 Fault Light (XL-1310-3E)
Aeration Blower No. 3 In Auto Light (YCL-1310-3B)
Aeration Blower No. 4 Run Light (YRL-1310-4D)
Aeration Blower No. 4 Fault Light (XL-1310-4E)
Aeration Blower No. 4 In Auto Light (YCL-1310-4B)

SCADA PLC/OWS:

Aeration Blower No. 3 In Auto Indication (YCI-1310-3)
Aeration Blower No. 3 Running Indication (YRI-1310-3)
Aeration Blower No. 3 Fault Alarm (YFI-1310-3)
Aeration Blower No. 3 Motor High Temperature Alarm (TAH-1310-3)
Aeration Blower No. 3 Start/Stop Command (HSS-1310-3)
Aeration Blower No. 3 Amps Indication (II-1310-3)
Aeration Blower No. 3 Inlet Bearing Vibration Indication (VI-1310-3A)
Aeration Blower No. 3 Outlet Bearing Vibration Indication (VI-1310-3B)
Aeration Blower No. 3 KWH Indication (JI-1310-3)

Aeration Blower No. 4 In Auto Indication (YCI-1310-4B)
Aeration Blower No. 4 Running Indication (YRI-1310-4)
Aeration Blower No. 4 Fault Alarm (YFI-1310-4)
Aeration Blower No. 4 Motor High Temperature Alarm (TAH-1310-4)
Aeration Blower No. 4 Start/Stop Command (HSS-1310-4)
Aeration Blower No. 4 Amps Indication (II-1310-4)
Aeration Blower No. 4 Inlet Bearing Vibration Indication (VI-1310-4A)
Aeration Blower No. 4 Outlet Bearing Vibration Indication (VI-1310-4B)
Aeration Blower No. 4 KWH Indication (JI-1310-4)

LOOP 1311-2 DOVE SPRINGS – TREATMENT UNIT NO. 2 AERATION BLOWERS DISCHARGE PRESSURE
PLC: DS-PLC
P&ID: DS-ID-2

A. General:

1. The aeration blowers discharge pressure is monitored and displayed on SCADA.

B. Control:

1. Local:

a. None.

2. SCADA PLC/OWS:

a. None.

C. Alarms/Monitoring:

1. Local:

a. Pressure Indication (PI-1311-2)

2. SCADA PLC/OWS:

Pressure Indication (PI-1311-2)
Calculated Pressure High Alarm (PAH-1311-2)
Calculated Pressure High-High Alarm (PAHH-1311-2)
Calculated Pressure Low Alarm (PAL-1311-2)
Calculated Pressure Low-Low Alarm (PALL-1311-2)

APPENDIX ONE: 750 kW WWTP GENERATOR STARTUP SEQUENCE

A. General

1. The estimated maximum running standby load is 750 kW.

2. A power monitor will continuously monitor the power load while the generator is in operation. If the combined load reaches 95% of the rated capacity, no further equipment will be started.

3. The Automatic Transfer Switch (ATS) will indicate if utility power is lost. On power loss, process equipment will be interlocked, and the generator will be called to START. When all generators are confirmed RUNNING, process equipment previously running in AUTO will be sequentially called to restart. Time delays between each step of the sequence will prevent generator overload.

B. Control

1. Each step of the sequence has an HMI adjustable step time setpoint (initially set to 20 seconds). The PLC will not proceed to the next step until the current steps' timer expires.

2

2. The automatic start-up sequence is as follows:
   a. Energize E-house Buildings (to ensure all PLCs and controls are functional before process equipment)
   b. UV System
   c. Treatment Unit Blowers
   d. NPW Pumps
   e. Headworks Fine Screen
   f. Clarifier Drives
   g. PD Blowers
   h. Filtrate Lift Station
   i. Belt Filter Press and Polymer System

   Alarms/Monitoring

3. The HMI will display START-UP FAULT alarm if any of the steps in the automatic start-up sequence are not confirmed complete before the step timer expires.

C. Data Collection:

1. None

APPENDIX TWO: 350 kW PACKAGE PLANT GENERATOR STARTUP SEQUENCE

A. General

1. The estimated maximum running standby load is 350 kW.

2. A power monitor will continuously monitor the power load while the generator is in operation. If the combined load reaches 95% of the rated capacity, no further equipment will be started.

3. The Automatic Transfer Switch (ATS) will indicate if utility power is lost. On power loss, process equipment will be interlocked, and the generator will be called to START. When all generators are confirmed RUNNING, process equipment previously running in AUTO will be sequentially called to restart. Time delays between each step of the sequence will prevent generator overload.

B. Control

1. Each step of the sequence has an HMI adjustable step time setpoint (initially set to 20 seconds). The PLC will not proceed to the next step until the current steps' timer expires.

2. The automatic start-up sequence is as follows:

a. Energize Package Plant (to ensure all PLCs and controls are functional before process equipment)

b. Aeration Blower 1

c. Clarifier drives

d. Sludge Transfer Pump

e. Aeration Blower 2

C. Alarms/Monitoring

1. The HMI will display START-UP FAULT alarm if any of the steps in the automatic start-up sequence are not confirmed complete before the step timer expires.

D. Data Collection:

1. None

END OF SECTION 406196

SECTION 406263 - OPERATOR INTERFACE TERMINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes operator interface terminals.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 406343 “Programmable Logic Controllers.”
4. Section 406863 “Configuration of HMI Software.”

1.3 DEFINITIONS

A. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Provide components compatible with functions required to form complete working system.

1.8 TECHNOLOGY OBSOLESCENCE MITIGATION

A. Due to rapidly evolving technology of specified equipment, the requirements specified are to establish a baseline for the type of equipment required. Provide current version of hardware and software of similar specification at the time of purchase equivalent in cost to that which is specified. Procedure for submitting and releasing the equipment is as follows:

1. PCSS to submit for approval the required data for the equipment as part of the Hardware Package Submittal.
2. Order equipment as late as possible dependent on the construction schedule to ensure the latest equipment available is provided. Just prior to ordering, resubmit for approval the required data of the latest available hardware and software equivalent in cost to that which is specified. Do not order equipment more than 6 months prior to when it is needed to be continuously used on the project.
3. Specific hardware in this Section that is that will adhere to this requirement are as follows:

    a. Operator Interface Terminal (OIT).

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of computers that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Provide next day on-site service covering parts and labor for one years from date of purchase. The on-site service is to be performed by an authorized representative of the manufacturer.

PART 2 - PRODUCTS

2.1 OPERATOR INTERFACE TERMINAL (OIT)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following without substitution nor equal:

a. Rockwell Automation Allen-Bradley – PanelView Plus 7 Performance series.

B. General:

1. OITs are standalone devices with an integrated hardware/software platform to monitor and control a process through an interactive display.

C. Features:

1. Software:

a. OITs pre-packaged with all configuration and programming software necessary to perform functions as shown on drawings and within the specifications.
b. Integrated OIT software has the following features:

1) Trending.
2) Data logging.
3) Alarms.
4) Graphic symbols.
5) Animations.

2. Hardware:

a. Minimum one Secure Digital (SD) card slot.

D. Communications:

1. Ports:

a. Minimum two 10/100MB Ethernet.
b. Minimum one USB.
c. Minimum one serial RS-232.

2. Protocols:

a. EtherNet/IP.
b. Modbus TCP/IP.

E. Display:

1. Minimum of 15 inches viewable as measured diagonally across screen.
2. Minimum display resolution:

a. 320 x 240 for 4 inch to 6 inch displays.
b. 800 x 600 for 8 inch to 10 inch displays.
c. 1024 x 768 for 12 inch to 15 inch displays.
d. 1280 x 1024 for displays larger than 15 inches.

3. Color Active Matrix TFT.
4. Display supports touch screen input.

F. Environmental:

1. Rating: OIT rated to maintain rating of control panel it will be mounted on and meet area classification.
2. Operating Temperature: 32 to 122 degrees F.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where operator interface terminals will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Operator interface terminals will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports in accordance with the following Sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121. 20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, include software support for two years in service agreement.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software includes operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days in advance to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 406263

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SECTION 406343 - PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Programmable logic controllers for DS-PLC.
2. Remove the existing MOSCAD RTU and turn it over to the owner. Transfer all the logic, input/output, and network connection associated with MOSCAD RTU to existing DC-PLC for fully functional.
3. Modifications of existing HWKS-PLC to add required Input/output modules with 20% spare for connecting the Headworks effluent flow meter (Existing); Ammonia Analyzer (Existing) and new modulating gate installed in the Package Plant.
4. Refer to control system architecture DS-I-1 for vendor package system PLCs and electrical devices communication requirements.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406717 “Industrial Enclosures.”
3. Section 406733 “Panel Wiring.”
4. Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.”

1.3 DEFINITIONS

A. Analog Input (AI): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) to be interpreted by a PLC.

B. Analog Output (AO): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) sent from a PLC to a field device.

C. Digital/Discrete Input (DI): A binary signal (0 or 1) to be interpreted by a PLC.

D. Digital/Discrete Output (DO): A binary signal (0 or 1) sent from a PLC to a field device.

E. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Processor: Provide a spare processor unit for processor installed.
2. I/O Cards: Provide spares for each unique I/O module type installed. Provide two cards or 10 percent of installed quantity, whichever is greater.
3. PLC Power Supplies: Provide spare power supplies for power supply installed.
4. Miscellaneous Components: Provide spares for each unique component installed, including cables.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of computers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Provide next day on-site service covering parts and labor for two years from date of purchase. The on-site service is to be performed by an authorized representative of the manufacturer.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Configuration: Networked programmable controller incorporated into main PLC system control panels for controlling Dove Springs Wastewater Treatment Plant system.

2.2 SPARE I/O, SLOTS, AND FUTURE EXPANSION

A. Spare PLC I/O:

1. Provide 20 percent minimum of four points per type AI AO**,** DI, and DO for future use, regardless of whether any of those point types are used in that panel or not.
2. Provide spare I/O points of same type of I/O modules supplied.

B. Future PLC Expansion (Non-Chassis-Based PLC Systems):

1. Provide adequate space to the right of the last I/O card per row of I/O cards for 2 future I/O cards.
2. Card width based on the widest I/O card provided in panel.

C. Provide external relays for spare output points that require their use.

D. Wire all unused points on all I/O to terminal blocks in the order that they occur on the I/O modules.

2.3 CHASSIS BASED PLC SYSTEM

A. Manufacturers:

1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third-party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.

2. Manufacturers and their products are subject to compliance with requirements. Provide the following:

a. Rockwell Automation Allen-Bradley – 1756-L8 ControlLogix
b. Substitutions: Not permitted.

3. Basis-of-Design Product: Subject to compliance with requirements, provide PLCs and compatible components by Rockwell Automation Allen-Bradley 1756-L82EK or comparable product.

B. General:

1. Provide processor, power supply, I/O modules, communication modules, redundancy modules, and remote interface modules as required to meet system requirements.
2. Listed and classified by UL, CSA, or FM approval as suitable for purpose specified and indicated.
3. Contains the required memory and functional capacity to perform the specified sequence of operation with the scheduled inputs and output points.
4. Designed for continuous industrial service.
5. Provide products of a single manufacturer.
6. Provide equipment models that are currently in production.
7. In the event of power interruption, the system undergoes an orderly shutdown with no loss of memory and resumes normal operation without manual intervention when power is restored.
8. Provide PLCs that communicate between workstations, servers, instruments, switches, controllers, process actuators, etc. as shown on the Drawings.
9. PLC capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

C. Physical:

1. Vibration: 3.5mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150 Hz. Vibration tested in accordance with IEC 68-2-6 and JIS C 0911. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500 Hz. In accordance with one of the following:

a. DIN rail mounted PLC, 10 – 57 Hz., amplitude 0.075 mm, acceleration 25-100 Hz.
b. Panel or plate mounted PLC: 2-25 Hz., amplitude 1.6mm, acceleration 25-200 Hz.
c. In compliance with IEC 60068 and IEC 61131.

2. Shock: 15G, 11msec. Shock tested in accordance with IEC 68-2-6 and JIS C 0911. The system is to be operational during and after testing.
3. Operating Temperature: 32 to 140 degrees F (0 to 60 degrees C).
4. Storage Temperature: -13 to 158 degrees F (-25 to 70 degrees C).
5. Relative Humidity: 10 to 95 percent, non-condensing.
6. Noise Immunity: Tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.
7. Altitude (Operating): 0 to 6,500 feet (0 to 1,980 meters)
8. Altitude (Storage): 0 to 9,800 feet (0 to 2,990 meters)
9. Degree of protection: NEMA 1 (IP20).
10. All products have corrosion protection or be conformally coated.

D. Identification

1. Identify all major assemblies and sub-assemblies, circuit boards, and devices using permanent labels or markings indicating:

    a. Module product type such as analog or digital.
    b. Module catalog number.
    c. Module major revision number.
    d. Module minor revision number.
    e. Module manufacturer vendor.
    f. Module serial number.

E. PLC Central Processing Unit (CPU):

1. General:

    a. Minimum 16-bit microprocessor with system timing and is responsible with scheduling I/O updates with no user programming required to ensure discrete or analog update.
    b. Executes user relay ladder logic programs, communicates with intelligent I/O modules, and performs on-line diagnostics.
    c. Consists of a single module which solves application logic, stores the application program, stores numeric values related to the application processes and logic, and interfaces to the I/O.
    d. Samples all discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU processes the I/O with user programs(s) stored in memory and controls outputs based on the results of the logic operation.
    e. Supply the CPU with a battery-backed time of day clock and calendar.
    CPU family allows for user program transportability from one CPU model to another.

2. Diagnostics:

    a. Perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, initiate orderly system shutdown and fail-over. Monitor the following, at a minimum:

        1) Memory failure
        2) Memory battery low
        3) General fault
        4) Communications port failure
        5) Scan time over run
        6) I/O failure
        7) Analog or special function I/O module failure

    b. Make diagnostic information accessible to the host communications interfaces and to the PLC program.
    c. PLC indicators and on-board status area for the following conditions:

        1) CPU run.
        2) CPU error or fault.
        3) I/O failure or configuration fault.

4) Status of Battery or back-up power module.
5) Communications indicator.

3. Memory

a. Provide non-volatile battery backed memory of type CMOS RAM program memory or equivalent with 10MB capacity.
b. Memory Backup System: Provide lithium battery backup or equivalent capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.

1) Backup Storage: Provide backup battery or capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage or module error and an alarm bit in the PLC program.
2) SD Memory Card: Provide memory card storage with capacity greater than processor memory capacity. Install memory cards in processors for factory testing.

c. Operating system contained in non-volatile firmware.
d. The memory containing the operating system is field updateable via a separate update tool.

4. Programming Environment

a. Programming port: Use PLC Ethernet port for programming.
b. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.
c. Online programming including runtime editing.
d. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structured text.
e. Supply all hardware and software necessary to program the CPU in these languages.

5. Communication Ports:

a. Provide expandable CPU supplied with additional modules to support the required communication interfaces.

6. Remote I/O Communications:

a. Provide CPU capable of communicating with up to 12 remote base locations. Automatically sample and update all local and remote I/O modules each scan cycle of the CPU.
b. Provide communication link between the CPU and any RIO chassis as recommended by the PLC manufacturer.
c. Provide diagnostic and equipment status information from each RIO.
d. Provide remote I/O system with a remote input/output arrangement capable of operation at locations physically separated from the PLC CPU as detailed on the drawings.

e. Communicate with the remote I/O arrangement through cable as recommended by the PLC manufacturer and provided by the PLC system supplier under this specification Section.

F. Power Supplies:

1. Power Input: 85 to 265VAC, 47 - 63Hz.
2. Provide DC power supplies capable of handling ripple up to 2.4V peak to peak.
3. Chassis mounted power supplies to power the chassis backplane and provide power for the processor and applicable modules.
4. Provide clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.
5. Provide over-current and over-voltage protection designed to operate in most industrial environments without the need for isolation transformers.
6. Size power supplies to accommodate the nominal load plus 30%.
7. Provide power supplies capable of sustaining brown out conditions of at least 1/2 of a cycle, a harmonic rate of 10%, and continuous operation through momentary interruptions of AC line voltage of 10ms or less.
8. Automatically shut down the PLC system whenever its output power is detected as exceeding 125% of its rated power.
9. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line.

G. Chassis:

1. Distribute all system and signal power to the CPU and support modules on the backplane. No interconnecting wiring between these modules via plug-terminated jumpers is acceptable.
2. Provide free air cooling for all system modules, main and expansion chassis. No internal fans or other means of cooling except heat sinks is permitted.
3. Provide means to remove all system modules from the chassis or inserted to the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.
4. Modules designed to plug into a chassis and to be keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot or chassis via an electronic method for identifying a module. Perform an electronic keying check to ensure that the physical module is consistent with what was configured.

H. Discrete Input & Output Modules:

1. General:

a. Digital input and output modules provide ON/OFF detection and actuation capability.
b. Provide cards of I/O type and count as required to implement the functions specified plus an allowance for active spares, as specified herein.
c. Provide modules capable of being installed or removed while chassis power is applied.
d. Provide the following status indicators.

1) On/Off state of the field device.

2) Module's communication status.
3) Module health

2. Module Specifications – 120VAC Input Module

a. Nominal Input Voltage: 120VAC
b. On-State Current: 15mA at 132VAC, 47 - 63Hz maximum.
c. Maximum Off-State Voltage: 20V.
d. Maximum Off-State Current: 2.5mA.
e. Number of Points per Card: 16.

3. Module Specification – 120 VAC Solid State Output Module

a. For each triac type discrete output, provide an associated interposing relay located in the same control panel. Provide 120 VAC power for relay outputs from the associated motor starter control circuit (when used with motor starters) or other 120 VAC source (when I/O is not associated with a particular motor starter).
b. Output Voltage Range: 74 - 265 VAC, 47 - 63 Hz.
c. Output Current Rating:

1) Per Point: 0.5A maximum at 86 degrees F (30 degrees C); 0.25A maximum at 140 degrees F (60 degrees C); Linear Derating.
2) Per Module: 4A maximum at 86 degrees F (30 degrees C); 2A maximum at 140 degrees F (60 degrees C); Linear Derating.

d. Surge Current per Point: 5A for 43ms each, repeatable every 2s at 140 degrees F (60 degrees C).
e. Minimum Load Current: 10mA per point.
f. Maximum On-State Voltage Drop: 1.5V peak at 2.0A and 6V peak at load less than 50mA.
g. Maximum Off-State Leakage: 2.5mA per point.
h. Number of Points per Card: 16.

I. Analog Input & Output Modules:

1. General:

a. Analog input modules convert an analog signal (1 to 5 Volts DC, 4 to 20 milliamps, for example) that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal is transmitted on the backplane.
b. Furnish analog output modules to convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.
c. Provide modules designed to be installed or removed while chassis power is applied.
d. Provide the following status indicators:

1) Module's communication status.
2) Module health
3) Input/output devices

e. Hardware and software indication provided when a module fault has occurred. Each module provided with an LED fault indicator and the programming software displays the fault information.
f. Provide analog modules that are software configurable through the I/O configuration portion of the programming software.
g. Following status can be examined in ladder logic:

1) Module Fault Word: Provides fault summary reporting.
2) Channel Fault Word: Provides under-range, over-range and communications fault reporting.
3) Channel Status Words: Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.

h. Provide 24 VDC power for analog instrument loops as a part of the system. Derive 24 VDC power supply from the 120 VAC input power circuit to the PLC. Group the field side of the 24 VDC power sources(s) as individual or grouped (of logically associated circuits) fusing and provide with a readily visible, labeled blown fuse indicator.

2. Differential Analog Input Module:

a. Input Range: 0-20 mA.
b. Resolution: approximately 16 bits across range.
c. Input Impedance: Greater than 249 Ohms.
d. Overvoltage Protection: 8V ac/dc with on-board current resistor.
e. Normal Mode Rejection: 60 dB at 60 Hz.
f. Common Mode Noise Rejection: 120 dB at 60 Hz, 100 dB at 50 Hz.
g. Isolation Voltage:

1) Channel to Ground/Chassis - 100% tested at 1000 VDC minimum for 1s based on 250 VAC.

h. Provide individual isolators, in addition to the surge suppression devices specified, in the control panels listed in Section 406717 for all signals that enter the panel from outside the building.

i. Number of Points per Card: 8.

3. Isolated Analog Output Current Module:

a. Output Current Range: 4 to 20 mA.
b. Current Resolution: 12 bits across 20 mA.
c. Open Circuit Detection: None.
d. Output Overvoltage Protection: 24V DC/AC maximum.
e. Output Short Circuit Protection: 20 mA or less (electronically limited).
f. Calibration Accuracy: Better than 0.1% of range from 4 mA to 20 mA.
g. Number of Points per Card: 8.

J. Communication Interfaces:

1. Supported protocols:

a. EtherNet/IP (1756-EN2TRK).

2. Ports:

a. Two (2) 100MB/1G Ethernet.
b. USB.

3. Utilizing in-chassis communication modules or built-in ports on the PLC is not acceptable to meet communication interface requirements.

K. Required Accessories:

1. Include all necessary cables as specified by the manufacturer. Assemble and install cables per manufacturer recommendations.

2.4 SOURCE QUALITY CONTROL

A. Testing: Test programmable controller according to NEMA IA 2.2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where Programmable Logic Controllers will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections in accordance with the following sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121.20 “Process Control System Testing.”

B. Programmable Logic Controllers will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121. 20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
3. Refer to division 1 specification requirements.

3.7 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement includes software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software includes operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 406343

SECTION 406343 - PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Programmable logic controllers for DS-PLC.
2. Remove the existing MOSCAD RTU and turn it over to the owner. Transfer all the logic, input/output, and network connection associated with MOSCAD RTU to existing DC-PLC for fully functional.
3. Modifications of existing HWKS-PLC to add required Input/output modules with 20% spare for connecting the Headworks effluent flow meter (Existing); Ammonia Analyzer (Existing) and new modulating gate installed in the Package Plant.
4. Refer to control system architecture DS-I-1 for vendor package system PLCs and electrical devices communication requirements.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406717 “Industrial Enclosures.”
3. Section 406733 “Panel Wiring.”
4. Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.”

1.3 DEFINITIONS

A. Analog Input (AI): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) to be interpreted by a PLC.

B. Analog Output (AO): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) sent from a PLC to a field device.

C. Digital/Discrete Input (DI): A binary signal (0 or 1) to be interpreted by a PLC.

D. Digital/Discrete Output (DO): A binary signal (0 or 1) sent from a PLC to a field device.

E. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Processor: Provide a spare processor unit for processor installed.
2. I/O Cards: Provide spares for each unique I/O module type installed. Provide two cards or 10 percent of installed quantity, whichever is greater.
3. PLC Power Supplies: Provide spare power supplies for power supply installed.
4. Miscellaneous Components: Provide spares for each unique component installed, including cables.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of computers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Provide next day on-site service covering parts and labor for two years from date of purchase. The on-site service is to be performed by an authorized representative of the manufacturer.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Configuration: Networked programmable controller incorporated into main PLC system control panels for controlling Dove Springs Wastewater Treatment Plant system.

2.2 SPARE I/O, SLOTS, AND FUTURE EXPANSION

A. Spare PLC I/O:

1. Provide 20 percent minimum of four points per type AI AO**,** DI, and DO for future use, regardless of whether any of those point types are used in that panel or not.
2. Provide spare I/O points of same type of I/O modules supplied.

B. Future PLC Expansion (Non-Chassis-Based PLC Systems):

1. Provide adequate space to the right of the last I/O card per row of I/O cards for 2 future I/O cards.
2. Card width based on the widest I/O card provided in panel.

C. Provide external relays for spare output points that require their use.

D. Wire all unused points on all I/O to terminal blocks in the order that they occur on the I/O modules.

2.3 CHASSIS BASED PLC SYSTEM

A. Manufacturers:

1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third-party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.

2. Manufacturers and their products are subject to compliance with requirements. Provide the following:

a. Rockwell Automation Allen-Bradley – 1756-L8 ControlLogix
b. Substitutions: Not permitted.

3. Basis-of-Design Product: Subject to compliance with requirements, provide PLCs and compatible components by Rockwell Automation Allen-Bradley 1756-L82EK or comparable product.

B. General:

1. Provide processor, power supply, I/O modules, communication modules, redundancy modules, and remote interface modules as required to meet system requirements.
2. Listed and classified by UL, CSA, or FM approval as suitable for purpose specified and indicated.
3. Contains the required memory and functional capacity to perform the specified sequence of operation with the scheduled inputs and output points.
4. Designed for continuous industrial service.
5. Provide products of a single manufacturer.
6. Provide equipment models that are currently in production.
7. In the event of power interruption, the system undergoes an orderly shutdown with no loss of memory and resumes normal operation without manual intervention when power is restored.
8. Provide PLCs that communicate between workstations, servers, instruments, switches, controllers, process actuators, etc. as shown on the Drawings.
9. PLC capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

C. Physical:

1. Vibration: 3.5mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150 Hz. Vibration tested in accordance with IEC 68-2-6 and JIS C 0911. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500 Hz. In accordance with one of the following:

a. DIN rail mounted PLC, 10 – 57 Hz., amplitude 0.075 mm, acceleration 25-100 Hz.
b. Panel or plate mounted PLC: 2-25 Hz., amplitude 1.6mm, acceleration 25-200 Hz.
c. In compliance with IEC 60068 and IEC 61131.

2. Shock: 15G, 11msec. Shock tested in accordance with IEC 68-2-6 and JIS C 0911. The system is to be operational during and after testing.
3. Operating Temperature: 32 to 140 degrees F (0 to 60 degrees C).
4. Storage Temperature: -13 to 158 degrees F (-25 to 70 degrees C).
5. Relative Humidity: 10 to 95 percent, non-condensing.
6. Noise Immunity: Tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.
7. Altitude (Operating): 0 to 6,500 feet (0 to 1,980 meters)
8. Altitude (Storage): 0 to 9,800 feet (0 to 2,990 meters)
9. Degree of protection: NEMA 1 (IP20).
10. All products have corrosion protection or be conformally coated.

D. Identification

1. Identify all major assemblies and sub-assemblies, circuit boards, and devices using permanent labels or markings indicating:

    a. Module product type such as analog or digital.
    b. Module catalog number.
    c. Module major revision number.
    d. Module minor revision number.
    e. Module manufacturer vendor.
    f. Module serial number.

E. PLC Central Processing Unit (CPU):

1. General:

    a. Minimum 16-bit microprocessor with system timing and is responsible with scheduling I/O updates with no user programming required to ensure discrete or analog update.
    b. Executes user relay ladder logic programs, communicates with intelligent I/O modules, and performs on-line diagnostics.
    c. Consists of a single module which solves application logic, stores the application program, stores numeric values related to the application processes and logic, and interfaces to the I/O.
    d. Samples all discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU processes the I/O with user programs(s) stored in memory and controls outputs based on the results of the logic operation.
    e. Supply the CPU with a battery-backed time of day clock and calendar.
    CPU family allows for user program transportability from one CPU model to another.

2. Diagnostics:

    a. Perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, initiate orderly system shutdown and fail-over. Monitor the following, at a minimum:

        1) Memory failure
        2) Memory battery low
        3) General fault
        4) Communications port failure
        5) Scan time over run
        6) I/O failure
        7) Analog or special function I/O module failure

    b. Make diagnostic information accessible to the host communications interfaces and to the PLC program.
    c. PLC indicators and on-board status area for the following conditions:

        1) CPU run.
        2) CPU error or fault.
        3) I/O failure or configuration fault.

4) Status of Battery or back-up power module.
5) Communications indicator.

3. Memory

a. Provide non-volatile battery backed memory of type CMOS RAM program memory or equivalent with 10MB capacity.
b. Memory Backup System: Provide lithium battery backup or equivalent capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.

1) Backup Storage: Provide backup battery or capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage or module error and an alarm bit in the PLC program.
2) SD Memory Card: Provide memory card storage with capacity greater than processor memory capacity. Install memory cards in processors for factory testing.

c. Operating system contained in non-volatile firmware.
d. The memory containing the operating system is field updateable via a separate update tool.

4. Programming Environment

a. Programming port: Use PLC Ethernet port for programming.
b. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.
c. Online programming including runtime editing.
d. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structured text.
e. Supply all hardware and software necessary to program the CPU in these languages.

5. Communication Ports:

a. Provide expandable CPU supplied with additional modules to support the required communication interfaces.

6. Remote I/O Communications:

a. Provide CPU capable of communicating with up to 12 remote base locations. Automatically sample and update all local and remote I/O modules each scan cycle of the CPU.
b. Provide communication link between the CPU and any RIO chassis as recommended by the PLC manufacturer.
c. Provide diagnostic and equipment status information from each RIO.
d. Provide remote I/O system with a remote input/output arrangement capable of operation at locations physically separated from the PLC CPU as detailed on the drawings.

e. Communicate with the remote I/O arrangement through cable as recommended by the PLC manufacturer and provided by the PLC system supplier under this specification Section.

F. Power Supplies:

1. Power Input: 85 to 265VAC, 47 - 63Hz.
2. Provide DC power supplies capable of handling ripple up to 2.4V peak to peak.
3. Chassis mounted power supplies to power the chassis backplane and provide power for the processor and applicable modules.
4. Provide clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.
5. Provide over-current and over-voltage protection designed to operate in most industrial environments without the need for isolation transformers.
6. Size power supplies to accommodate the nominal load plus 30%.
7. Provide power supplies capable of sustaining brown out conditions of at least 1/2 of a cycle, a harmonic rate of 10%, and continuous operation through momentary interruptions of AC line voltage of 10ms or less.
8. Automatically shut down the PLC system whenever its output power is detected as exceeding 125% of its rated power.
9. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line.

G. Chassis:

1. Distribute all system and signal power to the CPU and support modules on the backplane. No interconnecting wiring between these modules via plug-terminated jumpers is acceptable.
2. Provide free air cooling for all system modules, main and expansion chassis. No internal fans or other means of cooling except heat sinks is permitted.
3. Provide means to remove all system modules from the chassis or inserted to the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.
4. Modules designed to plug into a chassis and to be keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot or chassis via an electronic method for identifying a module. Perform an electronic keying check to ensure that the physical module is consistent with what was configured.

H. Discrete Input & Output Modules:

1. General:

a. Digital input and output modules provide ON/OFF detection and actuation capability.
b. Provide cards of I/O type and count as required to implement the functions specified plus an allowance for active spares, as specified herein.
c. Provide modules capable of being installed or removed while chassis power is applied.
d. Provide the following status indicators.

1) On/Off state of the field device.

2) Module's communication status.
3) Module health

2. Module Specifications – 120VAC Input Module

a. Nominal Input Voltage: 120VAC
b. On-State Current: 15mA at 132VAC, 47 - 63Hz maximum.
c. Maximum Off-State Voltage: 20V.
d. Maximum Off-State Current: 2.5mA.
e. Number of Points per Card: 16.

3. Module Specification – 120 VAC Solid State Output Module

a. For each triac type discrete output, provide an associated interposing relay located in the same control panel. Provide 120 VAC power for relay outputs from the associated motor starter control circuit (when used with motor starters) or other 120 VAC source (when I/O is not associated with a particular motor starter).
b. Output Voltage Range: 74 - 265 VAC, 47 - 63 Hz.
c. Output Current Rating:

1) Per Point: 0.5A maximum at 86 degrees F (30 degrees C); 0.25A maximum at 140 degrees F (60 degrees C); Linear Derating.
2) Per Module: 4A maximum at 86 degrees F (30 degrees C); 2A maximum at 140 degrees F (60 degrees C); Linear Derating.

d. Surge Current per Point: 5A for 43ms each, repeatable every 2s at 140 degrees F (60 degrees C).
e. Minimum Load Current: 10mA per point.
f. Maximum On-State Voltage Drop: 1.5V peak at 2.0A and 6V peak at load less than 50mA.
g. Maximum Off-State Leakage: 2.5mA per point.
h. Number of Points per Card: 16.

I. Analog Input & Output Modules:

1. General:

a. Analog input modules convert an analog signal (1 to 5 Volts DC, 4 to 20 milliamps, for example) that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal is transmitted on the backplane.
b. Furnish analog output modules to convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.
c. Provide modules designed to be installed or removed while chassis power is applied.
d. Provide the following status indicators:

1) Module's communication status.
2) Module health
3) Input/output devices

e. Hardware and software indication provided when a module fault has occurred. Each module provided with an LED fault indicator and the programming software displays the fault information.
f. Provide analog modules that are software configurable through the I/O configuration portion of the programming software.
g. Following status can be examined in ladder logic:

1) Module Fault Word: Provides fault summary reporting.
2) Channel Fault Word: Provides under-range, over-range and communications fault reporting.
3) Channel Status Words: Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.

h. Provide 24 VDC power for analog instrument loops as a part of the system. Derive 24 VDC power supply from the 120 VAC input power circuit to the PLC. Group the field side of the 24 VDC power sources(s) as individual or grouped (of logically associated circuits) fusing and provide with a readily visible, labeled blown fuse indicator.

2. Differential Analog Input Module:

a. Input Range: 0-20 mA.
b. Resolution: approximately 16 bits across range.
c. Input Impedance: Greater than 249 Ohms.
d. Overvoltage Protection: 8V ac/dc with on-board current resistor.
e. Normal Mode Rejection: 60 dB at 60 Hz.
f. Common Mode Noise Rejection: 120 dB at 60 Hz, 100 dB at 50 Hz.
g. Isolation Voltage:

1) Channel to Ground/Chassis - 100% tested at 1000 VDC minimum for 1s based on 250 VAC.

h. Provide individual isolators, in addition to the surge suppression devices specified, in the control panels listed in Section 406717 for all signals that enter the panel from outside the building.

i. Number of Points per Card: 8.

3. Isolated Analog Output Current Module:

a. Output Current Range: 4 to 20 mA.
b. Current Resolution: 12 bits across 20 mA.
c. Open Circuit Detection: None.
d. Output Overvoltage Protection: 24V DC/AC maximum.
e. Output Short Circuit Protection: 20 mA or less (electronically limited).
f. Calibration Accuracy: Better than 0.1% of range from 4 mA to 20 mA.
g. Number of Points per Card: 8.

J. Communication Interfaces:

1. Supported protocols:

a. EtherNet/IP (1756-EN2TRK).

2. Ports:

a. Two (2) 100MB/1G Ethernet.
b. USB.

3. Utilizing in-chassis communication modules or built-in ports on the PLC is not acceptable to meet communication interface requirements.

K. Required Accessories:

1. Include all necessary cables as specified by the manufacturer. Assemble and install cables per manufacturer recommendations.

2.4 SOURCE QUALITY CONTROL

A. Testing: Test programmable controller according to NEMA IA 2.2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where Programmable Logic Controllers will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections in accordance with the following sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121.20 “Process Control System Testing.”

B. Programmable Logic Controllers will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121. 20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
3. Refer to division 1 specification requirements.

3.7 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement includes software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software includes operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 406343

SECTION 406613 - SWITCHES AND ROUTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Switches and routers.
2. PCSS is responsible for performing configuration services for equipment provided under this Section.

B. Related Requirements:
1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 406343 “Programmable Logic Controllers.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Ethernet Switch: Provide one spare switch per each type installed.
2. Manufacturer’s cables: Provide one spare of each type installed.
3. Shielded Cat-6: Provide five 10-foot CAT-6 cables with connectors installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of computers that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Provide next day on-site service covering parts and labor for two years from date of purchase. The on-site service is to be performed by an authorized representative of the manufacturer.

PART 2 - PRODUCTS

2.1 INDUSTRIAL MANAGED ETHERNET SWITCH

A. Manufacturers:
1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following without substitution nor equal:
a. Ruggedcom RS900.
b. Ruggedcom RSG2100P.

B. General:

1. Provide a DIN rail mountable industrial managed Ethernet switch for connection to the network as shown in the Drawings and specified herein.
2. Provide ethernet switches by the same manufacturer for the project, regardless of type.

C. Physical Features:
1. SFP Slots: 1G/10G SFP ports.

2. Power-over-Ethernet Plus (PoE+) Copper Ports: 10/100/1000BaseT(X) ports.
3. Copper Ports: 10/100/1000BaseT(X) ports.
4. Operating Temperature: 0 to 130 degrees F.
5. Power: redundant 24VDC power input.
6. Enclosure: Metal case.
7. Rating: UL Class 1, Division 2 Groups A, B, C, and D.

D. Network Features:
1. Layer 2 switching.
2. Spanning Tree Protocol (STP).
3. Rapid Spanning Tree Protocol (RSTP) (IEEE 802.1w).
4. Full duplex on all port.
5. Auto negotiation and manual configurable speed and duplex.
6. Wire speed switching fabric.
7. IGMP snooping.
8. IGMP filtering.
9. Configuration password protected.
10. Configuration backup capability required.
11. SNMP V3.
12. Lock port function for blocking unauthorized access based on MAC address.

E. Additional Features:

1. Provide dry contact rated for 120 VAC 5A to be used for common trouble alarm and programmable alarm. If the contact cannot use 120 VAC 5A, provide the necessary 24 VDC power from the PLC panel and provide interposing relays in the PLC panel.

2.2 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden CDT Networking Division/NORDX.
2. CommScope, Inc.
3. General Cable; General Cable Corporation.
4. Mohawk; a division of Belden Networking, Inc.

C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Shielded twisted pairs (FTP).

F. Cable Rating: Plenum.

G. Jacket: Blue thermoplastic.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where computers will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections in accordance with the following Sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121 “Process Control System Testing.”

B. Switchers and routers will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121. 20 Process Control System Testing.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. For Managed Ethernet Switches:

   a. Enable the lock port function to block unauthorized access based on MAC address for each switch and router. Assign static IP addresses to devices connecting to switch.
   b. Lock down all spare switch and router ports.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

3.8 SWITCHES AND ROUTERS SCHEDULE

A. Provide the devices in the following schedules:

Table 1. Ethernet Switch Schedule

Switch Designation	Type	Mount	Fiber Uplinks (1G/10G SFP)	Copper Ports (10/100/1000 BaseT(X), RJ45)	PoE Copper Ports (10/100/1000 BaseT(X), RJ45)
MES-RIO1	Managed Ethernet Switch	DIN Rail	0	8	0
MES-TU1	Managed Ethernet Switch	DIN Rail	0	8	0
MES-RIO2	Managed Ethernet Switch	DIN Rail	0	8	0

END OF SECTION 406613

SECTION 406717 – INDUSTRIAL ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes industrial enclosures.

B. Related Requirements:
   1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
   2. Section 406733 “Panel Wiring.”
   3. Section 406343 “Programmable Logic Controllers.”
   4. Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

   1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

C. Calculation

   1. Heat and colling calculations to demonstrate compliance to industrial panel temperature control requirements.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Touch-up Paint: Provide touch-up paint of each type and color used for all cabinets, panels, and consoles supplied.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with UL 508.

B. Provide components compatible with functions required to form complete working system.

C. Provide UL 508 label on complete assembly.

D. Maintain copies of panel drawings on site.

1.6 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.7 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of enclosures that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Provide next day on-site service covering parts and labor for two years from date of purchase.

PART 2 - PRODUCTS

2.1 INDUSTRIAL ENCLOSURES

A. Manufacturers:
   1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:
      a. Hoffman.
      b. Rittal.

B. Structure and Enclosure:

   1. Panels in indoor, dry, non-corrosive environments:

      a. NEMA 12, painted steel or aluminum construction, as required by the schedule in PART 3.

   2. Panels in outdoor, wet, or chemically corrosive environments:

      a. NEMA 4X, stainless steel or FRP construction, as required by the schedule in PART 3.

   3. Panels located in hazardous locations:

a. Rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

4. Construction:

   a. Freestanding and floor-mounted vertical panels:

      1) Panels of 12-gauge sheet steel.
      2) Front panels or panels containing instruments: provide 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.

   b. Wall and Unistrut mounted panels:

      1) Panels no less than 14-gauge steel.

   c. Consoles:

      1) Panels of 12-gauge sheet steel.
      2) Front panels: provide 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.

5. Provide angle stiffeners on the back of the panel face to prevent panel deflection under instrument loading or operation, as follows:

   a. Structural framework internal to the panel allows for instrument support and panel bracing.
   b. Interior structure framework to permit panel lifting without racking or distortion.
   c. Removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

6. Full height and fully gasketed access door with full-length, continuous, piano type stainless steel hinges with stainless steel pins.

   a. Provide doors with three-point stainless steel latch and heavy-duty stainless-steel locking handle.
   b. Provide front access doors of sufficient width to permit instrument or control device mounting without interference from flush mounted instruments.
   c. Clamp-type door latches are not permitted.

7. Avoid kinks and sharp bends in wiring.

   a. Route wiring for easy access to other components for maintenance and inspection purposes.

8. Panel suitable for top and bottom conduit entry as required by the Electrical Drawings

   a. For top mounted conduit entry, provide panel top with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations.
   b. Provide all conduit and cable penetrations with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

C. General Requirements:

1. UL labeled control panels and cabinets.

    a. UL listing includes enclosure, specific equipment supplied with enclosure, and equipment installation and wiring within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses, and other equipment necessary to achieve compliance with UL 508A requirement. The Drawings do not detail all UL 508A requirements.

2. Panel door handles with lock, or a hasp and staple for padlocking: key the locks for all control panels provided under this Contract alike.
3. Arrange devices for rear of panel mounting within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.

    a. Locate heat generating devices, such as power supplies, at or near the top of the panel.

4. Mount all components in a manner that permits servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component.

    a. Mount interior panel components on removable plates (sub-panels) and not directly on the enclosure.
    b. Unless shock mounting is required by the manufacturer to protect equipment from vibration, provide rigid and stable mounting.
    c. Mount and orient components in accordance with manufacturer's recommendations.
    d. Identify internal components with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawings and specifications.

5. Mount all panel components on a single rear-of-panel sub-panel unless the density of devices exceeds the panel mounting space permitted by the minimum panel dimensions specified. Side panel mounted components are not permitted without review and approval by Engineer.

6. Type 316 stainless steel hardware and fasteners:

    a. Provide drilled and tapped mounting screws; self-tapping screws are not permitted.

7. Install suitable gaskets and faceplates, required to maintain NEMA rating of the panel.

D. Mounting Elevations:

1. Refer to ISA Recommended Practice RP60.3 for guidance on layout and arrangement of panels and panel mount components. Account for housekeeping pad dimensions.
2. Locate centerline of indicators and controllers no lower than 48 inches or higher than 66 inches above the floor on a panel face.
3. Locate centerline of lights, selector switches, and pushbuttons no lower than 32 inches or higher than 70 inches above the floor on a panel face.
4. Locate tops of annunciators no higher than 86 inches above the floor on a panel face.

5. Install panel components in accordance with manufacturer's guidelines.

2.2 TEMPERATURE CONTROL

A. Provide force air ventilation or air conditioning units as required to prevent temperature buildup inside of panel.

B. Heat Load Calculations:

1. Submit heat load calculations for all control panels located in areas where either venting is not possible due to NEMA rating of panel or control panel is located in an area or building without air conditioning.
2. Utilize manufacturer available thermal calculators to determine heating/cooling requirements (i.e. Saginaw SCE thermal calculator, Vent Hoffman cooling selection tool, or equivalent).
3. Ensure the internal temperature of the panel is regulated between 45 to 104 degrees F under all conditions.
4. Account for the following conditions in the heat load calculations:

    a. Loading and dissipation effects on all surfaces of the enclosure. Account for surfaces not available for heat transfer (e.g., against a wall).
    b. Internal heat load of components (load and duty cycle).
    c. For outside temperature limits, refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

C. Sun Shields:

1. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:

    a. Fabricate sun shields from a material suited for the area classification rating of its environment.
    b. Design, fabricate, install, and support the unit to fully cover and shade the top, sides, and back of the enclosure, and to partially shade the front panel of the enclosure from direct exposure to sunlight from sunrise to sunset.
    c. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure, to preserve rigidity.
    d. Design and mount sun shields with a minimum 3-inch air gap around the enclosure for air circulation and heat dissipation.
    e. Drilling holes or welding studs directly to the enclosure for sun shield mounting is not permitted.
    f. Slope the top section of the sun shield a minimum angle of 5 degrees from horizontal.

        1) Wall mounted enclosures: slope the top section downward away from the wall and towards the front of the enclosure.
        2) Free standing, floor mounted, and frame mounted enclosures: slope the top section downward towards the back side of the enclosure.

g. Incorporate a narrow and more steeply sloped drip shield segment on the front edge of the top section to shed water away from the front of the enclosure and prevent dripping or running directly onto the front panel of the enclosure.
h. Fabricate sun shields with continuous seam welds that are ground smooth.
i. Smooth round or chamfer exposed corners, edges, and projections to prevent injury.

D. Louvers:

1. If louvers are used, provide louver plate and filter kit.
2. Provide louver plates of stamped sheet metal construction.
3. Provide washable and replaceable filters.
4. Install louvers on the rear, top, or bottom of the panel, as required by the panel installation location.
5. For wall mounted enclosures with their backs directly adjacent to a wall, install louvers on the sides.

E. Forced Air Ventilation:

1. Provide forced air ventilation fans to create positive internal pressure within the panel.
2. Provide washable and replaceable filters.
3. Fan motors operate on 120-volt, 60-Hz power.

F. Air Conditioning:

1. For panels with internal heat that cannot be adequately dissipated with natural convention and heat sinks, or forced air ventilation, provide an air conditioner sized to deliver sufficient cooling.
2. NEMA rating equivalent to the NEMA rating of the panel. Maintain NEMA rating of panel when installed.
3. Provide air conditioner with conformal coating on exposed surfaces.
4. Mount air conditioners on panel side. If provided, cut sun shields to accommodate air conditioner.

G. Heating:

1. Provide an integral heater, fan, and adjustable thermostat for outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture, to reduce condensation and maintain the minimum internal panel temperature.

a. Mount unit near enclosure bottom with discharge away from heat-sensitive equipment.
b. Provide Hoffman DAH series, or equal.

2.3 ACCESSORIES

A. Nameplates:

1. Identify the panel and individual devices as required, unless otherwise indicated:

a. Include up to three lines:

1) First line containing the device tag number as shown on Drawings.
2) Second line containing a functional description (e.g., Recirculation Pump No. 1).
3) Third line containing a functional control description (e.g., Start).

2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings:

a. Furnish nameplates as 3/32-inch thick, black against white background unless otherwise noted, Lamicoid with engraved inscriptions. Bevel and smooth edges of nameplate.
b. Nameplates with chipped or rough edges are not acceptable.

3. Mount or fasten cabinet mounted nameplates with epoxy adhesive or stainless-steel screws.
4. Provide a panel nameplate with a minimum of 1-inch high letters for every panel.
5. Provide legend plates or 1-inch by 3-inch engraved nameplates with 1/4-inch lettering for identification of door mounted control devices, pilot lights, and meters.
6. Use single Lamicoid nameplates with multiple legends for grouping of devices such as selector switches and pilot lights that relate to one function.

B. Print Storage Pockets:
1. Provide print storage pockets of steel construction, welded onto the door of the enclosure.
2. Size storage pockets to accommodate all prints required to service the equipment, and to accommodate 8.5-inch by 11-inch documents without folding.

C. Corrosion Control:

1. Protect panels from internal corrosion by use of corrosion-inhibiting vapor capsules. Size and quantity as necessary per manufacturer recommendations.
2. Manufacturer: Provide one of the following or equal:

a. Zerust VC.
b. Hoffman Model AHCI.

2.4 GENERAL FINISH REQUIREMENTS

A. Descale, degrease, fill, grind, and finish sections.

B. Finish steel-fabricated enclosures with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which are applied by either hot air spray or conventional cold spray methods.

1. Brushed anodized aluminum, stainless steel, and FRP panels do not require a paint finish.

C. Grind smooth, sandblast, and then clean with solvent. Fill surface voids and grind smooth.

D. Immediately after cleaning, apply one coat of a rust-inhibiting primer inside and outside, followed by an exterior intermediate and topcoat of a two-component type epoxy enamel.

1. Apply final sanding to the intermediate exterior coat before top coating.

E. Apply a minimum of two coats of manufacturer’s standard, flat light-colored lacquer, on the panel interior after priming.

F. Unless otherwise noted, finish exterior colors as ANSI 61 gray with textured finish.

G. Finish products after assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where industrial enclosures will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for cable trays.
3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 ADJUSTING

A. Adjust hardware and moving parts to function smoothly and lubricate as recommended by manufacturer.

3.4 INDUSTRIAL ENCLOSURE SCHEDULE

A. Provide the following industrial enclosures:

Table 1. Industrial Enclosure Schedule

Panel Designation	Minimum Size	Enclosure Rating	Construction	General Requirements
LRP-1001-1	24-inch high by 24-inch wide by 8-inch deep	NEMA Type 7	316 Steel	Wall-mounted, single door, front-access only.
LRP-1401-1	24-inch high by 24-inch wide by 8-inch deep	NEMA Type 7	316 Steel	Wall-mounted, single door, front-access only.
DS-RIO1	36-inch high by 36-inch wide by 8-inch deep	NEMA Type 7	316 Steel	Wall-mounted, single door, front-access only.
DS-TU1	24-inch high by 24-inch wide by 8-inch deep	NEMA Type 4X	Painted steel	Wall-mounted, single door, front-access only.
DS-RIO2	36-inch high by 36-inch wide by 8-inch deep	NEMA Type 4X	Painted steel	Wall-mounted, single door, front-access only.

END OF SECTION 406717

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SECTION 406733 - PANEL WIRING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for internal wiring of control panels and consoles.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”

1.3 ACTION SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring:

1. Provide stranded, type MTW interconnecting wiring:

a. Use 600-volt insulation rated for not less than 90 degrees Celsius.
b. Segregate wiring for systems operating at voltages in excess of 120 VAC from other panel wiring.

1) Locate either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier.

c. Develop panel layout such that technicians have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

2. For power distribution wiring on the line side of fuses or breakers:

a. Use 12 AWG minimum.
b. For control wiring on the secondary side of fuses:

1) Use 16 AWG minimum.
2) Utilize 18 AWG shielded, twisted pair cable insulated for not less than 600 volts for electronic analog circuits.

3. Cover power distribution blocks with protective guards to meet "finger-safe" requirements of IP20.
4. Route power and low voltage DC wiring systems in separate wireways.

a. Cross different system wires at right angles.
b. Separate different system wires routed parallel to each other by at least 6-inches.
c. Terminate different wiring systems on separate terminal blocks.
d. Do not fill wiring troughs to more than 60 percent visible fill.

5. Terminations:

a. Terminate wiring onto single tier terminal blocks:

1) Uniquely and sequentially number each terminal block.
2) Direct wiring between field equipment and panel components is not acceptable.
3) Multi-level terminal blocks or strips are not acceptable.

b. Arrange terminal blocks in vertical rows and separated into groups (power, AC control, DC signal).

1) Provide each group of terminal blocks with a minimum of 25 percent spares.

c. Use compression type, fused, unfused, or switched terminal blocks.

1) Use two terminals per point for discrete inputs and outputs (DI and DO) with adjacent terminal assignments.
2) Wire all active and spare PLC and controller points to terminal blocks.

d. Use three terminals per point for analog inputs and outputs (AI and AO) per shielded pair connection with adjacent terminal assignments for each point.

1) The third terminal is for shielded ground connection for cable pairs.

a) Ground the shielded signal cable at the PLC cabinet.
b) Wire all active and spare PLC and controller points to terminal blocks.

e. Use sleeve-type wire and tube markers with heat impressed letters and numbers.
f. Use only one side of a terminal block row for internal wiring.

1) Field wiring side of the terminal not to be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free-standing

panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.

g. Isolate circuit power from the SCADA cabinet to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards with an isolating switch terminal block with flip cover that is supplied with a dummy fuse.

1) Use Allen Bradley Model 1492-H7 or equal.
2) One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.

h. Isolate all PLC discrete outputs to the field with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator.

1) Use Allen Bradley 1492-H4 or equal.

6. Clearly identify wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection as such.
7. Clearly tag and color code wiring.

a. Tag numbers and color coding to correspond to panel wiring diagrams and loop drawings prepared by the PCSS.
b. Power wiring, control wiring, grounding, and DC wiring to utilize different color insulation for each wiring system used.
c. Color coding scheme to be in accordance with UL 508a.

8. Provide surge protectors on all incoming power supply lines at each panel per requirements of Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”
9. Each field instrument furnished under Division 40 and shown on Drawings as deriving input power from the control panel(s) to have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication.

a. Power instruments requiring 120VAC power as shown on Drawings.

10. Wiring trough for supporting internal wiring:

a. Plastic type with snap-on covers.
b. Side walls to be open top type to permit wire changing without disconnecting.
c. Trough to be supported to the subpanel by stainless steel screws.
d. Do not bond trough to the panel with glue or adhesives.

11. Provide each panel with a single tube, LED light fixture, 20 Watt in size (minimum).

a. Mounted internally to the ceiling of the panel.
b. Light fixture to be switched and be complete with the lamp.

12. Each panel to have a specification grade duplex convenience receptacle with ground fault interrupter:

a. Mount internally within a stamped steel device box with appropriate cover.

b. Convenience receptacle is not to be powered from a UPS.
c. Protect by a dedicated fuse or circuit breaker.

13. Each panel to be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding to be in accordance with the instrumentation manufacturer's recommendations.
14. Provide each panel with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
15. Each panel to have control, signal, and communication line surge suppression in accordance with Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”
16. Microprocessor-based electronic devices in the panel that are powered by 120VAC to be powered by the UPS.
17. Provide each panel with a circuit breaker to interrupt incoming power.
18. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. to follow the requirements of Division 26.

B. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26 or shown on Drawings to be provided under this Section.

C. Orientation of devices including PLC and I/O when installed to be per the manufacturer's recommendations.

1. No vertical orientation of PLC racks are allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

END OF SECTION 406733

SECTION 406863 - CONFIGURATION OF HMI SOFTWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system. Control of all equipment to be in conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment. Include the following information:
    a. Configuration of the HMI System Software, Operator Interface Terminals, and drivers provided for all equipment shown on the drawings, including equipment provided by vendor package systems.
    b. Configuration of any alarm dialer provided.
    c. Configuration of the SCADA Historian Software.
    d. Configuration of system reports using the Reporting Software provided.
    e. Communications and functionality data between all connected devices (such as PLCs) and the HMI software packages, including devices supplied by others, as depicted on the system architecture drawings in order to provide a comprehensive working system of data collection, storage and reporting.
2. Coordinate all work with plant operating personnel to minimize impacts on daily operation. Note delays caused for any reason and formally submit to Engineer and Owner in the form of a letter.
3. If referred to anywhere else in the project manual, AE or AESS services include, but are not limited to, those services specified in this Section.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406126 “Process Control System Training.”
3. Section 406196 “Process Control Descriptions.”
4. Section 406263 “Operator Interface Terminals”
5. Section 406343 “Programmable Logic Controllers.”
6. Section 406863 “Configuration of HMI Software.”
7. Section 406866 “Configuration of Controller Software.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): Entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Application Engineering (AE): Application Engineering.

1.4 PREINSTALLATION MEETINGS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.” The meetings below are in addition to the meetings specified in that section.

B. Schedule and conduct a standards and conventions workshop. The purpose of this workshop is to review the standards, conventions, and methodologies that will be used to program and develop the programs (i.e., HMI and PLC databases, HMI graphics, and PLC programming, etc.) and will solicit Engineer and Owner's input. Submit an agenda with examples for items to be discussed at client workshop.

C. Schedule and conduct a draft graphics review meeting. The purpose of this meeting is to present draft graphics for the Owner's and Engineer's review and feedback prior to creating the full set of graphics for review. For repetitive graphics such as graphics for multiple process trains, include an example of the first graphic only for discussion. Include discussion of process and overview displays, examples of pop-ups, trends, and system navigation tools. Expect major comments and incorporate any changes resulting from those comments.

D. Schedule and conduct a second graphics review meeting. The purpose of this meeting is to finalize the process of building the required HMI system. This meeting will be held after return of the draft graphics submittal and incorporation of comments. At this meeting, present the actual software displays, databases, security system, reports, and the like. The Owner will make comments on the system for incorporation prior to factory test. Bring a working system to allow for live demonstration of graphics.

E. Schedule and conduct a historical data management and reports workshop. The purpose of this workshop is to discuss and solicit Engineer/Owner input for storage and management of historical data; format of daily, monthly, and yearly reports; development of data entry templates; report formats and layouts; and user interface displays for accessing and generating reports. Bring examples of these documents for review and discussion.

F. Schedule and conduct a factory-testing coordination meeting, two weeks prior to factory testing. The purpose of this meeting is to discuss the specifics of proposed tests and provide a forum for coordinating required factory testing.

G. Schedule and conduct a field-testing coordination meeting, two weeks prior to field testing. The purpose of this meeting is to discuss specifics of proposed tests and provide a forum for coordinating required field-testing.

1.5 ACTION SUBMITTALS

A. Provide the submittals listed below:

1. System Standards and Conventions.

2. Operator Interface.
3. Controller Program.
4. Reports.
5. Historical Data Management.

B. System Standards and Conventions Submittal:

1. Following the standards and conventions workshop, submit standards and conventions to be used on this project. Define the submittal, at a minimum:

   a. Graphic display standards, including color conventions, equipment symbols, display format, equipment control pop-up displays, trend displays, and display navigation. Include samples of each proposed type of graphic display (i.e., overview, detail, diagnostic, tabular, etc.).
   b. System naming conventions, such as graphic displays naming, database naming, tag names, and computer naming.
   c. System configuration, including network addressing and PLC/RTU addressing.
   d. Alarm configuration standards, including priorities and logging.
   e. Security configuration standards, including user groups and privileges.
   f. PLC/RTU standard programming modules, including analog input scaling, flow totalization, equipment runtime, motor start/stop, valve open/close, and any other standard logic planned to be used.

2. To facilitate the Owner's future operation and maintenance, use the submitted standards and conventions as basis for programming and configuration of the system. Do not begin the system programming and configuration prior to the System Standards and Conventions Submittal.

C. Operator Interface:

1. Following the approval of the standards and conventions submittal, submit a draft of all proposed graphic displays, examples of each type of pop-up (faceplate) displays, and examples of trends. For those graphics, which will be duplicated more than once for similar type of equipment, submit graphics for the first equipment only.
2. Following the draft graphics review meeting and prior to the factory test, submit a ready-for testing version of all graphic displays. These graphics should be completely finished other than the incorporation of comments and changes resulting from testing.
3. Submitted graphic displays and trends are to be no less than 8.5 inches by 11 inches and in full color.
4. Modify the existing graphics for Irrigation transfer pump station and Pecan Branch Transfer Pumps to accommodate the changes required to fulfill control requirements as per 406196 Control descriptions.

D. Historical Data Management:

1. Following the Historical Workshop, submit all aspects of the historical data management system and include as a minimum the following:

   a. A complete listing of all signals to be collected and stored, including data sampling rate and duration for which the data will be immediately accessible.
   b. Data reduction methods, rates, and the duration data will be immediately accessible.

c. Storage space requirements and supporting calculations.
d. Historical database design description, including data flow diagram, table definitions, procedures and queries used; and description of method of accumulating and displaying run times and flow totals. Define the method of interfacing to the reporting system, methods of handling Data Quality Flags, and methods of storing and displaying trending information.
e. Description of methodology for restoring data collected locally during times when the historical data management system is not available. Description of database failure and recovery, including data correction.
f. Description of selecting only the active real-time data source for systems that are utilizing redundant data acquisition nodes.
g. List of data source interfaces to be used with the system (for example, OPC, file collection, historian-historian collector, HMI applications, etc.)

E. Reports:

1. Following the Historical Workshop, submit all aspects of the reports generation system and include as a minimum the following:

a. A complete list of all reports to be developed.

b. Complete listing of all signals to be reported, including calculated values.
c. Description of reporting data storage design, including method data is polled and stored.
d. Description of methodology for entering manual data and interfaced used.
e. Procedures for recall, generation and printing of reports
f. Printout of each report to be provided with details of each cell, where data comes from, and calculation of raw data.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. System specified performs the following generalized functions:

1. Allows operator to control equipment such as pumps and valves as shown on Drawings and as defined in Section 406196 “Process Control Descriptions.”
2. Perform real-time process control, including proportional integral derivative control action, sequencing, and process calculations.
3. Collect, calculate, and store accurate, reliable operating information for present and future uses.
4. Assist remote site operating personnel by noting and communicating of normal operating conditions and equipment failures.
5. Accumulate and store equipment running times for use in preventative maintenance.
6. Provide color graphic displays and reports for use by the system operating and supervisory personnel.
7. Provide trending for analog values.

8. Provide control system diagnostics.
9. Perform process control functions including PID, calculations, sequencing, timing, in the process controller. The HMI software performs the real-time database, report generation, graphic screens, program development, set point modification, data archiving, etc.
10. Allow the operator to manually control (by keyboard entry and mouse type pointing device) the status of pumps, valves, e.g., on/off, open/close, setpoint value,) when viewing the appropriate graphic screen on the HMI.

3.2 GRAPHIC DISPLAYS - GENERAL

A. Ensure displays contain and continuously update the displayed process variables, date, and time of day, with process values showing in engineering units. Incorporate on displays:

1. References to both instrumentation tag numbers and plant equipment numbers.
2. Process variables on their associated display(s) with correct engineering units.
3. Process variables with their associated data quality flags.

B. Operator commands related to controlling field devices or system attributes require multiple keystrokes or mouse actions to protect against inadvertent operations. Confirmation to the operator for the selected point to be controlled is provided, at which time a cancellation of the control can be affected.

C. Process graphic displays are depicted from the P&ID's, site plan drawings, mechanical drawings and electrical drawings included in these Contract Documents. The graphic displays include process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.

D. Include on main graphical screens a title bar, main graphic area, navigational buttons, and alarm summary bar.

1. Title bar displayed on the top of each screen and include display name, description and time/date.
2. Main graphical area contains primary screen data in graphical format.
3. Navigational buttons include a minimum of main menu, trends, main alarm summary, and security log in.
4. Alarm summary bar displays the last three valid alarms on the bottom of each screen.

E. Provide animation to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors to change when opened and closed.

F. Adjust from the operator interface timers, setpoints, alarm actuation levels, unless specifically noted.

G. Ensure the system show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri-state must be represented in three conditions.

H. Ensure conditions in the field designated as alarm conditions report to the operator workstation, actuate an audible alarm, and provide a visual blinking image on the associated graphic page. Display alarms and events on the screen and archived.

I. Identify interlocks that affect equipment operation both by alarm and by HMI indication.

J. Check analog inputs for out of range (via high and low limit checks) and alarmed.

K. Label process flow streams and color-code using the project color schedule in Division 09. Identify structures and equipment by name and appropriate equipment and loop tags.

L. Color coding for equipment status and alarms is as follows:

1. Red for on or open.
2. Green for off or closed.
3. Flashing red for alarm.
4. Yellow for acknowledged alarm.

M. Automatically record alarm and events should any of the following sequences or events occur:

1. Date/Time entry.
2. Limit changes.
3. Commanded or un-commanded change of any point.
4. Alarm conditions.
5. PLC activation or deactivation.
6. Operator login or logout activity.

N. There may be additional general programming requirements listed in PART 1 of the Section 406196 “Process Control Descriptions” that impact the HMI configuration.

3.3 SPECIFIC GRAPHIC SCREENS

A. At a minimum, provide the following types of graphic screen indicated below.

1. Plant Overview screen including a site plan representation, indicating the geographic location of each process and building.
2. Process graphic displays shall be based on the P&ID’s, site plan drawings, mechanical drawings and electrical drawings included in these contract documents. The graphic displays shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.

3. Main menu screen linking all screens and process areas; complete and logical listing names and number of all screens.
4. Overall plant process block flow diagram screen showing major processes in block form with flow arrows. Each block includes a text description of key individual treatment processes. Navigational buttons to the individual treatment processes can be performed by pressing on the text description.
5. Individual treatment process screens graphically screening key process variables and equipment. Features:

    a. No operator entries are available from these screens.
    b. Individual process flow screens for each process include all process components, including tanks, pumps, blowers, mixers, drives, flow meters, valves, mechanical devices, as well as manual shutoff and isolation valves.

c. These diagrams are generally depicted from the P&ID's with at least 1 screen per P&ID on average.

6. Individual unit process screens depicted from the P&ID's are used for control and screen of each major item of process equipment, process variables, and control devices, including pumps, blowers, valves, gates, mixers, and drives. Navigational buttons consist of the P&ID's flow arrows to other individual unit processes. The unit process screens provide the ability for the operator to go to individual equipment popup screens. These diagrams are generally depicted from the P&ID's with at least 2 screens per P&ID on average.
7. Provide popup screens for each piece of equipment to start/stop equipment, open / close valves, implement automatic control, adjust set points, establish and adjust tuning parameters, set alarm limits, and initiate a sequence.
8. PLC system diagnostic screens, showing the operational status, and fault conditions of all PLC components, including processors, I/O modules, OIT's, power supplies and UPS units.
9. Communications diagnostic screens, showing the details of network status, communications status of all major components including Operator Work Stations, peripheral devices and network components.
10. Maintenance screens display the raw value for each analog and digital I/O point in the system. They allow the operators/maintenance personnel to enter an override value for an analog point that is then used by the system instead of the value read from the input card / communications link.
11. Trend screens with the capability to screen up to eight, operator assigned, analog and/or digital process variables. Each analog value will be shown on a trend screen.
12. Main alarm summary screen includes the following information for each alarm: Time, tag name, description, alarm type, current value, and status. An acknowledge alarm button acknowledges all new unacknowledged alarms. Display alarms in the alarm summary screen and in the alarm banner as follows:

    a. Unacknowledged and active alarm: Displayed on screen, blinking
    b. Acknowledged and active alarm: Displayed on screen, not blinking.
    c. Unacknowledged and inactive alarm: Displayed on screen, blinking. Text/background of the alarm displayed in a different color than active alarms.
    d. Acknowledged and inactive alarm: Not displayed in banner.

13. Analog variable screens showing a tabular summary of all plant process variables, in operator assigned groupings.

3.4 SECURITY

A. Configure and implement the system with security to prevent unauthorized access. The system allows authorized changes to system operation through defined user accounts and password verification.

B. Coordinate with Owner user account information, including login name and password for each account.

C. Assign security levels of "display only," "operator mode," "supervisor mode," and "engineer mode" through assignable passwords. On system startup, automatically enter the "display only" security level. In the "display only" mode, information is available to be displayed on the

screen, but no changes may be made. In the "operator mode," changes may be made to process set points, times, etc.; however, the overall control concepts may not be modified. In the "supervisor mode," all operator functions can be modified, and any special reports or critical process set points (data can be modified; however, the overall control concepts may not be modified). In the "engineer mode" level, all user modifiable parameters of the system are available for modification.

3.5 ALARM/EQUIPMENT STATUS REPORTING

A. Display on the alarm log all alarms as they occur. Include on the alarm message the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal are displayed. Include on all reports the plant equipment number of the associated device.

B. Log the equipment status whenever a change in status occurs (i.e., start, stop). Include on the equipment status log the time, equipment name, tag number, and the particular change in status.

3.6 HISTORICAL DATA MANAGEMENT

A. Provide the following features for processing and storage of system historical data:

1. Each system point (analog or digital, real or pseudo) has the capability of being historically logged. A point can be deleted from historical log at any time. Points can be added or deleted from the system using minimal keystrokes.

2. Sample and store all process analogs and all flow totals and run time indications of all primary process equipment motors in the historical data management system.
3. Data Processing: Store the real time instantaneous values in a historical log file on the hard disk at defined sampling rates.
4. Data Correction: Manually modify historical data by personnel with appropriate security levels. Differentiate such data from actual monitored values on reports, in the database and in trends.
5. Data Quality: Propagate data Quality flags to the next higher level of the history based on user selectable percentage determining tolerance levels for averages and totals. If the percentage of suspect data exceeds the tolerance level, the suspect data flag propagates to the next higher level. Maximums and minimums are taken from good data.
6. Manual Input Data Handling: This data consists of additional values not obtainable by the system such as laboratory analysis for use in reports. Enter and store all manually entered data in the appropriate engineering units. Display all data entered for confirmation on the display prior to incorporation to the database.

3.7 REPORTS

A. Determine quantity and format of reports at the historical data management and reports workshop and as a minimum include shift, daily, monthly and yearly reports. Provide a minimum of one of each type, shift, daily, monthly, and yearly reports.

B. The system generates reports from on-line historical data files or prompt the user for the appropriate archived data files.

C. Initiate reports automatically based upon time of day or manually upon operator's request.

D. Develop user-interface displays for report generation with easy recall of reports by entering time:day:year target values.

E. User interface displays allows the operator to define the destination of the report (e.g., display, printer, computer file, etc.) and when to print (e.g., immediately, on demand, or automatically at a specified time).

F. Print quality tags alongside the value.

G. Identify values for which there are no data with a special character. Thus, print only values which are actually zero.

H. Operational Report Types. Provide the following operational report types with the system:

1. Shift Operation Summary Report:

    a. Summarize plant operation from the start and finish time of operation on an operator-adjustable time interval shift operation report.
    b. Consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identification, and engineering units.

2. Daily Operation Summary Report:

    a. Summarize plant operation for the previous day on the daily operation report. Printed information is stored values (not averages) including scanned, lab, and manually entered data.
    b. The report format consists of the following: correct date, plant name, report name, page number, group headings, subheadings, point identifications, and engineering units.
    c. Also calculate the daily minimum, average, maximum, and total where applicable and print and store for each point.

3. Monthly Operation Summary Report:

    a. Summarize plant operation for the previous calendar month on the monthly operation summary report.
    b. Arrange the report format so that the first several pages conform to the requirements of the state regulatory agencies and separate from the rest of the monthly operation report for transmittal to the regulatory agency.
    c. Report format similar to the daily operation summary report, consisting of the following: month and year, plant name, report name, page number, group headings, sub-headings, point identifications, and engineering units.
    d. Print monthly minimum, average, maximum, and totals, where applicable, for each column of points printed.

4. Annual Operation Summary Report:

    a. Summarize plant operation for the previous calendar year on the annual operation summary report. Report consists of scanned data, lab data, and manually entered data.

b. Format of the report is identical with the monthly operation summary report except for replacing month with year in the heading and replacing date with calendar month.

3.8 TESTING

A. Refer to Section 406121.20 “Process Control System Testing”.

B. Supplement to Field Testing requirements:

1. Prior to leaving the site, use the Owner's programming computer to monitor all PLC processors online, make on-line changes, upload, and download the processor to ensure programming software version compatibility.

2. Loop Tuning: Tune all PID control loops (single or cascade) following device installation but prior to commencement of the Functional Demonstration Test.

a. Achieve optimal loop tuning either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, or other documented process tuning method.
b. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under the control PID. Adjust each control loop that includes anti-reset windup features to provide optimum response following startup from an integral action saturation condition.
c. Tune all PID control loops to eliminate excessive oscillating final control elements. Adjust loop parameters to achieve a decay ratio of 1/4 or better. In addition, achieve loop steady state at least as fast as the loop response time associated with critical damping.
d. Verify loop performance and stability by step changes to setpoint in the field.
e. Submit loop tuning documentation as specified in PART 1 of this Section.

3.9 TRAINING

A. Refer to Section 406126 “Process Control System Training” for general training requirements

B. Furnish training as shown in the table below.

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Control System Overview Seminar	2	12	1	Management
Operator Training (Pre start-up)	8	12	1	Operations
Operator Training (Post start-up)	8	12	1	Operations
Software Maintenance	2	2	1	Maintenance
System Reports and Historian	2	2	1	Maintenance

C. Control System Overview Seminar:

1. Provide Control System Overview seminar for Owner's personnel at Owner's facility. Objective of this seminar is to provide personnel with an overview understanding of Control System. Target seminar material to Owner's management, engineering, and other non-operations personnel. Seminar includes, but not limited to, the following:

    a. An overview of the Control system explaining how the hardware and software supplied under this Contract is used for the operation and control of the facilities.
    b. A block diagram presentation of the Control system showing how and what information flow within the system and what each functional unit does.
    c. An explanation of the operator interfaces including a demonstration of how to use an operator's workstation to monitor, control, navigate, display trends, and all other operational features of the system. Address outside of this course a discussion of process control of individual processes.
    d. A walkthrough of the installed system explaining each of the items covered in the functional units' discussion. Discuss the features and functions of operator controls and interfaces.

D. Operator Control System Training (pre- or post start-up):

1. Cover during operator training plant operation with the control system and use of the HMI display screens, including at a minimum all the following items:

    a. Basics of HMI control and navigation.
    b. Alarming and Interlocks.
    c. Auto functionality of automated processes and HMI control.
    d. Failure modes of equipment and operator responses.

2. Hold a minimum of two operator-training sessions (Pre-Startup) for operators one week before system startup. Use the Simulator specified in this project for the pre-startup training. Hold additional one or two operator-training sessions (Post-Startup) for operators one week after system startup.
3. Hold operator training at the convenience of Owner. Hold this training during the day, late at night, or very early in the morning to accommodate Owner's shift schedule.
4. Operator training is introductory in nature during pre-startup training and more in-depth and detailed during post-startup training.
5. At a minimum, provide the following teaching aids for distribution during Operator training sessions:

    a. Preliminary O&M Manuals (pre-startup); Final O&M Manuals (post-startup).
    b. P&IDs.
    c. Daily syllabus.

6. Fifty percent of the Operator training is "hands on" utilizing the installed Control System to the fullest extent possible. Confirm the operability of the Control System before commencing training. Training performed using a non-functioning Control System is not permitted.

E. Software Maintenance:

1. Provide training of how to back-up PLCs, HMIs, OITs, and any other software in this system.
2. Provide training on all aspects covered in the O&M Software Maintenance Manuals.

3. Provide training on PLC program structure, HMI configuration structure, tips in how to edit programming code, and other items which will supplement the maintenance staff's ability to edit and maintain the programs.

F. Historian and System Reports:

1. Provide training of how to run the reports, how to manually enter data, and how to print and reprint the reports.
2. Provide training on how to execute data queries that are outside of those defined in the reports.
3. Provide training on Historian configuration, report configuration, database maintenance and backup, and repair of failed reports.

END OF SECTION 406863

SECTION 406866 - CONFIGURATION OF CONTROLLER SOFTWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system. Control all equipment in full conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment.

    a. Provide configuration of the DS-PLC provided for all equipment shown on the drawings, except for controls equipment shown being provided as part of a vendor package system.
    b. Provide configuration of the existing DC-PLC, HWKS-PLC provided for all equipment shown on the drawings.
    c. The following process equipment vendors shall provide all programming, configuration and related services required to achieve fully operational vendor-supplied systems. Control all equipment in full conformity with the Contract Drawings and Specifications related to these systems:

        1) Aeration Blowers - Package Plant

        2) Aeration Blowers – Treatment Unit

        3) UV System – PLC replacement

        4) Switchgears

        5) Generators

        6) Power Quality Meters

2. Coordinate all work with plant operating personnel to minimize impacts on daily operation. Note delays caused for any reason and formally submitted to Engineer and Owner in the form of a letter.

3. If referred to anywhere else in the project manual, AE or AESS services include, but are not limited to, those services specified in this Section.
4. The PLC-based control functions at each process equipment vendor's control panel shall include control and operator interface capability plus connectivity to the plant control system for monitoring and/or control as shown in the Contract Drawings. Vendor-supplied PLC programming shall be performed by the associated vendor. The process equipment vendors shall be responsible for coordinating with the Process Control System Supplier (PCSS) to ensure that all functions are properly incorporated into the respective supervisory control panel and plant control system (PCS).
5. Process equipment vendors shall coordinate with the PCSS and provide complete I/O lists and memory map of PLC registers including set points, controls, calculated alarms and variables, etc., to be included on the PCS HMI screens for their respective process equipment PLCs.
6. Process equipment vendors shall coordinate with the PCSS to incorporate any required peer-to-peer messaging for controls and interlocks between their respective process equipment PLCs and other plant PLCs.
7. PCSS is to modify the existing PLC programming of PLC-IHSPS to automate the Irrigation Pump station based on Clearwell level as per control description 406196.

B. Related Requirements:
1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
2. Section 406196 "Process Control Descriptions."
3. Section 406263 "Operator Interface Terminals"
4. Section 406343 "Programmable Logic Controllers."
5. Section 406863 "Configuration of HMI Software."

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): Entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

1.4 PREINSTALLATION MEETINGS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions." The meetings below are in addition to the meetings specified in that section.

1.5 ACTION SUBMITTALS

A. Controller Program Submittal:
1. For each controller, submit the following using the controller manufacturer's built-in printing functions. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. Review will be for general program organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The review will not attempt to confirm the logic works correctly for every loop.

a. PLC programs showing ladder logic, function block, high level language or another controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Clearly present each logic segment, describe the function of each timer, label and define the purpose of each subroutine call, etc. Ensure that program documentation is sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with Drawings. The submittal demonstrates that all logic provided under this project follows the same structure and format and reflects a common programming approach.
b. Submit a memory usage report for the controller. Indicate total memory capacity and unused memory capacity.
c. Submit cross reference index of I/O allocation and controller memory address. Include every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme.

2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit an HMI tag database showing all signals exchanged between the PLCs and HMI. Define any specific communication block memory addresses.

B. Submit all electronic files associated with the controller such that Owner and Engineer can open a complete copy of the controller program using the controllers native programming package.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTROLLER PROGRAMS

A. Develop all application programs in a structured manner and follow an intuitive arrangement so that an instrumentation technician with basic programming knowledge will be able to understand. Utilize standard program templates or subroutines for repetitive logic such as equipment control, flow total calculations, equipment runtime calculations.

B. Make changes to the application programs and software configuration, based on comments during the submittals, the factory tests, the field tests, and during the commissioning process to meet the design intent, at no additional cost to Owner.

END OF SECTION 406866

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SECTION 407000 - INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the general requirements to furnishing, installing, and servicing PCSS provided instruments.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 407113 “Magnetic Flow Meters.”
3. Section 407223 “Radar Level Meters.”
4. Section 407276 “Level Switches.”
5. Section 407313 “Pressure and Differential Pressure Gauges.”
6. Section 407326 “Gauge-Pressure Transmitters.”
7. Section 407466 “Temperature Switches.”

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): Entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

1.4 ACTION SUBMITTALS

A. Submit complete documentation for all field instruments in one comprehensive submittal. Use ISA-TR20.00.01-2007 data sheet format as a cover sheet for each instrument prior to data sheets. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment, sorted by Loop Number.

B. Submit separate data sheets for each instrument type:

1. Plant Equipment Number and ISA tag number per Drawings.
2. Product (item) name used herein and on Drawings.
3. Manufacturer's complete model number.
4. Location of the device.
5. Input - output characteristics.
6. Range, size, and graduations in engineering units.

C. Submit the following information for each instrument type:

1. Include construction details, material descriptions, dimensions of individual components and profiles.
2. Sizing calculations where applicable.
3. Indicate which instruments will be provided with certified calibration data (i.e., all flow metering devices) as part of O&M manual.
4. Include rated capacities, operating characteristics, electrical characteristics and furnished specialties and accessories.
5. Two-wire or four-wire device type as applicable.
6. Indicate which instruments will be provided with manufacturer's maintenance services if specified.

D. Instrument Vendor Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of instrument.
4. Include diagrams for power, signal, and control wiring.

E. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

F. Submit index and data sheets in electronic format as well as hard copies on 8-1/2 inch x 11 inch formats. Submit electronic copies in Microsoft Excel or Word format on USB thumb drive.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Refer to individual instrument specifications for spare parts requirements.

B. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for PCSS requirements regarding submission of maintenance materials.

1.8 QUALITY ASSURANCE

A. Refer to individual instrument specifications for quality assurance requirements as well as which specific instruments require manufacturer's start-up and training services.

B. Provide components compatible with functions required to form complete working system.

C. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for overall quality assurance requirements for PCSS scope of work.

PART 2 - PRODUCTS

2.1 INSTRUMENT TAGS

A. Permanent stainless steel or other non-corrosive material tag firmly attached and indelibly marked with the instrument tag number, as indicated in the Drawings. Tag equipment before shipping to the site.

B. Provide 1/8-inch by 3/8-inch, Type 316 stainless-steel button head machine screws.

C. All supplied instrument transmitters and instrument transmitter elements require a stainless-steel identification tag. Attach tag via stainless steel chain or stainless-steel wire, 24-gauge min, to a non-removable part of the device. Stamp the ISA alphanumeric instrument number as indicated on the P&ID, loop, or detail drawings into the tag. Minimum tag size is 1 inch H x 3 inch W with 3/16 inch high alphanumeric characters.

PART 3 - EXECUTION

3.1 GENERAL

A. See execution requirements in Section 406100 "Process Control and Enterprise Management Systems General Provisions".

B. Unless specifically indicated, do not mount direct reading or electrical transmitting instrumentation on process piping. Mount instrumentation on instrument racks or stands. Provide all instrumentation connections with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for calibration, testing and blow down service will be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections will be provided.

3.2 INSTALLATION

A. See installation requirements in individual specification Sections.

3.3 ATTACHMENTS

A. APPENDIX A - Field Instrument Schedule.

END OF SECTION 407000

DRAWING NO.	ISA TAG NAME AND LOOP NO.	LOOP SUFFIX	TYPE	RANGE	SET POINT	UNITS	LOCATION & DESCRIPTION	PROVIDED BY	SPECIFICATION	INSTALLATION DETAIL (I DRAWING UNLESS OTHERWISE STATED)
DS-IA-1	LE/LT-1005	1	Radar Level Meter	0-15.5	N/A	FT	Filtrate Lift Station Level	40	407223	F
DS-IA-1	LI-1005	1	Level Indicator	N/A	N/A	FT	Filtrate Lift Station Level	40	407813	F
DS-IA-1	LSHH-1001	1	Float Level Switch	N/A	734.6	FT	Filtrate Lift Station Level High High	40	407276	E
DS-IA-1	LSH-1001	1	Float Level Switch	N/A	732.85	FT	Filtrate Lift Station Level High	40	407276	E
DS-IA-1	LSL-1001	1	Float Level Switch	N/A	730.5	FT	Filtrate Lift Station Level Low	40	407276	E
DS-IA-1	LSLL-1001	1	Float Level Switch	N/A	730.2	FT	Filtrate Lift Station Level Low Low	40	407276	E
DS-IA-1	TSH-1001	1	Temperature switch	N/A	N/A	Deg F	Dove Springs Electrical House Temperature	40	407466	-
DS-IB-1	PI-1330	1	Pressure Gauge	0-30	N/A	PSI	Package Plant Aeration Blower No. 1 Discharge Pressure	40	407313	B
DS-IB-1	PI-1330	2	Pressure Gauge	0-30	N/A	PSI	Package Plant Aeration Blower No. 2 Discharge Pressure	40	407313	B
DS-IB-1	PI-1330	3	Pressure Gauge	0-30	N/A	PSI	Package Plant Aeration Blower No. 3 Discharge Pressure	40	407313	B
DS-IB-1	FIT-1102	1	Magnetic Flowmeter	0-1500	N/A	GPM	Aeration Basins Inlet Flow	40	407113	D
DS-IB-1	LSHH-1401	1	Float Level Switch	N/A	747.87	FT	Package Plant Sludge Holding Basin Level High High (Setpoint may vary depending on selected manufacturer)	40	407276	E
DS-IB-1	LSH-1401	1	Float Level Switch	N/A	743.5	FT	Package Plant Sludge Holding Basin Level High (Setpoint may vary depending on selected manufacturer)	40	407276	E
DS-IB-1	LSL-1401	1	Float Level Switch	N/A	740.5	FT	Package Plant Sludge Holding Basin Level Low (Setpoint may vary depending on selected manufacturer)	40	407276	E
DS-IB-1	LSLL-1401	1	Float Level Switch	N/A	740	FT	Package Plant Sludge Holding Basin Level Low Low (Setpoint may vary depending on selected manufacturer)	40	407276	E
DS-ID-1	PI-1310	1B	Pressure Gauge	0-30	N/A	PSI	Aeration Blower No. 1 Discharge Pressure	43	407313	B
DS-ID-1	PI-1310	2B	Pressure Gauge	0-30	N/A	PSI	Aeration Blower No. 2 Discharge Pressure	43	407313	B
DS-ID-1	PT-1311	1	Pressure Transmitter	0-30	N/A	PSI	Treatment No. 1 Aeration Blowers Discharge Pressure	40	407326	C
DS-ID-1	PIT-1311	1	Pressure Indicator Transmitter	0-30	N/A	PSI	Treatment No. 1 Aeration Blowers Discharge Pressure	40	407813	C
DS-ID-2	PI-1310	3B	Pressure Gauge	0-30	N/A	PSI	Aeration Blower No. 3 Discharge Pressure	43	407313	B

DRAWING NO.	ISA TAG NAME AND LOOP NO.	LOOP SUFFIX	TYPE	RANGE	SET POINT	UNITS	LOCATION & DESCRIPTION	PROVIDED BY	SPECIFICATION	INSTALLATION DETAIL (I DRAWING UNLESS OTHERWISE STATED)
DS-ID-2	PI-1310	4B	Pressure Gauge	0-30	N/A	PSI	Aeration Blower No. 4 Discharge Pressure	43	407313	B
DS-ID-2	PT-1311	2	Pressure Transmitter	0-30	N/A	PSI	Treatment No. 2 Aeration Blowers Discharge Pressure	40	407326	C
DS-ID-2	PIT-1311	2	Pressure Indicator Transmitter	0-30	N/A	PSI	Treatment No. 2 Aeration Blowers Discharge Pressure	40	407813	C

SECTION 407113 - MAGNETIC FLOW METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes magnetic flow meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each Magnetic Flow Meter, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and:

1. Package with protective covering for storage
2. Identify with labels describing contents.
3. Magnetic Flow Meters: One per each type of Magnetic Flow Meter installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of Magnetic Flow Meter that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Furnish sensors, field preamplifiers, signal conditioners, offset and span adjustments, amplifiers, transducers, transmitters, control devices, interconnecting cables, and unit conversions and algorithms as required for application.

2.2 MAGNETIC FLOW METERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

    a. ABB Instrumentation
    b. Endress+Hauser
    c. Foxboro
    d. Krohne
    e. Rosemount
    f. Siemens
    g. Sparling
    h. Substitutions: Or equal

B. General:

1. Low-frequency, electromagnetic induction-type flow meter, producing a linear signal directly proportional to flow rate, consisting of flow tube, signal cable, and transmitter.

C. Type:

1. Between-flange mounting.
2. Comply with AWWA M33.

D. Performance and Design Criteria:

1. Process Fluid: Screened Raw Wastewater
2. Flow Rate Range: As shown in the instrument schedule in section 407000.
3. Accuracy: Plus or minus 0.5 percent of actual flow rate over a 30:1 range, within velocity limits of 0.1 to 10 ft/sec.
4. Size: As shown on Drawings and instrument schedule in Section 407000.
5. Flow Tubes:
    a. Body Material: Type 304 stainless steel or equivalent.
6. Liner: Polyurethane
7. Flanges: AWWA Class D Mechanical-type couplings
8. Flange Material: Stainless-steel.
9. Environment: For meters with remote mounted transmitters, meters below grade to be suitable for submergence for up to 48 hours to a depth of 30 feet. Meters above grade to be NEMA 4X (IP65).

E. Electrodes:

1. Type 316L stainless steel.
2. Self-cleaning.

F. Accessories:

1. Provide manufacturer cable between transmitter and receiver. Actual length shall be defined between Electrical Contractor, General Contractor, and PCSS prior to shop drawing submittal.
2. Furnish stainless-steel grounding rings, wires, and gaskets as recommended by the manufacturer. All materials must be suitable for the process and surrounding pipe.

2.3 TRANSMITTERS

A. Manufacturer: Same manufacturer as meter.

B. Transmitter Output:

1. 4- to 20-mA DC analog signal.

C. Housing: NEMA 4X (IP65), suitable for surface or pipe stand mounting.

D. Display:

1. Touch-screen programming, functioning through enclosure window without opening enclosure.
2. Size: Four lines by 16 characters.
3. Type: Backlit digital display.
4. User-selectable engineering units.
5. Readout of diagnostic error messages.

E. Control Power:

1. 120VAC, single phase, 60 Hz.
2. Wire in accordance with Section 260503 “Equipment Wiring Connections.”
3. Provide local transformers as required.

F. Mounting:

1. Mounting: Remote, up to 300 feet from flow meter.
2. Remote Mounting Locations Less Than 4 feet above Grade: Provide stainless-steel mounting posts.

G. Transmitter Communication Interface: HART.

H. Required Accessories:

1. A fully configurable and locally viewable totalizer integral to the transmitter.
2. Current signal output simulation.
3. Empty pipe detection.
4. Self-diagnostics.
5. Signal Cable: Provided by flow meter manufacturer.
6. Automatic zero adjust.

2.4 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of meters according to AWWA M6.

B. Owner Inspection:

1. Make completed flow meter available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing:

1. Allow witnessing of factory inspections and tests at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

D. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where magnetic flow meters will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions”.
2. Section 407000 “Instrumentation for Process Systems”.

C. Magnetic flow meters will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions”.
2. Section 407000 “Instrumentation for Process Systems”.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

A. Not Required

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the manufacturer to provide training to the Owner's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.
2. Provided 1 time and last up to 2 hours in the field.

END OF SECTION 407113

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SECTION 407223 - RADAR LEVEL METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes radar level meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each radar level meter, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Radar level meters: One of each type of radar level meter installed.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of each radar level meter that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 NON- CONTACT RADAR-LEVEL MEASUREMENT DEVICE

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Rosemount.
b. Siemens Automation Technology; Siemens AG Industry Sector.

c. VEGA Americas, Inc.
d. Substitutions: Or equal.

B. Type:

1. Non-contact, microwave type level meter.
2. High 24-26 GHZ radar frequency for continuous level measurement of slurry, corrosive liquids, low dielectric liquids and bulk solids in storage vessels. Also for measurement in tall or narrow tanks and for processes that have high pressure and temperature.
3. Antenna: Rod, Horn, Parabolic, or Encapsulated.

C. Function/Performance:

1. Measuring Range: As shown in the instrument schedule in Section 407000 “Instrumentation for Process Systems”.
2. Accuracy: Plus or minus 0.32 inches.
3. Operating Temperature: -40 to 149 degrees F.
4. Output: Isolated 4-20 mA output.
5. Display: Digital indicator displaying level or volume in engineering units or percent, as indicated on the Drawings or in the Instrument Device Schedule.
6. Diagnostics: On-screen instructions and display of self-diagnostics.

D. Physical:

1. Antenna: PVDF, Type 316 stainless steel, Hastelloy C or other material depending upon its compatibility to the process in which it is measuring.
2. Provide integral antenna with transmitter
3. Provide with a minimum Class 150 pound (DN 80, PN16) mounting flange to match vessel flange size, material and class when mounted on vessel.
4. NEMA 4X (IP66) housing. Where the instrument is installed in a hazardous area, provide explosion-proof housing, approved for Class I, Division 1, Groups C and D installation and certified for installation of the antenna in a Class I, Division 1, Groups C and D (Zone 0) environment.
5. Power Requirements**:** 24 VDC loop powered
6. Remote Display: Digital indicator by the same manufacturer as the meter, displaying level in engineering units or percent, as indicated on the Drawings or in the instrument schedule. Display unit used to remotely program the transmitter.

E. Required Accessories:

1. Hand-held programmer where required for configuration and calibration of the instrument.

F. Manufacturer Start-up and Training services:

1. Provide manufacturer's start-up and training services as specified in the start-up and training services paragraph.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where radar level meters will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Comply with NEC.

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Perform the tests and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121 “Process Control System Testing”.

B. Radar level meters will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121 “Process Control System Testing”.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the manufacturer to provide training to the Owner's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.
2. Training to be provided 1 time and can last up to 2 hours in the field.

END OF SECTION 407223

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SECTION 407276 - LEVEL SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes level switches.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Level Switches: One per each type of Float Switch installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace float switches that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FLOAT SWITCHES

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:

a. Contegra FS 90.
b. Evoqua Water Technologies Model 9G-EF.

B. Type:

1. Mercury free ball float switch.

C. Function/Performance:

a. Differential: Less than 8-inch.
b. Type of Switch: SPDT snap switch.
c. Switch Rating: 1A at 120 VAC or 100 VA @ 120 VAC.

D. Physical:

1. Type 316 stainless steel, Teflon, or non-stick coating, minimum 5 in diameter.
2. Totally encapsulated switch.
3. Heavy-duty cable, PVC, or equivalent jacketed integral to float.

E. Required Accessories:

1. Provide stainless steel hardware.
2. Lead wire to be waterproof cable of sufficient length so that no splice or junction box is required in the vault.
3. Provide cast-aluminum weatherproof junction box outside the sump pit with terminals for all floats and tapped as required for conduit connections.
4. Provide mounting equipment as shown on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where level switch will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radius.

3.3 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the following :

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

B. Level switches will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407276

SECTION 407313 - PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pressure and differential pressure gauges.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each Pressure and Differential Pressure Gauge, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Pressure and Differential Pressure Gauges: One per each type of Gauge installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:

a. Ametek US Gauge.
b. Ashcroft.
c. Weksler.

B. Type:

1. Bourdon tube actuated dial face pressure and differential pressure gauge.

C. Function/Performance:

1. Accuracy: Plus or minus 1.0 percent of full-scale range.
2. Provide for zero-reading adjustment.
3. Adjusting Screws: Accessible from rear of case without need for disassembly.
4. Comply with ASME B40.100.

D. Physical:

1. Dial:

a. Nominal Diameter: 4-1/2 inches.
b. Face: White, laminated plastic dials with black graduations.
c. Scale: Extend over arc not less than 200 and not more than 270 degrees.
d. Ranges and Graduation Units: As indicated on instrument schedule.

2. Cases:

a. Liquid filled.
b. Material: Phenolic or Type 316 stainless steel.
c. Provide removable rear plate.
d. For gauge pressure, vented case for temperature/atmospheric compensation
e. Windows:

1) Material: Clear acrylic or shatterproof glass.
2) Thickness: 1/8 inch.
3) Provide gasket.

3. Bourdon Tubes:

a. Material: Stainless steel, to brass socket.
b. Provide welded, stress-relieved joints.

4. Connection:

a. Location: Bottom.
b. Socket:

1) 1/2-inch NPT male thread.
2) Material: Brass forging.
3) Extend minimum 1-1/4 inches below gage cases.
4) Provide wrench flats.

c. Mounting: Stem or surface

E. Required Accessories:

1. Pressure Snubber:

a. Material: Type 316 stainless steel.
b. Provide isolation valve.

2. Shutoff Cocks: Furnished by gauge manufacturer.
3. Provide diaphragm seals as shown on Drawings.
4. Special scales: Engineer reserves the right to require special scales and/or calibration if the manufacturer's standard is not suitable for the application.
5. Liquid fill gauges at the factory.
6. For each differential pressure switch, provide a three-valve manifold. Manifold to be Type 316 stainless steel. Manifolds to be D/A Manufacturing or Anderson Greenwood.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pipelines and process area for suitable conditions where pressure gauges will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA.

3.3 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121.20 “Process Control System Testing.”

B. Pressure and differential pressure gauges will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Start-up services include calibration. Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407313

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SECTION 407326 - GAUGE-PRESSURE TRANSMITTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes gauge-pressure transmitters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each Gauge Pressure Transmitter, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Gauge Pressure Transmitters: One per each type of Gauge Pressure Transmitter installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace Gauge Pressure Transmitters that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GAUGE PRESSURE TRANSMITTERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:

a. ABB 266HRH.
b. Foxboro IGP20.
c. Rosemount 3051CG.
d. Siemens Sitrans P DS III.
e. Smar LD301M.

A. Type:

1. Microprocessor based, intelligent type.

B. Function/Performance:

1. Measuring Range: As shown in the instrument schedule in Section 407000.
2. Accuracy: 0.075 percent of span.
3. Operating Temperature: -4 to 176 degrees F.
4. Temperature Effect: Combined temperature effects less than 0.2 percent of maximum span per 82 degrees F temperature change.
5. Output Signal: 4 to 20 mA DC linear with pressure, with HART protocol.
6. Output: Zero adjustable over the range of the instrument calibrated span is greater than the minimum calibrated span.
7. Stability: 0.05 percent of upper range limit for 1 year.
8. Response Time: Less than 1 ms.
9. Display: Digital indicator displaying pressure in the engineering units indicated on the Drawings or in the instrument device schedule.
10. Diagnostics:

    a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
    b. Simulation capability for inputs and loop outputs.
    c. Test terminals available to ease connection for test equipment without opening the loop.
    d. Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to be available.

11. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored.

C. Physical:

1. Power Supply: 24 VDC loop power
2. Enclosure:

    a. NEMA 4X (IP66), explosion proof.
    b. Approved for Class I, Division 1, Groups C and D.
    c. Instruments for hazardous locations have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified herein and as indicated on Drawings or in instrument device schedule.

3. Process Wetted Parts (except for ozone/oxygen service):

    a. Isolating diaphragm and other wetted metal parts: Type 316L stainless steel.
    b. Gaskets and O-rings: Teflon.

4. Sensor Fill Fluid (except for ozone/oxygen service): Silicone.

D. Required Accessories:

1. Shutoff Cocks: Furnished by gauge manufacturer.
2. Provide diaphragm seals as shown on Drawings.

2.2 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where gauge pressure transmitter will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections in accordance with the following Sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

B. Gauge-pressure transmitters will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports in accordance with the following Sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, manufacturer to provide training to Owner's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain sensor and transmitter.
2. Provide one time and can last up to two hours in the field.

END OF SECTION 407326

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SECTION 407466 - TEMPERATURE SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes temperature switches.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Single Pole Double Throw (SPDT): A switch with a single input and single output.

B. Double Pole Double Throw (DPDT): A switch with two inputs and two outputs.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each Temperature Switch, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Temperature Switches: One per each type of Temperature Switch installed.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of Temperature Switches that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INDUSTRIAL THERMOSTAT

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:

a. Dayton 6EDY5
b. Johnson Controls A19PRC.
c. PECO Controls TH109.

B. Type:

1. Line voltage mechanical thermostat.
2. Fluid filled coil sensor.

C. Function/Performance:

1. Range: 40 to 100 degrees F.
2. Sensitivity: Plus or minus 3 degrees F.
3. Set Point: Field adjustable and set between 20 and 80 percent of the adjustable range.
4. Deadband: Fixed deadband.
5. Reset: Automatic reset type.
6. Switch Rating: 25 amps at 240VAC.

D. Physical:

1. Input Voltage: 24 to 277VAC.
2. Mounting: Wall-mounted, flat surface.
3. NEMA 4X (IP66) for non-hazardous locations. Where indicated on Drawings to be mounted in hazardous locations, provide explosion proof switch housing, approved for Class I, Division 1, Groups C and D.
4. Switching Arrangement: Single pole double throw (SPDT) unless double pole double throw (DPDT) switches are indicated on the instrument device schedule.

E. Required Accessories:

1. Provide all mounting hardware required for manufacturer recommended installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where temperature switches will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical System.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

B. Temperature switches will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

3.6 Insert "Cleaning" Article for specific requirements for cleaning the completed Work so it functions and performs properly.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, manufacturer to provide training to Owner's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.
2. Provide one time and last up to two hours in the field.

END OF SECTION 407466

SECTION 407813 - INDICATORS AND METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes indicators and meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each Indicator and meter, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Indicators and Meters: One per each type of indicator and meter installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of indicators and meters that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL-MOUNTED DIGITAL INDICATORS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:

a. Precision Digital ProVu Series
b. Red Lion Controls PAXDP Series.

B. Type:

1. Digital indicator.

C. Function/Performance:

1. Accuracy: Plus or minus 0.25 percent of calibrated range.
2. Operating Temperature: -4 to 158 degrees F.
3. Input: One 4 to 20 mA.
4. Output: One 4 to 20 mA.
5. Digital Outputs: Two Form C programmable contacts rated for 5A at 120/240 VAC.
6. Display: 0.56-inch-high efficiency, 5-digit LED display.

7. Indicator Failure: Failure of the indicator will not cause failure of the 4-20 mA loop.

D. Physical:

1. Suitable for panel mounting.
2. Case size nominal 2.5-inch-high by 5-inch-wide by 6 inch deep.
3. NEMA 4X and explosion-proof approved for Class I, Division 1, Groups C and D areas.
4. Programmable via integrated keypad.
5. Power Requirements: 120 VAC/60 Hz.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where indicators and meters will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections in accordance with the following Sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

C. Indicators and meters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports in accordance with the following Sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

2. Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument.

    a. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC).
    b. Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, manufacturer to provide training to Owner's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the indicators and meters.
2. Provide one time and last up to two hours in the field.

END OF SECTION 407813

SECTION 407816 - INDICATING LIGHTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes indicating lights.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each indicating light, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Indicating Lights: One per each type of indicating light installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

C. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of Indicating Lights that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PILOT TYPE INDICATING LIGHTS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal**:**

a. Cutler-Hammer.
b. Allen Bradley.
c. General Electric.
d. Square D.
e. Crouse Hinds (NEMA 7).

B. Type:

1. Energy efficient, Solid-State LED Lamps.

C. Function/Performance:

1. Low voltage LED lamps suitable for the voltage supplied.
2. Integral reduced voltage transformers for 120VAC powered lights.
3. Replaceable lamps from the front of the unit.

D. Physical:

1. NEMA 4X.
2. Lens caps: 1.18-inch diameter.
3. Lens color:

a. Running, on, open - Red.
b. Stopped, off, closed - Green.
c. Alarm - Amber.
d. White - Power on.
e. Blue - All other status indications not covered by the above.

4. Provide legend faceplates engraved to indicate the required function of each device.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where indicating lights will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections in accordance with the following Sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

C. Indicating lights will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports in accordance with the following Sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
   Section 406121.20 “Process Control System Testing.”

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407816

SECTION 407819 - SWITCHES AND PUSH BUTTONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes switches and push buttons.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
   1. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELECTOR SWITCHES AND PUSHBUTTONS

A. Manufacturers:

   1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

      a. Allen Bradley.
      b. Crouse Hinds (NEMA 7).
      c. Cutler-Hammer.
      d. General Electric.
      e. Square D.
      f. Substitutions: Or equal

B. Type:

   1. Heavy-duty oil tight type with stackable contact blocks.

C. Function/Performance:

   1. Contact arrangement and switching action as required for the control system specified.
   2. For 120VAC service, provide contacts rated 10A at 120VAC. For 24VDC service, provide silver sliding contacts rated 5A at 125VDC. For electronic (millivolt/milliamp) switching, provide contacts rated 1A at 28VDC.

D. Physical:

   1. NEMA 4X.
   2. Size: 1.18-inch (30 mm) diameter.
   3. Pushbuttons: Flush type operators.
   4. Selector switches: Knob or wing lever operators.

5. Provide legend plates denoting switch/pushbutton position and/or function.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where switches and push buttons will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Switches and push buttons will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407819

SECTION 407853 - RELAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes relays.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each relays, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Relays: One of each type of relays installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace relays that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE RELAYS AND TIME DELAYS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:

a. Allen Bradley.
b. IDEC.
c. Omron.
d. Schneider Electric.

B. Type:

1. General purpose plug-in type.

C. Function/Performance:

1. Provide all relays with number of poles required to meet the design intent.
2. Mechanical life expectancy to be in excess of 10 million.
3. Provide solid state time delays with polarity protection (DC units) and transient protection.

4. Time delay units in ranges from 0.1 second to 4.5 hours.

D. Physical:

1. Mounting: DIN rail.
2. Integral indicating light to indicate if relay is energized.
3. For 120 VAC service, provide contacts rated 10A at 120VAC. For 24 VDC service, provide contacts rated 5A at 28VDC. For electronic (milliamp/millivolt) switching applicator, provide gold plated contacts rated for electronic service.
4. Dust and moisture resistant covers.

E. Required Accessories:

1. Provide DIN rail mounted relay socket for each relay, rated 10A at 300VAC.
2. Provide relay retaining clips as required.
3. Provide LED/neon lamp indicator.
4. Provide diode suppression.

2.2 SIGNAL RELAY SWITCHES (CURRENT TRIPS)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:

a. Acromag.
b. Action Instruments Slim Pak.

B. Type:

1. Solid state, ASIC technology, electronic type.

C. Functional:

1. Input: 4-20 mA.
2. Output: Isolated contact output, double pole double throw, rated 5A at 120VAC.
3. Accuracy: 0.1 percent.
4. Protection: Provide RFI protection.
5. Deadband: Adjustable between 0.1 and 5.0 percent of span.
6. Set point Adjustment: Single Point alarms adjustable to trip on rising or falling input signal, dual point alarms adjustable to trip on rising and falling input signals.
7. Repeatability: Trip point repeatability at least 0.1 percent of span.

D. Physical:

1. Mounting: DIN rail.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where relays will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Refer to Section 406717 “Industrial Enclosures.”

3.2 INSTALLATION

A. UL: Comply with UL508A for installation of relays.

B. NFPA: Comply with NFPA 70 (NEC) for installation of relays.

C. Comply with NECA 1.

D. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections in accordance with the following Sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

C. Annunciators will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports in accordance with the following Sections:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

2. Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Test relays during the loop testing from the field device, through the relay, to the PLC I/O module and to the HMI/SCADA graphics.

3.7 DEMONSTRATION

A. Refer to Section 406717 “Industrial Enclosures.”

END OF SECTION 407853

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SECTION 407856 - ISOLATORS, INTRINSICALLY SAFE BARRIERS, AND SURGE SUPPRESSORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Isolators, intrinsically safe barriers, and surge suppressors.
2. Lightning/surge protection to protect electronic instrumentation system from induced surges propagating along the signal and power supply lines.
3. Analog surge protection for all 4-20 mA signals to and from field and PLC, or pumps and PLC.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”
4. Section 406733 “Panel Wiring.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions. Shop Drawings:

1.4 Refer to Section 406100 “Process Control and Enterprise Management System General Provisions. INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Isolators, Intrinsically Safe Barriers, and Surge Suppressors: Furnish two of each type installed.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.8 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.9 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Warranty Period: Provide next day on-site service covering parts and labor 2 years from date of purchase. On-site service is to be performed by an authorized representative of manufacturer.

PART 2 - PRODUCTS

2.1 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:

a. Acromag.
b. Action Instruments Slim Pak.

B. Type:

1. Solid state, ASIC technology; electronic type.

C. Function/Performance:

1. Accuracy: 0.15 percent.
2. Inputs: Current, voltage, frequency, temperature, or resistance as required.
3. Outputs: Current or voltage as required.
4. Isolation: Complete isolation between input circuitry, output circuitry, and the power supply.

5. Adjustments: Zero and span adjustment.
6. Protection: Provide RFI protection.

D. Physical:

1. Mounting: DIN Rail.

2.2 INTRINSIC SAFETY BARRIERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
   a. Gems – 54800 (4-20mA) and 65800 (dry contacts).
   b. R. Stahl - Intrinspak
   c. Siemens Water Technologies – IS1 (4-20mA) and IS6 (dry contacts).

B. Type:

1. Solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.

C. Function/Performance:

1. Provide a barrier for instrumentation and equipment transmitting analog or digital signals that originate in a hazardous area as indicated in the design documents.
2. Locate in non-hazardous areas.
3. Match power supply provided.

D. Physical:

1. Mounting: DIN Rail.

2.3 INTRINSIC SAFETY BARRIERS (FOR 2-WIRE TRANSMITTER SYSTEMS)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
   a. Gems.
   b. P&F.
   c. Unitech.

B. Type:

1. Passive devices requiring no external voltage supply.

C. Function/Performance:

1. Supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.
2. Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).

D. Physical:

1. Mounting: DIN Rail.

2.4 SURGE PROTECTION FOR CONTROL SYSTEMS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following or equal:

a. Citel DLA series.
b. MJ8 series.
c. MTL Surge Technologies (Telematic) NP Series.
d. Phoenix Contact PlugTrab Series.
e. Transtector FSP Series.

B. Function/Performance:

1. Provides surge protection of electronic instrumentation from induced surges propagated along the signal and power supply lines from lightning, utility, or the plan electrical systems.
2. Protection system lower than the instrument withstand level, while not interfering with normal operation.
3. Maintenance free and self-restoring.
4. Response time: Less than 50 nanoseconds.
5. Discharge surge current: At least 8kA (at an 8x20µs impulse waveform).

C. Required Surge Protection:

1. Analog Signal (4-20mA) Circuits:

a. Provide surge protection where any part of the circuit is outside of the building envelope.
b. Protect circuits at both the transmitter and the control system end of the circuit.
c. Mount transmitter surge protectors in separate NEMA 4X enclosure or conduit mount.
d. Use of a single device to protect both 120VAC and 4-20mA wires is acceptable.
e. Provide surge protector from one of the following or equal:

1) Phoenix Contact PT Series.
2) MTL Surge Technologies (Telematic) TP48.
3) Citel DLA or CAD series.

2. Control Panel Power Feed (120VAC):

    a. Provide protection of 120VAC power feed into control panels, instruments, and control room equipment.
    b. Provide surge protector from one of the following or equal:

        1) Citel DS40 series.
        2) MCG Surge Protection 400 Series.
        3) Phoenix Contact “Mains-PlugTrab”.
        4) Transtector ACP-100BW Series.

3. Non-Fiber Based Data Highway or Communications Circuits:

    a. Provide protection on all communication and data highway circuits that leave a building or are routed external to a building.
    b. Provide circuit protection at both ends of the line.
    c. Provide surge protector from one of the following or equal:

        1) Phoenix Contact PlugTrab Series.
        2) Transtector FSP Series.
        3) MTL Surge Technologies (Telematic) NP Series.
        4) Citel DLA series.
        5) MJ8 series.

4. RF Coaxial Cable:

    a. Provide protection on communication cables between radios and antennas, mounted either inside the panel, or in the wall of the enclosure.
    b. Protected in accordance with NEMA and UL 497E standards.
    c. Provide surge protector from one of the following or equal:

        1) Citel P8AX series.
        2) Polyphaser.

5. Inductive Loads:

    a. Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120VA or less that drive solenoid, coil, or motor loads.

6. Telephone Circuits:

    a. Provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.
    b. Provide surge protector from one of the following or equal:

        1) Citel DLA-170.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and rooms for suitable conditions where computers will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 IDENTIFICATION

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121.20 “Process Control System Testing.”

B. Isolators, intrinsically safe barriers, and surge suppressors will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports in accordance with the following:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121.20 “Process Control System Testing.”

3.5 STARTUP SERVICE

A. Perform startup service

1. Complete installation and startup checks according to manufacturer's written instructions.

END OF SECTION 407856

SECTION 431117 - MULTISTAGE CENTRIFUGAL BLOWER REFURBISHMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Shipment of existing three Multistage Centrifugal Blowers at Dove Springs WWTP to Blower Manufacturer factory for testing and refurbishment of existing blowers including new motors, new skids and local control stations.
2. Shipment and then re-installation of refurbished equipment at Dove Springs WWTP Temporary Package Plant.

B. Necessary and ancillary accessory equipment and auxiliaries, whether specifically mentioned in this Section or not. Include supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation, and maintenance of the equipment.

C. Related Requirements:

1. Section 260519 “Low-Voltage Electrical Power Conductors and Cables” for wiring to blower motor and manufacturers local control station.
2. Section 400524 “Steel Process Pipe”.
3. Section 400507 “Hangers and Supports for Process Piping” for pipe hangers and supports.
4. Section 400593.23 “Low-Voltage Motor Requirements for Process Equipment” for electric motors.
5. Division 26 for electrical work, except as specified in this Section.
6. Section 406100 “Process Control and Enterprise Management Systems” for instrumentation and control wiring, except for factory wired equipment and lockout stop pushbutton stations.
7. Section 406121.20 “Process Control System Testing”.
8. Section 406126 “Process Control System Training”.
9. Section 406196 “Process Control Descriptions”.

1.3 ACTION SUBMITTALS

A. Product Data:

1. General:

a. Manufacturer's name and address.
b. Manufacturer's model number.

c. Bill of materials for equipment supplied.
d. Total weight of equipment including the weight of all major items or components.
e. Center of gravity and lifting point locations for free-standing equipment.

2. Blower and Base Frame: Minimum data to be included on nameplates.

   a. Shaft Coupling: Make, model number, dimensions, materials of construction and alignment tolerances.

3. Filter/Silencer Data (Inlet):

   a. Manufacturer.
   b. Model Number.
   c. Size.
   d. Dimensions.
   e. Head loss at rated flow (as specified).
   f. Materials of construction.

4. Monitoring and Control System: Supplied local control station.

   a. Written description of operating functions describing logic and sequences associated with blower startup, operation, surge suppression protection, and shutdown.
   b. Descriptive Literature Bulletins and/or Catalogs for the following:

      1) Components installed panel.
      2) Components installed as part of panel.
      3) Supplied field instrumentation.

5. Blower Local Control Station:

   a. Dimension and layout details.
   b. Materials of construction.
   c. Bill of Materials: Complete and detailed including brand names, OEM catalog numbers, and literature on control devices such as, but not limited to:

      1) Fused disconnects.
      2) Terminal blocks.
      3) Alarm devices.
      4) Switches and lights.
      5) Timers, relays, and related equipment.
      6) Programmable Logic Controller (PLC).
      7) Operator Interface Terminal (OIT).

   d. Screen shots of OIT screens.
   e. PLC database including available monitoring and alarm tags to be monitored.
   f. Detailed point-to-point wiring diagrams showing terminal blocks and internal wire tag numbers and block wiring diagrams that show number, type and size of conductors connected externally to blower local control station.

6. Complete Wiring Diagrams: Elementary or control schematics, including coordination with other electrical control devices such as the blower motor reduced voltage starter and the plant PLC.

    a. Suitable control panel outline drawings before proceeding with manufacture.

        1) Standard preprinted sheets or drawings marked to indicate applicability to this contract is not acceptable.
        2) Individual electrical control schematics and wiring diagrams for each valve operator with external interfaces, identified exactly as detailed on electrical and instrumentation Drawings.

            a) Standard catalogue cut sheets that show typical wiring diagrams only are not acceptable.

B. Electric Motor: Design and product information as specified in Section 400593.23 “Low-Voltage Motor Requirements for Process Equipment” for electric motors.

1. Motor to be compatible with the Reduced Voltage Solid State Starter.
2. Motor Manufacturer to certify that the motors are capable of specified ramp time.

C. Blower Performance Data: Expected performance of blower units at inlet conditions specified.

1. Submit curves for each of the performance condition specified in PART 2 showing how each is affected by variations in inlet conditions.

D. Certified Shop and Installation Drawings: Include at a minimum:

1. Materials, details of construction, dimensions, and anchor bolt locations.
2. Blower Unit Assembly:

    a. Dimensioned and scaled general arrangement drawings.
    b. Cross-sectional view drawings.
    c. Point-to-point wiring diagrams identifying all wire and terminal numbers uniquely.
    d. Drawings cross-referenced to replacement parts list including part number and materials of construction.

3. Motor outline drawings identifying location of field wiring termination cabinets.
4. Process and instrumentation diagram drawings.
5. Control Panel:

    a. Ladder logic diagram drawings for control panel resident hardwiring. Identify internal devices, wire tag numbers, terminal tag numbers, and interconnections with external devices and signals.
    b. Dimensioned and scaled outline drawings identifying the location of internal and external panel mounted equipment and devices along with a description of such equipment and devices.

E. Manufacturer Reports: Test reports and certificates for the following tests:

3

1. Post-refurbishment compressor performance tests per ASME testing method PTC-13.
2. Equipment installation certificates: Furnish a certificate from equipment manufacturer stating installation of equipment is satisfactory, and ready for operation and operating personnel have been suitably instructed in the operation, lubrication, and care of each unit.
3. Motor routine test report.

1.4 INFORMATIONAL SUBMITTALS

A. Description of shop prime painting and shop finish painting systems.

B. Manufacturers' Instructions: Submit with Installation and O&M Manual.

C. Source Quality Control Submittals: Results of factory tests and inspections.

D. Field Quality Control Submittals: Results of Contractor furnished tests and inspections including field test reports for blower unit field acceptance tests.

E. Manufacturer Reports:

1. Conduct inventory, condition, and functionality assessment of the existing equipment prior to any alterations of the blowers. Report to include suitability of equipment for future use and identify necessary maintenance items. This assessment shall be submitted prior to commencement of refurbishment at the factory.
2. Certify equipment is installed according to manufacturer instructions. Statement will include the following:

    a. Installation of equipment is satisfactory.
    b. Units are satisfactorily tested, and ready for operation.
    c. Operating personnel have been suitably instructed in the operation and care of the units.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and final orientation of equipment.

B. Warranty: Submit a detailed description of the Manufacturer’s warranty on components and services provided herein for review.

C. Operating and Maintenance Manuals:

1. Prepare data sheets, drawings, equipment lists, maintenance recommendations, troubleshooting recommendations, etc. for components replaced under this Section.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts, Manufacturer Recommended: Ordering information including name, phone number of nearest service center, and pricing. Include gaskets, seals, bearings, and lubrication products.

B. One set of special wrenches, gages, and other devices required for normal operation and maintenance.

1. Package in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended. Complete with lock and duplicate keys.

C. List of blower unit and blower unit motor repair facilities within the United States including addresses, contact names and phone numbers.

D. Recommended summer and winter grades of lubricants along with alternative references to equal products of other manufacturers.

E. One complete set of equipment supplier's recommended spare parts.

F. A list of spare and replacement parts with individual prices and locations where available. Prices to remain in effect for a period of one year after startup and final acceptance.

1.7 QUALITY ASSURANCE

A. Steel, Cast Iron, and Ductile Iron Fabrications: Conform to applicable AWWA, ANSI, and ASME, standards. Heat treatment of metal is required for reduction of stresses due to welding, bending, forming, and machining, etc.

B. Like items of materials/equipment are to be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.

C. Substitution: Equipment other than specified but equal in performance, will be acceptable only if any revisions in the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate the substitution is made at no additional cost to the Owner and approved by the Engineer.

1.8 QUALIFICATIONS

A. Blower Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

1. Successful installations of manufactured blower units in the United States similar in design, type, and service, and comparable in size, head, and capacity to those specified in this Section.
2. Comparable blower units in operation for a period of no fewer than five years.

B. Motor Manufacturer: At least 10 years prior experience in design and manufacture of motors specified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's packaging including application instructions.

B. Inspection: Accept blowers on Site. Inspect for damage.

C. Store blowers according to manufacturer's instructions.

D. Skid mount or crate equipment to protect against damage during shipment.

E. Protect parts so no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and units and equipment are ready for operation.

F. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

G. Mechanical and electrical equipment to be coated, wrapped, and otherwise protected from snow, rain, drippings of any sort, dust, dirt, mud, flood, and condensed water vapor during shipment and while installed in place during construction. Protective coverings to remain in place until work areas are substantially free of construction dust and debris. Submit details of proposed protective measures for approval to Engineer prior to shipment. Follow manufacturer's instructions for long term storage and maintain warranty on equipment.

H. Protect finished surfaces of exposed flanges. Protect by wooden blank flanges, strongly built, and securely bolted thereto.

I. Protect un-painted finished iron or steel surfaces to prevent rust and corrosion.

J. Equip each blower motor with a space heater in the motor enclosure to maintain a motor temperature above the dew point preventing condensation in the enclosure. Contractor will energize the space heaters as soon as motors are delivered to the Site. Heaters are to remain energized until the motors are electrically connected in place and energized by the control circuit.

K. Factory Assembled Parts and Components: Not to be dismantled for shipment unless permission is received in writing from the Engineer.

L. No shipment will be made until approved by the Engineer in writing.

M. Store all equipment delivered to Site.

1.10 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Document field measurements on Shop Drawings.

1.11 WARRANTY

A. Provide refurbished blowers with a warranty for replacement of defective parts provided during refurbishment, assuming Owner has operated the blower under normal conditions, for a period of 2-years from the date of Substantial Completion. Warranty covers all defects or failures of materials or workmanship resulting from normal operation and service during the warranty period.

1. The warranty must stipulate equipment furnished is suitable for purpose intended and is free from defects of material and workmanship for duration of the warranty. If equipment fails to perform as specified, promptly repair or replace defective equipment. without additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:

1. Lone Star Blower.
2. Or Engineer-approved equal.

B. Use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

2.2 SYSTEM DESCRIPTION

A. Existing Multistage blowers to be shipped to Manufacturer’s factory for refurbishment to meet the following objectives:

1. Prior to conducting any work, test each blower package for mechanical integrity for temperature and vibration analysis under full load of the existing motors. If any of the blower packages does not pass the mechanical factory test, notify the engineer prior to proceeding.
2. Meet the performance requirements specified herein for use at the Dove Springs Temporary Package Plant for coarse bubble aeration and airlift pumps.
3. Update motor and local control station to be suitable for outdoor installation.

B. Blower Refurbishment: Existing vertically split, multi-stage, centrifugal type to be direct coupled to a new electric motor. Factory mounted on a new common base.

C. Existing Multistage Blowers Nameplate Data:

1. Blowers 1 and 3 (6-stage):

a. Compressor:

1) Houston Service Industries
2) Size M850
3) Six stages

b. Motor:

1) 125HP
2) Baldor TECO Westinghouse
3) Frame 404TS

2. Blower 2 (7-stage):

a. Compressor:

1) Lone Star Blower
2) Size MC82

3) Seven stages

b. Motor:

1) 150HP
2) Baldor Reliance SuperE
3) Frame 405TS

D. Equipment shall be tested by Manufacturer at the factory to verify adequate condition and suitability for and use by the Owner after refurbishment.

1. For 4-hour continuous duty service at all points within the defined operating range without surging, abnormal noise, excessive vibration or strain, hunting, overloading the main drive motor, or excessive heating of the bearings.
2. Limit heat generation and gain to that specified over the defined capacity operating range.
3. No harmful nor damaging vibrations occur at all points within the defined operating capacity range.
4. Able to operate with multiple units running at a time discharging into a common header. The condition of several units running at a time shall be met and the safety margin between delivery pressure and surge pressure shall be maintained at the same value for each machine operating in parallel.

E. Refurbished components of the Blower systems to consist of the following:
1. Electric motor.
2. Base frame.
3. Inlet air filter/silencer.
4. Compressor and main drive motor bearing temperature monitoring system.
5. Flexible coupling for motor connection.
6. Blower local control station.

2.3 PERFORMANCE REQUIREMENTS

A. Each blower shall be refurbished to meet the following conditions of service:

1. Site Conditions:

1)	Mean Sea Level Elevation:	740 feet.
2)	Atmospheric Pressure:	14.3 psia.
3)	Maximum Inlet Temperature:	110 degrees F.
4)	Minimum Inlet Temperature:	20 degrees F.
5)	Maximum Relative Humidity:	65 percent.
6)	Minimum Relative Humidity:	20 percent.

2. Blower Requirements:

a. Dove Springs WWTP Temporary Package Plant:

1)	Number of Units:	3 total / 2 duty & 1 standby.
a)	Design Air Flow for Each Blower:	2,500 scfm.

b)	Minimum Pressure at Inlet Flange:	14.1 psia.
d)	Discharge Air Pressure:	5.50 psig.
e)	Maximum Motor Power Requirements:	150 HP.
f)	Minimum Rise to Surge at Design Air Flow:	0.75 psig.
h)	Motor Speed:	3600 RPM.

b. Inlet Filters: Headloss of 0.20 psi at maximum inlet flow.

c. Deliver compressed air against a pressure of no less than 6.25 psig without surging.

B. Limit operating sound pressure levels (sum of all octave bands) in a factory test environment to 85 dBa in any direction at a distance of 3 feet from the equipment over the defined capacity range.

C. Blowers operating at or between any combinations of design conditions:

1. Electrical Power Draw of Job Motors: Not to exceed nameplate rating of 150 HP and blowers (new or existing) will not surge.

2.4 COMPRESSORS

A. Materials:

1. Equipment: Designed and proportioned to have strength, stability, and stiffness for the intended service. Provide ample room and facilities for inspection, repairs, and adjustments.
2. Structural Steel Used in Equipment Fabrication: Conform to requirements of ASTM A36. Welding to conform to latest standards of AWS.

B. Nameplates: Provide equipment information nameplates for each major piece of equipment including compressor, main drive motor, valves, local control stations, etc.

1. Construct information nameplates of stainless steel and affix to equipment using stainless steel mechanical fasteners.
2. Nameplate Lettering: Embossed.
3. At a minimum, include the following information on each nameplate:

a. Blower nameplate: Manufacturer’s name, make, model number, serial number, and date of manufacture.
b. Motor nameplate: Electrical voltage requirements and ampere draw at rated voltage.
c. Blower Unit’s Compressor nameplate: Include the following information.

1) Rated capacity: scfm.
2) Rated discharge pressure: psig.
3) Rated impeller speed: rpm.
4) Impeller diameter inches.
5) Isentropic efficiency at rated capacity and discharge pressure (percent).
6) Brake horsepower requirement at rated capacity and discharge pressure.
7) Lubrication oil requirements.

d. Blower unit main drive motor nameplate:

1) All information required by NEMA MG1 20.60.1.
2) Efficiency at rated horsepower output.
3) Power factor at rated horsepower output.
4) Winding insulation system designation and type.
5) Power lead current transformer ratio.
6) Bearing model and serial number.

C. Shaft Coupling:

1. Type: Furnish flexible coupling of not less than 1.5 times the motor nameplate horsepower to connect the motor shaft to the compressor shaft.
2. Material: Elastomeric.
3. Allows either shaft of the blower unit to be decoupled and removed without disturbing or adjusting the other.
4. Provide an OSHA approved steel guard the coupling. Paint guard safety yellow.

D. Base Frame:

1. Mount blower and motor on a common structural steel base plate of adequate size to support the compressor and main drive motor.

    a. Corners to be rounded smooth and welds ground.
    b. Base frame to be free of warping or cupping.
    c. To prevent distortion and facilitate accurate alignment during installation machine contact points between the blower and motor feet and base plate.

2. Provide blower with a minimum of eight molded synthetic rubber base pads, a minimum of 0.5 inches thick.
3. Blower unit base frame is to serve as the mounting platform for the field wiring termination cabinet for the compressor and motor bearing temperature sensors.
4. Cabinet: NEMA 4X stainless steel and sized to adequately contain all required terminations.
5. Terminal blocks, base frame mounted conduit, and wires to be as specified in Division 26.
6. Provide lifting lugs for equipment weighing over 100 pounds.
7. Foundation Bolts, Plates, Nuts and Washers:

    a. Type 316 stainless steel to facilitate installation of the blower unit and control panel.

8. Anchorage and Bearing Pads: As required to mount each blower on its independent concrete base.

    a. Anchors of a size recommended by the manufacturer to be furnished by the installing Contractor.

2.5 ELECTRICAL

A. Motors:

1. Refer to Section 400593.23 “Low-Voltage Motor Requirements for Process Equipment” for electric motors.

2. Squirrel Cage Induction, Premium efficiency and in accordance with latest NEMA, IEEE, ANSI, and ABMA standards where applicable.
3. Power Factor: As required per NEMA MG1
4. Connection: Direct Coupled.
5. Motor Rating: For a minimum turndown of 3:1.
6. Enclosure: Totally enclosed fan cooled.
7. Operate on a 460-volt 3 phase, 60 Hz alternating current system.
8. Motor Speed and Horsepower: As specified in "Performance and Design Criteria."
9. Do not overload motors, nor the service factor reduced when the blowers are operated at any point on the design speed performance curve at the design differential pressure across the blower.
10. Provide 120V space heaters and Bearing 100-ohm platinum RTDs for each motor bearing.

2.6 CONTROL

A. Each blower shall be furnished with a PLC-based local control panel (LCP). All controls and instruments shall fail into a safe condition.

B. Communication with SCADA system: Use: Ethernet cable capable of communicating with Allen Bradley PLC.

C. The enclosure shall be Type 4X rated. Each assembled LCP shall carry a UL label (UL-C for Canadian service) certifying the complete assembled industrial control panel complies with UL 508A.

D. The control panel shall be powered by a 120VAC source as shown in the project drawings and a 120VAC Type2/3 SPD (surge protection device) shall be provided in the panel.

E. Each LCP shall contain provisions for signals to interface with the main motor starter. The starter for the main drive motor shall be installed by the CONTRACTOR as shown on Drawings.

F. Blower Controls: Through a L-O-R switch at a Local Control Station provided under this Section by the Blower Manufacturer.

1. When placed in "Local" position at the Local Control Station, the blower will start. When placed in "OFF" the blower will not run.
2. When placed in "Remote" position at the Local Control Station, the blower will start and stop manually or automatically based on settings at SCADA.
3. All alarms (low suction pressure, high discharge pressure and high discharge temperature) will be hardwired from the enclosure to the motor starter to automatically stop the blower.
4. The blower will also stop by an E-Stop at the Local Control Station provided by Division 26.

G. Readouts and Totalizers: Program the following readouts and totalizer values back to SCADA from each supplied blower.

1. Current (amperes).
2. Run Time (hours).
3. Alarms (type, count).
4. Pressure (psig).

5. Temperature (fahrenheit).

H. I/O channels from the PLC shall be pre-wired to terminal blocks and each circuit shall be individually fused. Discrete output channels shall be pre-wired to interposing relays to provide dry contacts for output signals.

I. Use destination tagging printed on a wire sleeve marker to identify each wire. Destination tagging identifies the landing point of the other end of the wire.

J. Panel mounted selector switches, pushbuttons, and indicators shall include:

1. Emergency stop mushroom button.
2. Remote / Local Selector Switch.
3. Running indicator / pilot light (Green).
4. Alarm indicator / pilot light (Amber).

K. Equip local control panel with the following additional accessories and hardware at a minimum:

1. 24VDC power supply for control power.
2. HMI cover with hinged clear lid.
3. 120VAC Receptacle for temporary laptop use.

L. PLC shall be a model AXC F 2152 as manufactured by Phoenix Contact, or pre-approved equal. At a minimum, the PLC shall meet the following requirements.

1. Ambient temperature operation up to 60 degrees C.
2. Dual Core 800MHz Processor or faster.
3. 512 Mbyte DDR3 SDRAM.
4. 8 Mbyte Program Memory.
5. 16 Mbyte Mass Storage.
6. Realtime Clock.
7. X2 RJ45 Ethernet ports capable of 10/100 Mbps (full duplex).
8. Developed according to security standard IEC 62443.
9. Integrated and configurable firewall.

M. HMI shall be a model BWP 2102W as manufactured by Phoenix Contact, or pre-approved equal. At a minimum the HMI shall meet the following requirements:

1. 7 inch or larger color touchscreen.
2. HTML5 capable.
3. 1024 x 600 pixel resolution.
4. Minimum 65° viewing angle from the sides.
5. X1 RJ45 Ethernet port capable of 10/100 Mbps.
6. X1 USB Host 2.0 interface.

N. HMI programming shall be part of the PLC program and accessible from the controller via HTML5. This functionality is to allow temporary HMI functionality from a device with a web browser in the event of an HMI failure or easy integration of HMI functionality to additional workstations in the facility.

O. A copy of the PLC and HMI programming software shall be provided to Owner.

P. Operating screens (pages) shall provide not only start-stop and operational mode interfaces, but also alarm status and diagnostics. The following features shall be provided as part of the operator interface screens:

1. Status Bar (all screens): Top of every screen shall provide a status bar giving status information for primary functions such as running state, alarms, local/remote, and operation mode. Additionally, it should be indicated on the status bar if there are any bypass or override values enabled (see Settings Screens).
2. Main Menu Buttons (all screens): Left side of each screen shall provide navigation buttons to primary screens starting below the status bar. Navigation buttons should be provided for run control, monitoring, alarms, vendor contact info screen, and a settings menu.
3. Run Control Screens: Run control screens shall provide the primary interface for starting/stopping the blower and changing its output.
4. Monitoring Screens: Monitoring screens shall allow for viewing the blower data and status in different formats at the preference of the operator. The displayed values shall update according to the engineering units selected. At least two visual modes shall be available:

    a. Equipment view showing the blower package with live values and status indicators.
    b. List view showing the live values for each parameter in a list format with readings for related instruments grouped together.

5. Alarm Screen: Show any recent alarm conditions from the equipment. The list of alarms shall be configurable to show the alarm history (active and inactive alarms) or only active alarms. The alarm history shall only be resettable from a settings screen and only when using a technician or administrative level login. The alarm screen shall show a date and time stamp of the last time the alarm history was cleared.
6. Settings Screens: Be viewable under all login levels but shall only allow changes to setpoints and configuration under a technician or administrative level login. Any settings related to the operation of the equipment shall be available via the HMI. This includes, but is not limited to, scaling values, alarm, and trip setpoints, timer settings, and other configuration related items. Additionally, each instrument shall have options for an override value or to bypass trips related to the instrument. A bypass or override may only be enabled under a technician or administrative level login and is intended only for temporary use but would provide capability for the blower to be operated in the event of a failed sensor until a replacement can be installed.

Q. Each blower LCP shall contain controls for blower motor starting, blower output control, surge, and overload detection, monitoring and protection from other instruments equipped, shutdown control, alarm and emergency shutdown systems.

R. LCP shall be capable of being operated in either a Manual or Auto mode. Auto mode shall operate the blower either based on a constant power output or constant discharge pressure (operator selected). No matter what mode the control system is operating in, set point constraints shall be provided to keep the blower in an acceptable operating range between surge and overload.

S. Blowers shall start when initiated by the local start signal or a remote start signal when in remote mode. Once all pre-start permissives are confirmed, the blower motor shall be started. A feedback signal from the main motor starter shall confirm that the main drive motor has been energized.

Provide a sequence fail alarm and trip if any portion of the start, run, or stop sequence is not properly executed.

T. Monitoring and Safety Shutdowns / Alarms: Each instrument shall be able to be enabled, disabled, or remapped to a different input/output channel via the HMI interface without any programming changes needed. While not all the following functionalities might be used with the initial instrumentation, the functionality shall be capable of being enabled if instruments are added in the future. The LCP shall contain alarm and shutdown logic for the following functionality.

1. E-Stop.
2. Main Motor Starter Monitoring.
3. Blower Surge.
4. Motor Overload.
5. Motor Bearing Temperature.
6. Blower Bearing Temperature

U. Surge and overload events shall be avoided using active measures performed by the control system. If the blower system is approaching a surge or overload condition, the control system shall intervene and adjust the blower inlet valve and output setpoint to avoid surge or overload. If avoidance of surge or overload is not possible, the control panel shall trip the blower offline.

V. When a blower inlet temperature sensor in equipped and enabled, the local control panel shall be capable of providing temperature compensated surge protection to increase blower flow range.

W. Data communication shall be provided between the PLC and the plant systems via the EtherNet IP protocol. Configuring the interface to the plant system shall be the responsibility of the systems integrator; however, the Manufacturer shall actively participate by providing proper interface documentation and support as needed.

2.7 FINISHES

A. Blowers and Discharge Piping Accessories:

1. Factory finish paint per manufacturer's standard and matching existing skid motor/ mount as possible for high temperature paint. Submit description of surface preparation and paint with shop drawings.
2. Appurtenances to receive shop prime paint as part of the work of this Section.
3. Do not paint stainless steel surfaces.

2.8 INSTRUMENTATION

A. RTD Monitor System:

1. Include 100 ohm platinum RTD's embedded in each loaded bearing.
2. RTD's monitored by the blower LCP. The LCP to include a protective relay system to shut down the motor on high bearing temperature and annunciate the fault.
3. The system must monitor and display actual bearing temperature.
4. Include an adjustable alarm feature such that when bearings reach the selected temperature, an alarm light illuminates until reset and the unit shuts down.

B. Anchorage and Bearing Pads:

1. As required to mount each blower on its independent concrete base. Anchors of a size recommended by the manufacturer to be furnished by the installing Contractor.

2.9 ACOUSTICAL ENCLOSURE (NOT USED)

2.10 ACCESSORIES

A. Inlet Filters/Silencers: For all (3) three blower units.

1. Provide each blower unit with an inlet air filter with integral silencer and weather hood.
2. Inlet filter vertically mounted in the configuration shown on Drawings.
    a. Dry type Cartridge style.
    b. 120 percent of design volume.
    c. Manufacturers:
    d. Panel Style by:
        1) TriVent PO9 Series by Endustra.
        2) Universal CCS-10 with Concentric Redcuer
    e. Engineer-approved equal.
3. Furnish each air filter/silencer with:
    a. Tap for connection of gauge to the filter/silencer housing.
    b. Mounting hardware.
    c. Other appurtenances required for a complete differential pressure indication system.
4. Maximum clean filter pressure drop of the inlet filter/silencer with the elements installed to be 0.09 psig. Maximum pressure drop with dirty inlet filters to be 0.30 psig.
5. Filter Elements:
    a. Cartridge Style:
        1) Circular, interchangeable element options.
        2) Removable weather hood for easy access to filter element.
        3) Filter element media: Pleated felt with 98 percent removal of particles greater than 10 microns.
    b. Size filters for a maximum face velocity of 575 ft/min at peak air flow.
6. Connect the filter/silencer to the blower inlet via the inlet spool piece provided by the contractor.

2.11 SOURCE QUALITY CONTROL

A. Prior to commencing motor and skid replacement, test each blower in accordance with ASME PTC-13 to confirm capability of blowers to meet performance requirements specified.

B. Test sound pressure level from the equipment in accordance with CAGI S5.1 or AMCA 300-67 and include contributions from the main drive motor.
   1. Test for noise and vibration in accordance with IEEE test procedures.
   2. Furnish a certified motor data sheet for approval prior to shipment.

C. At least 30 days prior to scheduled testing, submit test procedures to the Engineer for review.

D. Upon completion of assembly, each blower, motor skid to be functionally tested with the local control station (LCS) connected to all skidded instruments, electric valves and appurtenances as applicable.

E. Test Results of Motors, Blowers and Package Functional Tests: Include in the Operations and Maintenance Manual.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation: According to manufacturer's instructions.

B. Install blower unit and appurtenances in strict accordance with blower manufacturer / supplier’s instructions and recommendations. Make necessary adjustments to provide complete and satisfactory operation upon completion of the Contract.

C. Provide blower field alignment by a qualified millwright to meet blower manufacturer instructions and specifications.

D. Support new piping to preclude the possibility of exerting undue forces and moments on the blower flanges. Provide suitable expansion joints to isolate the blowers from the piping system. Mount blower on a flat and level concrete equipment pad of the dimensions shown on the Drawings.

E. Install blower base on suitable anti vibration strips. Install blower and motor parts so that all items revolve smoothly and are free of excessive noise and vibration.

F. Deviation of Pipe Connection and Arrangements from Drawings: Acceptable, if new air pipe arrangement is furnished as approved by the Engineer.

G. Installation to include furnishing the required grease for initial operation. The grades of grease to be in accordance with the manufacturer's recommendations.

H. Field Tests: Do not conduct until such time that the entire installation is complete and ready for testing.

I. Install a temporary heavy wire mesh using Type 304 stainless steel wire, providing a 1/2 inch maximum mesh on blower inlet, to prevent objects inadvertently left in the air inlet system from entering the blower. Remove mesh after initial operation and just prior to field testing.

3.2 FIELD QUALITY CONTROL

A. After the installation of the blowers, motors, controls and all appurtenances, each complete blower unit will be subject to field acceptance tests under actual operating conditions.

B. Field acceptance tests will determine the characteristics of each blower unit and in addition will demonstrate that under all conditions of operation each unit:

1. Has not been damaged by transportation or installation.
2. Has been properly installed.
3. Has no mechanical defects.
4. Is in proper alignment.
5. Has been properly connected.
6. Is free of overheating of any parts.
7. Is free of objectionable vibration and noise.
8. Is free of overloading of any parts.

C. Conduct field acceptance testing after installation of all equipment has been completed and operated for a sufficient period to make all desirable corrections and adjustments. Tests to prove that operation of each blower unit and all associated equipment is satisfactory and in compliance with this Section.

D. During the field acceptance tests, each unit to be operated for a minimum of 4 hours.

E. Take readings at 30-minute intervals and record on suitable log sheets.

1. Include data from the following:

a. Pressure and temperature gages.
b. Power (Amps).
c. SCFM output (Calculated).
d. All other information necessary to calculate the actual performance characteristics of the blower, driver and ancillary equipment.

2. Coordinate connection of analog cables for data readout from the motor starter to be provided by the electrical contractor.

F. Submit a written report to Engineer tabulating equipment tested, test results, problems encountered and corrective action to be taken within two weeks after test completion.

G. Mutually arrange and coordinate with Owner's plant personnel and representatives.

1. Schedule testing procedures with the full knowledge and consent of Engineer.
2. Schedule should not adversely affect the operation of plant facilities.

H. Units Failing to meet Performance Test:

1. Take corrective action and retest to assure full compliance with the Specifications.
2. Submit a revised written report to the Engineer.

I. A 7-day operating period of stable and vibration-free operation is required for each blower unit prior to final acceptance.

J. Vibration tests:

1. No harmful vibration in the blower units or in the system piping.
2. Vibration not to exceed specified limits.

K. Manufacturer Service:

1. Provide services of a factory certified service engineer specifically trained in the installation, start-up, testing, operation, and maintenance of the equipment as herein specified.
2. A direct, full-time employee of the blower manufacturer or a representative who is factory-trained and certified to perform these services. Submit qualifications of service engineer for approval.
3. Services of the blower manufacturer/supplier to be in accordance with this Section.

    a. Service time to include assistance as required with installation, startup, testing, programming, calibration, and training.
    b. Provide a total of two 8-hour days for field services.

        1) Hours suggested are exclusive of travel time and do not relieve Contractor of the obligation to provide sufficient service to place the equipment in satisfactory operation.

    c. Provide one 8-hour day at the site for service inspections during the first year of actual operation, in addition to the days indicated above, for use at the Owner's request and exclusive of repair, malfunction or other troubleshooting service calls.

4. Blower manufacturer/supplier will advise, consult, and instruct on installation procedures and adjustments and inspect the equipment during installation (i.e., provide installation oversight).
5. Blower manufacturer/supplier is responsible for the inspection and start-up of the equipment. Additionally, blower manufacturer/supplier is to certify the equipment has been properly assembled, lubricants have been properly installed, electrical connections have been properly made, protective set points have been properly adjusted, and that the equipment is ready for service.

3.3 DEMONSTRATION AND TRAINING

A. Manufacturer's representative will provide both operational and maintenance instruction of Owner's personnel.

B. Training will be given at times convenient to the operations and maintenance teams being trained considering operational shifts and duties while on shift. Training services is required to be recorded. Manufacturer to coordinate with Owner for recording efforts. Upon completion of training, provide digital videography to Owner.

1. Operational training to include the following at a minimum:

    a. Theory of operation.
    b. Troubleshooting guidance.
    c. Recognizing normal and abnormal operating conditions.
    d. Step-by-step startup and shutdown procedures.

e. Discussion of operational limitations.

2. Maintenance training to include the following at a minimum:

   a. Replacement part identification and ordering procedures.
   b. Lubrication procedures, including drain-down and refill procedures.
   c. Recommended routine preventive maintenance procedures.
   d. Troubleshooting and diagnostic procedures.
   e. Adjustment and calibration of all temperature, pressure, level, flow amperage, speed, and vibration instrumentation.

3. Contractor is responsible for requesting and coordinating services of manufacturer's representative, including coordination with all affected trades. Contractor is also responsible for documenting the delivery of all manufacturer/vendor on site services.
4. Instruction of Owner's personnel is to be scheduled at least 10 days in advance with Owner and take place prior to acceptance by Owner.

END OF SECTION 431117

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SECTION 431118 - VERTICALLY SPLIT MULTISTAGE CENTRIFUGAL BLOWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Multistage Centrifugal Blowers and specified appurtenances for:

1. Dove Springs WWTP Treatment Unit #1.

2. Dove Springs WWTP Treatment Unit #2

B. Necessary and ancillary accessory equipment and auxiliaries, whether specifically mentioned in this Section or not. Include supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation, and maintenance of the equipment.

C. Related Requirements:

1. Section 260519 “Low-Voltage Electrical Power Conductors and Cables” for wiring to blower motor and manufacturers local control station.
2. Section 400523 “Stainless Steel Process Pipe and Tubing” for Stainless Steel piping.
3. Section 400507 “Hangers and Supports for Process Piping” for pipe hangers and supports.
4. Section 400551 “Common Requirements for Process Valves” for valves except as specified in this Section.
5. Section 400593.23 “Low-Voltage Motor Requirements for Process Equipment” for electric motors.
6. Division 26 for electrical work, except as specified in this Section.
7. Section 406100 “Process Control and Enterprise Management Systems” for instrumentation and control wiring, except for factory wired equipment and lockout stop pushbutton stations.
8. Section 406121.20 “Process Control System Testing”.
9. Section 406126 “Process Control System Training”.
10. Section 406196 “Process Control Descriptions”.
11. Section 407000 “Instrumentation for Process Systems”.
12. Section 465136 “Ceramic Fine Disc Bubble Diffusers”.

1.3 ACTION SUBMITTALS

A. Product Data:

1. General:

a. Manufacturer's name and address.
b. Manufacturer's model number.
c. Descriptive literature bulletins and/or catalogs of instrumentation, equipment, materials, etc. provided by blower manufacturer/supplier. Clearly document exact size, type, and/or manufacturer’s model number of equipment or instrumentation being provided.
d. Bill of materials for equipment supplied.
e. List of required materials, not supplied, but necessary to complete installation of supplied equipment.
f. Total weight of equipment including the weight of all major items or components.
g. Center of gravity and lifting point locations for free-standing equipment.

2. Blower and Base Frame: Minimum data to be included on nameplates.

a. Shaft Coupling: Make, model number, dimensions, materials of construction and alignment tolerances.
b. Bearings: Make, model number, dimensions, materials of construction, installation tolerances, and bearing life in hours.
c. Lubrication System: Materials of construction information.
d. Vibration Sensor: Make, model number, mounting details, wiring details, performance data and limitations, and materials of construction.
e. Bearing Temperature Sensor: Make, model number, mounting details, wiring details, performance data and limitations, and materials of construction.
f. Compressor: Impeller diameter, impeller speed (design and maximum allowable), and materials of construction for all components.

3. Silencer Data (Inlet and Discharge) Manufacturer:

a. Model Number.
b. Size.
c. Dimensions.
d. Attenuation Data.
e. Head loss at rated flow (as specified).
f. Materials of construction.

4. Valve and Operator Data (all valves):

a. Manufacturer.
b. Model number.
c. Size and weight.
d. Dimensions.
e. Details and materials of construction.
f. Head loss at rated flow for non-throttling valves.

5. Filter Data (Inlet):

a. Manufacturer.
b. Model Number.
c. Size.
d. Dimensions.

e. Head loss at rated flow (as specified).
f. Materials of construction.

6. Monitoring and Control System: Supplied local control station.

a. Written description of operating functions describing logic and sequences associated with blower startup, operation, surge suppression protection, and shutdown.
b. Descriptive Literature Bulletins and/or Catalogs for the following:

1) Components installed panel.
2) Components installed as part of panel.
3) Supplied field instrumentation.

7. Blower Local Control Station:

a. Dimension and layout details.
b. Materials of construction.
c. Bill of Materials: Complete and detailed including brand names, OEM catalog numbers, and literature on control devices such as, but not limited to:

1) Fused disconnects.
2) Terminal blocks.
3) Alarm devices.
4) Switches and lights.
5) Timers, relays, and related equipment.
6) Programmable Logic Controller (PLC).
7) Operator Interface Terminal (OIT).

d. Screen shots of OIT screens.
e. PLC database including available monitoring and alarm tags to be monitored.
f. Detailed point-to-point wiring diagrams showing terminal blocks and internal wire tag numbers and block wiring diagrams that show number, type and size of conductors connected externally to blower local control station.

8. Complete Wiring Diagrams: Elementary or control schematics, including coordination with other electrical control devices such as the blower motor reduced voltage starter and the plant PLC.

a. Suitable control panel outline drawings before proceeding with manufacture.

1) Standard preprinted sheets or drawings marked to indicate applicability to this contract is not acceptable.
2) Individual electrical control schematics and wiring diagrams for each valve operator with external interfaces, identified exactly as detailed on electrical and instrumentation Drawings.

a) Standard catalogue cut sheets that show typical wiring diagrams only are not acceptable.

B. Electric Motor: Design and product information as specified in Section 400593.23 “Low-Voltage Motor Requirements for Process Equipment” for electric motors.

1. Motor to be compatible with the Reduced Voltage Solid State Starter.
2. Motor Manufacturer to certify that the motors are capable of specified ramp time.

C. Preliminary Blower Performance Data: Expected performance of blower units at inlet conditions specified.

1. Submit curves for each of the performance condition specified in PART 2 showing how each is affected by variations in inlet conditions.

D. Shop and Installation Drawings: Include at a minimum:

1. Materials, details of construction, dimensions, and anchor bolt locations.
2. Blower Unit Assembly:

    a. Dimensioned and scaled general arrangement drawings.
    b. Cross-sectional view drawings.
    c. Point-to-point wiring diagrams identifying all wire and terminal numbers uniquely.
    d. Drawings cross-referenced to replacement parts list including part number and materials of construction.

3. Motor outline drawings identifying location of field wiring termination cabinets.
4. Process and instrumentation diagram drawings.
5. Control Panel:

    a. Ladder logic diagram drawings for control panel resident hardwiring. Identify internal devices, wire tag numbers, terminal tag numbers, and interconnections with external devices and signals.
    b. Dimensioned and scaled outline drawings identifying the location of internal and external panel mounted equipment and devices along with a description of such equipment and devices.

E. Manufacturer Reports: Test reports and certificates for the following tests:

1. Compressor performance tests per ASME testing method PTC-13.
2. Equipment installation certificates: Furnish a certificate from each equipment manufacturer stating installation of his equipment is satisfactory, and ready for operation and operating personnel have been suitably instructed in the operation, lubrication, and care of each unit.
3. Impeller balance.
4. Motor tests.
5. Certified blower performance curves and design point in accordance with this Specification.
6. Certified dBA noise level for entire package which satisfies noise level requirements specified.
7. Certified report attesting to the date and place of dynamic balancing, the accuracy achieved, and the type of balancing machine used.
8. Bearing life calculations. Bearing types and L-10 life in hours.

1.4 INFORMATIONAL SUBMITTALS

A. Description of shop surface preparation, shop prime painting, and shop finish painting systems.

B. Manufacturer's Certificate: Products meet or exceed specified requirements.

C. Test and Evaluation Reports.

D. Manufacturers' Instructions: Submit with Installation and O&M Manual.

E. Source Quality Control Submittals: Results of factory tests and inspections.

F. Field Quality Control Submittals: Results of Contractor furnished tests and inspections including field test reports for blower unit field acceptance tests.

G. Qualifications Statements:

1. Qualifications for manufacturer.
2. Manufacturer installation list of similar installations indicating discharge pressure, discharge air flow, motor horsepower, motor speed, and facility contact name and phone number.
3. Qualifications of service engineer for approval.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and final orientation of equipment.

B. Warranty and Service Agreements: Submit a detailed description of the Manufacturer’s warranty and service agreement for review.

C. Service Agreements: Include a detailed description of the Manufacturer’s service options. Include pricing structure in description.

D. Operating and Maintenance Manuals:

1. Prepare specifically for this installation and include required cut sheets, drawings, equipment lists, descriptions, maintenance recommendations, troubleshooting recommendations, etc. required to instruct operating and maintenance personnel unfamiliar with such equipment. Include the following at a minimum:

a. Step-by-step disassembly and reassembly instructions including tolerances and torque requirements.
b. Dimensional drawings of provided equipment with component weights.
c. Recommended frequency and duration of blower unit operation to prevent deterioration during long periods of disuse.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts, Manufacturer Recommended: Ordering information including name, phone number of nearest service center, and pricing. Include gaskets, seals, bearings, and lubrication products.

B. One set of special wrenches, gages, and other devices required for normal operation and maintenance.

1. Package in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended. Complete with lock and duplicate keys.

C. List of blower unit and blower unit motor repair facilities within the United States including addresses, contact names and phone numbers.

D. Recommended summer and winter grades of lubricants along with alternative references to equal products of other manufacturers.

E. One complete set of equipment supplier's recommended spare parts.

1. Furnish the following spare parts as a minimum:

a. One level sight glass oiler.
b. One bearing kit with gaskets.
c. One spare set of carbon rings, seals, and spring (if applicable).
d. One year supply of lubricants. Include summer and winter grades with reference to equal products of other manufacturers including lubricant specifications such as viscosity, AGMA numbers, etc.

F. A list of spare and replacement parts with individual prices and locations where available. Prices to remain in effect for a period of one year after startup and final acceptance.

1.7 QUALITY ASSURANCE

A. Steel, Cast Iron, and Ductile Iron Fabrications: Conform to applicable AWWA, ANSI, and ASME, standards. Heat treatment of metal is required for reduction of stresses due to welding, bending, forming, and machining, etc.

B. Like items of materials/equipment are to be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.

C. Air blowers and appurtenances specified in this Section:

1. Single manufacturer, fully experienced, reputable, and qualified in manufacture of equipment specified. Responsible for the blower package including accessory equipment.
2. Blowers to be standard catalogued product, modified as required providing complete compliance with construction documents, and service conditions.
3. Factory assemble blower, motor, base, coupling, and accessories as a single coordinated unit on a common base.

D. Substitution: Equipment other than specified but equal in performance, will be acceptable only if any revisions in the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate the substitution is made at no additional cost to the Owner and approved by the Engineer.

1.8 QUALIFICATIONS

A. Blower Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

1. Successful installations of manufactured blower units in the United States similar in design, type, and service, and comparable in size, head, and capacity to those specified in this Section.
2. Comparable blower units in operation for a period of no fewer than five years.

B. Motor Manufacturer: At least 10 years prior experience in design and manufacture of motors specified.

1.9 MANUFACTURER'S MANUALS

A. A minimum of three approved installation manuals to be shipped to the Contractor upon Engineer's approval of the submitted installation manual.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's packaging including application instructions.

B. Inspection: Accept blowers on Site. Inspect for damage.

C. Store blowers according to manufacturer's instructions.

D. Skid mount or crate equipment to protect against damage during shipment.

E. Protect parts so no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and units and equipment are ready for operation.

F. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

G. Mechanical and electrical equipment to be coated, wrapped, and otherwise protected from snow, rain, drippings of any sort, dust, dirt, mud, flood, and condensed water vapor during shipment and while installed in place during construction. Protective coverings to remain in place until work areas are substantially free of construction dust and debris. Submit details of proposed protective measures for approval to Engineer prior to shipment. Follow manufacturer's instructions for long term storage and maintain warranty on equipment.

H. Protect finished surfaces of exposed flanges. Protect by wooden blank flanges, strongly built, and securely bolted thereto.

I. Protect un-painted finished iron or steel surfaces to prevent rust and corrosion.

J. Equip each blower motor with a space heater in the motor enclosure to maintain a motor temperature above the dew point preventing condensation in the enclosure. Contractor will energize the space heaters as soon as motors are delivered to the Site. Heaters are to remain energized until the motors are electrically connected in place and energized by the control circuit.

K. Factory Assembled Parts and Components: Not to be dismantled for shipment unless permission is received in writing from the Engineer.

L. No shipment will be made until approved by the Engineer in writing.

M. Store all equipment delivered to Site.

1.11 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Document field measurements on Shop Drawings.

1.12 WARRANTY

A. Provide blowers with a warranty for replacement of all defective parts, assuming Owner has operated the blower under normal conditions, for a period of 2-years from the date of Substantial Completion. Warranty covers all defects or failures of materials or workmanship resulting from normal operation and service during the warranty period.

1. The warranty must stipulate equipment furnished is suitable for purpose intended and is free from defects of material and workmanship for duration of the extended warranty. If equipment fails to perform as specified, promptly repair or replace defective equipment. without additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Provide by one of the following or approved equal:

1. Lone Star Blower.
2. Continental Blower.
3. Hoffman Lamson by Gardner Denver.

B. Basis of Design: Layouts shown on Drawings are based on equipment manufactured by Lone Star Blower.

C. Blower Motor: Product of a motor manufacturer specified in Section 400593.23.

D. Use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

E. Like Items of Materials/Equipment: End products of one manufacturer providing standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.

2.2 SYSTEM DESCRIPTION

A. Equipment specified to be standard equipment for use in low pressure air systems.

1. For 24-hour continuous duty service at all points within the defined operating range without surging, abnormal noise, excessive vibration or strain, hunting, overloading the main drive motor, or excessive heating of the bearings.
2. Limit heat generation and gain to that specified over the defined capacity operating range.
3. No harmful nor damaging vibrations occur at all points within the defined operating capacity range.

B. Blowers Operation: Able to operate with multiple units running at a time discharging into a common header. The condition of several units running at a time shall be met and the safety margin between delivery pressure and surge pressure shall be maintained at the same value for each machine operating in parallel.

C. Blowers: Vertically split, multi-stage, integrally geared centrifugal type direct coupled to an electric motor. Factory mounted on a common base with accessories required for a complete system.

D. Blower systems consist of the following:

1. Vertically split multistage centrifugal blower.
2. Electric motor.
3. Base frame.
4. Inlet air filter/silencer.
5. Compressor and main drive motor bearing temperature monitoring system.
6. Flanged suction and discharge expansion joints.
7. Flanged discharge check valve.
8. Discharge butterfly isolation valve.
9. Inlet modulating (non motor-operated) butterfly valve.
10. Expansion joints.
11. Flexible coupling for motor connection.
12. Blower local control station.
13. Instrumentation specified herein.

E. Blowers specified will be used to supply:

1. Process air for:

   a. Treatment Unit # 1 & 2 fine bubble diffusers.

2. Install blowers at the each new outdoor blower canopy at grade level.
3. Discharge air flow from blowers to be manually controlled by inlet throttling to provide the air flow rate through the blower, as adjusted manually by the Owner’s personnel.
4. Install the local control station for each blower adjacent to the blower.

2.3 PERFORMANCE REQUIREMENTS

A. Each blower to be designed for the following conditions of service:

1. Site Conditions:

1)	Mean Sea Level Elevation:	740 feet.
2)	Atmospheric Pressure:	14.3 psia.
3)	Maximum Inlet Temperature:	110 degrees F.
4)	Minimum Inlet Temperature:	20 degrees F.
5)	Maximum Relative Humidity:	65 percent.
6)	Minimum Relative Humidity:	20 percent.

2. Blower Requirements:

a. Dove Springs WWTP Treatment Unit #1:

1) Number of Units: 2 total / 1 duty and 1 standby.

a)	Design Air Flow for Each Blower:	3,150 scfm.
b)	Minimum Pressure at Inlet Flange:	14.1 psia.
d)	Discharge Air Pressure:	8.25 psig.
e)	Maximum Motor Power Requirements:	200 HP.
f)	Minimum Rise to Surge at Design Air Flow:	0.75 psig.
h)	Motor Speed:	3600 RPM.

b. Dove Springs WWTP Treatment Unit #2:

1) Number of Units: 2 total / 1 duty and 1 standby.

a)	Design Air Flow for Each Blower:	3,150 scfm.
b)	Minimum Pressure at Inlet Flange:	14.1 psia.
c)	Discharge Air Pressure:	8.25 psig.
e)	Maximum Motor Power Requirements:	200 HP.
f)	Minimum Rise to Surge at Design Air Flow:	0.75 psig.
h)	Motor Speed:	3600 RPM.

c. Inlet Filters: Headloss of 0.20 psi at design maximum inlet flow.
d. Deliver compressed air against a pressure of no less than 9.0 psig without surging.

B. Limit operating sound pressure levels (sum of all octave bands) in a factory test environment to 85 dBa in any direction at a distance of 3 feet from the equipment over the defined capacity range.

C. Blowers operating at or between any combinations of design conditions:

1. Electrical Power Draw of Job Motors: Not to exceed nameplate rating of 200 HP and blowers (new or existing) will not surge.

D. Balancing of Blowers: Statically and dynamically balanced limiting vibration in any plane to a maximum of 1.5 mils (peak to peak displacement) when operating over the defined capacity range and measured at any bearing housing on the blower unit.

2.4 COMPRESSORS

A. Materials:

1. Equipment: Designed and proportioned to have strength, stability, and stiffness for the intended service. Provide ample room and facilities for inspection, repairs, and adjustments.
2. Structural Steel Used in Equipment Fabrication: Conform to requirements of ASTM A36. Welding to conform to latest standards of AWS.

B. Nameplates: Provide equipment information nameplates for each major piece of equipment including compressor, main drive motor, valves, local control stations, etc.

1. Construct information nameplates of stainless steel and affix to equipment using stainless steel mechanical fasteners.
2. Nameplate Lettering: Embossed.
3. At a minimum, include the following information on each nameplate:

    a. Blower nameplate: Manufacturer's name, make, model number, serial number, and date of manufacture.
    b. Motor nameplate: Electrical voltage requirements and ampere draw at rated voltage.
    c. Blower Unit's Compressor nameplate: Include the following information.

        1) Rated capacity: scfm.
        2) Rated discharge pressure: psig.
        3) Rated impeller speed: rpm.
        4) Impeller diameter inches.
        5) Isentropic efficiency at rated capacity and discharge pressure (percent).
        6) Brake horsepower requirement at rated capacity and discharge pressure.
        7) Lubrication oil requirements.

    d. Blower unit main drive motor nameplate:

        1) All information required by NEMA MG1 20.60.1.
        2) Efficiency at rated horsepower output.
        3) Power factor at rated horsepower output.
        4) Winding insulation system designation and type.
        5) Power lead current transformer ratio.
        6) Bearing model and serial number.

C. Blower:

1. Electric motor driven, horizontal shaft, multistage centrifugal type with outboard mounted bearing construction.
2. Blower to be of the type in which the diaphragm which receives air from the impeller and guides the air to the next impeller is cast integrally with the casing to ensure optimum operating efficiency.
3. Compressor Casing:

    a. Type: Cylindrical.
    b. Material: Cast iron construction per ASTM A278, Class 30B or ASTM A48, Class 30.
    c. Fit the rigid cast iron sections with rabbet joints held securely between inlet and outlet heads by steel tie rods.
    d. Compressor casing to be designed for:

        1) Minimum design temperature of 300 degrees F.

2) Minimum design pressure of 20 psig.
3) If the housing is not rated for 20 psig, then the manufacturer will hydrostatically test the blower casing at 20 psig before shipment and furnish test results.

4. Inlet and outlet connections to be ANSI Class 125 drilled and tapped flanges and be an integral part of the heads.

D. Shaft Coupling:

1. Type: Furnish flexible, double disc, dry type spacer coupling to connect the motor shaft to the compressor shaft.
2. Material: Forged Steel.
3. Balance: Coupling and spacer to AGMA, Class B or better, and sized with a minimum service factor of 1.5.
4. Allows either shaft of the blower unit to be decoupled and removed without disturbing or adjusting the other.
5. Provide an OSHA approved steel guard the coupling. Paint guard safety yellow.

E. Base Frame:

1. Mount blower and motor on a common structural steel base plate of adequate size to support the compressor and main drive motor.

   a. Corners to be rounded smooth and welds ground.
   b. Base frame to be free of warping or cupping.
   c. To prevent distortion and facilitate accurate alignment during installation machine contact points between the blower and motor feet and base plate.

2. Provide blower with a minimum of eight molded synthetic rubber base pads, a minimum of 0.5 inches thick.
3. Blower unit base frame is to serve as the mounting platform for the field wiring termination cabinet for the compressor and motor bearing temperature sensors.
4. Cabinet: NEMA 4X stainless steel and sized to adequately contain all required terminations.
5. Terminal blocks, base frame mounted conduit, and wires to be as specified in Division 26.
6. Provide lifting lugs for equipment weighing over 100 pounds.
7. Foundation Bolts, Plates, Nuts and Washers: Type 316 stainless steel to facilitate installation of the blower unit and control panel.
8. Anchorage and Bearing Pads: As required to mount each blower on its independent concrete base.

   a. Anchors of a size recommended by the manufacturer to be furnished by the equipment manufacturer.

F. Shafts and Seals:

1. Shafts: AISI 4140 carbon steel, ASTM A108 Grade 1045 or better.
2. Sufficient diameter to operate below first critical speed.
3. A cooling rotating shield to reduce heat transfer along the shaft to the bearing and lubricant.
4. Seals provided to prevent air leakage:

a. Outlet Heads: Labyrinth Type or Carbon Ring Type.

1) Labyrinth Seals: Zinc Alloy 12.
2) Carbon ring seals: High density, molded carbon-graphite with steel housing.

b. Replaceable without having to disconnect inlet or discharge piping.
c. Interstage Labyrinth shaft seals.

G. Bearings:

1. Type: Anti-friction.
2. Lubrication: Constant level oiler.
3. Sight Gauge: To observe of oil level at each bearing assembly.
4. Sized for a minimum expected L-10 bearing life of 100,000 hours in accordance with AFBMA Standards.
5. Capable of being inspected or replaced without disconnecting any piping or disassembling the blower.
6. Bearing Housing:

a. Material: Cast Iron ASTM A48 Grade 25.
b. Type: Open-air space to separate the bearing housing from the casting.
c. Fitted with resistance temperature detector-type (RTD) temperature sensing elements and vibration sensing elements as specified herein.
d. Provide labyrinth seal to eliminate lubricant leakage.

H. Impeller:

1. Impeller material shall be ANSI AA6061 with ASTM A356 hub and accurately machined.

a. Statically and dynamically balanced.
b. Vibration: 1.25 mils total amplitude maximum when measured on the bearing housing in either the horizontal, vertical, or axial direction.
c. Certified report attesting to the date and place of dynamic balancing, the accuracy achieved, and type of balancing machine used.
d. Operating speed of blower: A minimum of 20 percent below the first critical speed of the impeller assembly.

2.5 ELECTRICAL

A. Motors:

1. Refer to Section 400593.23 “Low-Voltage Motor Requirements for Process Equipment” for electric motors.
2. Squirrel Cage Induction, Premium efficiency and in accordance with latest NEMA, IEEE, ANSI, and ABMA standards where applicable.
3. Power Factor: As required per NEMA MG1
4. Connection: Direct Coupled.
5. Motor Rating: For a minimum turndown of 3:1.
6. Enclosure: Totally enclosed fan cooled.
7. Operate on a 460-volt 3 phase, 60 Hz alternating current system.

8. Motor Speed and Horsepower: As specified in "Performance and Design Criteria."
9. Do not overload motors, nor the service factor reduced when the blowers are operated at any point on the design speed performance curve at the design differential pressure across the blower.

2.6 CONTROL

A. Each blower shall be furnished with a PLC-based local control panel (LCP). All controls and instruments shall fail into a safe condition.

B. Communication with SCADA system: Use: Ethernet cable capable of communicating with Allen Bradley PLC.

C. The enclosure shall be Type 4X rated. Each assembled LCP shall carry a UL label (UL-C for Canadian service) certifying the complete assembled industrial control panel complies with UL 508A.

D. The control panel shall be powered by a 120VAC source as shown in the project drawings and a 120VAC Type2/3 SPD (surge protection device) shall be provided in the panel.

E. Each LCP shall contain provisions for signals to interface with the main motor starter. The starter for the main drive motor shall be installed by the CONTRACTOR as shown on Drawings.

F. Blower Controls: Through a L-O-R switch at a Local Control Station provided under this Section by the Blower Manufacturer.

1. When placed in "Local" position at the Local Control Station, the blower will start. When placed in "OFF" the blower will not run.
2. When placed in "Remote" position at the Local Control Station, the blower will start and stop manually or automatically based on settings at SCADA.
3. All alarms (low suction pressure, high discharge pressure and high discharge temperature) will be hardwired from the enclosure to the motor starter to automatically stop the blower.
4. The blower will also stop by an E-Stop at the Local Control Station provided by Division 26.

G. Readouts and Totalizers: Program the following readouts and totalizer values back to SCADA from each supplied blower.

1. Current (amperes).
2. Power (kW).
3. Run Time (hours).
4. Alarms (type, count).
5. Pressure (psig).
6. Temperature (fahrenheit).

H. I/O channels from the PLC shall be pre-wired to terminal blocks and each circuit shall be individually fused. Discrete output channels shall be pre-wired to interposing relays to provide dry contacts for output signals.

I. Use destination tagging printed on a wire sleeve marker to identify each wire. Destination tagging identifies the landing point of the other end of the wire.

J. Panel mounted selector switches, pushbuttons, and indicators shall include:

1. Emergency stop mushroom button.
2. Remote / Local Selector Switch.
3. Running indicator / pilot light (Green).
4. Alarm indicator / pilot light (Amber).

K. Equip local control panel with the following additional accessories and hardware at a minimum:

1. 24VDC power supply for control power.
2. HMI cover with hinged clear lid.
3. 120VAC Receptacle for temporary laptop use.

L. PLC shall be a model AXC F 2152 as manufactured by Phoenix Contact, or pre-approved equal. At a minimum, the PLC shall meet the following requirements.

1. Ambient temperature operation up to 60 degrees C.
2. Dual Core 800MHz Processor or faster.
3. 512 Mbyte DDR3 SDRAM.
4. 8 Mbyte Program Memory.
5. 16 Mbyte Mass Storage.
6. Realtime Clock.
7. X2 RJ45 Ethernet ports capable of 10/100 Mbps (full duplex).
8. Developed according to security standard IEC 62443.
9. Integrated and configurable firewall.

M. HMI shall be a model BWP 2102W as manufactured by Phoenix Contact, or pre-approved equal. At a minimum the HMI shall meet the following requirements:

1. 7 inch or larger color touchscreen.
2. HTML5 capable.
3. 1024 x 600 pixel resolution.
4. Minimum 65° viewing angle from the sides.
5. X1 RJ45 Ethernet port capable of 10/100 Mbps.
6. X1 USB Host 2.0 interface.

N. HMI programming shall be part of the PLC program and accessible from the controller via HTML5. This functionality is to allow temporary HMI functionality from a device with a web browser in the event of an HMI failure or easy integration of HMI functionality to additional workstations in the facility.

O. A copy of the PLC and HMI programming software shall be provided to Owner.

P. Operating screens (pages) shall provide not only start-stop and operational mode interfaces, but also alarm status and diagnostics. The following features shall be provided as part of the operator interface screens:

1. Status Bar (all screens): Top of every screen shall provide a status bar giving status information for primary functions such as running state, alarms, local/remote, and operation mode. Additionally, it should be indicated on the status bar if there are any bypass or override values enabled (see Settings Screens).

2. Main Menu Buttons (all screens): Left side of each screen shall provide navigation buttons to primary screens starting below the status bar. Navigation buttons should be provided for run control, monitoring, alarms, vendor contact info screen, and a settings menu.
3. Run Control Screens: Run control screens shall provide the primary interface for starting/stopping the blower and changing its output.
4. Monitoring Screens: Monitoring screens shall allow for viewing the blower data and status in different formats at the preference of the operator. The displayed values shall update according to the engineering units selected. At least two visual modes shall be available:

    a. Equipment view showing the blower package with live values and status indicators.
    b. List view showing the live values for each parameter in a list format with readings for related instruments grouped together.

5. Alarm Screen: Show any recent alarm conditions from the equipment. The list of alarms shall be configurable to show the alarm history (active and inactive alarms) or only active alarms. The alarm history shall only be resettable from a settings screen and only when using a technician or administrative level login. The alarm screen shall show a date and time stamp of the last time the alarm history was cleared.
6. Settings Screens: Be viewable under all login levels but shall only allow changes to setpoints and configuration under a technician or administrative level login. Any settings related to the operation of the equipment shall be available via the HMI. This includes, but is not limited to, scaling values, alarm, and trip setpoints, timer settings, and other configuration related items. Additionally, each instrument shall have options for an override value or to bypass trips related to the instrument. A bypass or override may only be enabled under a technician or administrative level login and is intended only for temporary use but would provide capability for the blower to be operated in the event of a failed sensor until a replacement can be installed.

Q. Each blower LCP shall contain controls for blower motor starting, blower output control, surge, and overload detection, monitoring and protection from other instruments equipped, shutdown control, alarm and emergency shutdown systems.

R. LCP shall be capable of being operated in either a Manual or Auto mode. Auto mode shall operate the blower either based on a constant power output or constant discharge pressure (operator selected). No matter what mode the control system is operating in, set point constraints shall be provided to keep the blower in an acceptable operating range between surge and overload.

S. Blowers shall start when initiated by the local start signal or a remote start signal when in remote mode. Once all pre-start permissives are confirmed, the blower motor shall be started. A feedback signal from the main motor starter shall confirm that the main drive motor has been energized. Provide a sequence fail alarm and trip if any portion of the start, run, or stop sequence is not properly executed.

T. Monitoring and Safety Shutdowns / Alarms: Each instrument shall be able to be enabled, disabled, or remapped to a different input/output channel via the HMI interface without any programming changes needed. While not all the following functionalities might be used with the initial instrumentation, the functionality shall be capable of being enabled if instruments are added in the future. The LCP shall contain alarm and shutdown logic for the following functionality.

    1. E-Stop.

2. Main Motor Starter Monitoring.
3. Blower Surge.
4. Motor Overload.
5. Motor Bearing Temperature.
6. Blower Bearing Vibration.
7. Motor Winding Temperature.
8. Blower Bearing Temperature

U. Surge and overload events shall be avoided using active measures performed by the control system. If the blower system is approaching a surge or overload condition, the control system shall intervene and adjust the blower inlet valve and output setpoint to avoid surge or overload. If avoidance of surge or overload is not possible, the control panel shall trip the blower offline.

V. When a blower inlet temperature sensor in equipped and enabled, the local control panel shall be capable of providing temperature compensated surge protection to increase blower flow range.

W. Data communication shall be provided between the PLC and the plant systems via the EtherNet IP protocol. Configuring the interface to the plant system shall be the responsibility of the systems integrator; however, the Manufacturer shall actively participate by providing proper interface documentation and support as needed.

2.7 FINISHES

A. Blowers and Discharge Piping Accessories:

1. Factory finish paint per manufacturer's standard for high temperature paint. Submit description of surface preparation and paint with shop drawings.
2. Appurtenances to receive surface preparation and shop prime paint as part of the work of this Section.
3. Do not paint stainless steel surfaces.

2.8 VALVES AND JOINTS

A. Check Valves:

1. On each blower discharge to main air header.
2. Refer to Section 400565.29 “Double-Disk Check Valve” for product requirements.

B. Butterfly Valves:

1. Provide each blower unit with the following valves:

a. Manually operated inlet throttling butterfly valve for modulation of blower output at Treatment Unit Blowers.
b. Manually operated discharge butterfly valve for open close control.

2. Refer to Section 400564 “Butterfly Valves” for product requirements.

C. Expansion Joints

1. Provide on each blower discharge.
2. Refer to Section 400506 “Couplings, Adapters, and Specials for Process Pipe”.

2.9 INSTRUMENTATION

A. RTD Monitor System:

1. Include 100 ohm platinum RTD's embedded in motor windings (two each phase; one active, one spare) and in each loaded bearing of both the motor and blower.
2. RTD's monitored by the blower LCP. The LCP to include a protective relay system to shut down the motor on high winding temperature and annunciate the fault.
3. The system must monitor and display actual bearing temperature.
4. Include an adjustable alarm feature such that when bearings reach the selected temperature, an alarm light illuminates until reset and the unit shuts down.

B. Vibration Monitoring System:

1. Each blower shall be provided with vibration transmitter on the inlet and outlet bearings to detect and monitor vibration level. Exceeding the vibration warning set point will initiate a vibration warning alarm. Exceeding the vibration shutdown set point will shut off the blower.
2. LCS will receive and display the vibration probe signals. Include an adjustable alarm feature such that when bearings reach the selected vibration, an alarm light illuminates until reset and the unit shuts down.

C. Vacuum and Pressure Gauges: Discharge provided for each blower.

1. Refer to Section 407313 “Pressure and Differential Pressure Gauges” for pressure gauge requirements.
2. Connect to taps in inlet piping and discharge piping as close as possible to the expansion joint joining the blower.
3. Furnish tubing to connect each gauge to its tap on the air piping, plus fittings, adaptors and shut-off and vent valves as required for a complete installation.

D. Anchorage and Bearing Pads:

1. As required to mount each blower on its independent concrete base. Anchors of a size recommended by the manufacturer to be furnished by the equipment manufacturer.

2.10 ACOUSTICAL ENCLOSURE (NOT USED)

2.11 ACCESSORIES

A. Inlet Filters/Silencers: For blower units.

1. Provide each blower unit with an inlet air filter with integral silencer and weather hood.
2. Inlet filter vertically mounted in the configuration shown on Drawings.

a. Dry type Panel style.
b. 120 percent of design volume.
c. Manufacturers:
d. Panel Style by:

1) TriVent PO9 Series by Endustra.
2) FSH Series by Universal Silencer.
3) FCRH Series by Universal Silencer.

e. Engineer-approved equal.

3. Furnish each air filter/silencer with:

a. Tap for connection of gauge to the filter/silencer housing.
b. Mounting hardware.
c. Other appurtenances required for a complete differential pressure indication system.

4. Maximum clean filter pressure drop of the inlet filter/silencer with the elements installed to be 0.09 psig. Maximum pressure drop with dirty inlet filters to be 0.30 psig.

5. Filter Elements:

a. Cartridge Style:

1) Circular, interchangeable element options.
2) Removable weather hood for easy access to filter element.
3) Filter element media: Pleated felt with 98 percent removal of particles greater than 10 microns.

b. Size filters for a maximum face velocity of 575 ft/min at peak air flow.

6. Install each inlet filter/silencer by press fitting a 1-inch foam rubber gasket, provided by the Manufacturer between the air inlet connection and the flange around the periphery of the inlet filter frame.
7. Connect the filter/silencer to the blower inlet via the inlet spool piece provided by the contractor.

2.12 SOURCE QUALITY CONTROL

A. Test sound pressure level from the equipment in accordance with CAGI S5.1 or AMCA 300-67 and include contributions from the main drive motor.

1. Each motor to be given a complete, non-witnessed test.
2. Test for noise and vibration in accordance with IEEE test procedures.
3. Furnish a certified motor data sheet for approval prior to shipment.

B. At least 30 days prior to scheduled testing, submit test procedures to the Engineer for review.

C. Test one of each blower model in accordance with ASME PTC-13.

D. Upon completion of assembly, each blower, motor and oil lubrication skid to be functionally tested with the local control station (LCS) connected to all skidded instruments, electric valves and appurtenances as applicable.

1. The oil lubrication system must be run and tested for leaks, all start/stop sequences and all safety and alarm systems tested, stimulating start of the blower motor.

E. Test Results of Motors, Blowers and Package Functional Tests: Include in the Operations and Maintenance Manual.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation: According to manufacturer's instructions.

B. Install blower unit and appurtenances in strict accordance with blower manufacturer / supplier's instructions and recommendations. Make necessary adjustments to provide complete and satisfactory operation upon completion of the Contract.

C. Provide blower field alignment by a qualified millwright to meet blower manufacturer instructions and specifications.

D. Support new piping to preclude the possibility of exerting undue forces and moments on the blower flanges. Provide suitable expansion joints to isolate the blowers from the piping system. Mount blower on a flat and level concrete equipment pad of the dimensions shown on the Drawings.

E. Install blower base on suitable anti vibration strips. Install blower and motor parts so that all items revolve smoothly and are free of excessive noise and vibration.

F. Deviation of Pipe Connection and Arrangements from Drawings: Acceptable, if new air pipe arrangement is furnished as approved by the Engineer.

G. Installation to include furnishing the required oil and grease for initial operation. The grades of oil and grease to be in accordance with the manufacturer's recommendations.

H. Field Tests: Do not conduct until such time that the entire installation is complete and ready for testing.

I. Install a temporary heavy wire mesh using Type 304 stainless steel wire, providing a 1/2 inch maximum mesh on blower inlet, to prevent objects inadvertently left in the air inlet system from entering the blower. Remove mesh after initial operation and just prior to field testing.

3.2 FIELD QUALITY CONTROL

A. After the installation of the blowers, motors, controls and all appurtenances, each complete blower unit will be subject to field acceptance tests under actual operating conditions.

B. Conduct field acceptance tests under the direct supervision of a qualified representative of the blower manufacturer and in the presence of Engineer.

1. Provide, calibrate and install all temporary gauges and motors, making necessary tapped holes in the piping and install all temporary piping and wiring required for the field tests.
2. Submit written test procedures to the Engineer for approval 30 days prior to testing.

C. Field acceptance tests will determine the characteristics of each blower unit and in addition will demonstrate that under all conditions of operation each unit:

1. Has not been damaged by transportation or installation.
2. Has been properly installed.
3. Has no mechanical defects.
4. Is in proper alignment.
5. Has been properly connected.
6. Is free of overheating of any parts.
7. Is free of objectionable vibration and noise.
8. Is free of overloading of any parts.

D. Conduct field acceptance testing after installation of all equipment has been completed and operated for a sufficient period to make all desirable corrections and adjustments. Tests to prove that operation of each blower unit and all associated equipment is satisfactory and in compliance with this Section.

E. During the field acceptance tests, each unit to be operated for a minimum of 24 hours.

F. Take readings at 30-minute intervals and record on suitable log sheets.

1. Include data from the following:

a. Pressure and temperature gages.
b. Relative humidity readings.
c. Power kW.
d. SCFM output.
e. All other information necessary to calculate the actual performance characteristics of the blower, driver and ancillary equipment.

2. Coordinate connection of analog cables for data readout from the motor starter to be provided by the electrical contractor.

G. Submit a written report to Engineer tabulating equipment tested, test results, problems encountered and corrective action to be taken within two weeks after test completion.

H. Mutually arrange and coordinate with Owner's plant personnel and representatives.

1. Schedule testing procedures with the full knowledge and consent of Engineer.
2. Schedule should not adversely affect the operation of plant facilities.

I. Units Failing to meet Performance Test:

1. Take corrective action and retest to assure full compliance with the Specifications.

2. Submit a revised written report to the Engineer.

J. A 7-day operating period of stable and vibration-free operation is required for each blower unit prior to final acceptance.

K. Noise and vibration tests:

1. No harmful vibration in the blower units or in the system piping.
2. Vibration not to exceed specified limits.

L. Manufacturer Service:

1. Provide services of a factory certified service engineer specifically trained in the installation, start-up, testing, operation, and maintenance of the equipment as herein specified.
2. A direct, full-time employee of the blower manufacturer or a representative who is factory-trained and certified to perform these services. Submit qualifications of service engineer for approval.
3. Services of the blower manufacturer/supplier to be in accordance with this Section.

    a. Service time to include assistance as required with installation, startup, testing, programming, calibration, and training.
    b. Provide for a total of three 8-hour days for services.

        1) Hours suggested are exclusive of travel time and do not relieve Contractor of the obligation to provide sufficient service to place the equipment in satisfactory operation.

    c. Provide one 8-hour day for service inspection during the first year of actual operation, in addition to the days indicated above, for use at the Owner's request and exclusive of repair, malfunction or other troubleshooting service calls.

4. Blower manufacturer/supplier will advise, consult, and instruct on installation procedures and adjustments and inspect the equipment during installation (i.e., provide installation oversight).
5. Blower manufacturer/supplier is responsible for the inspection and start-up of the equipment. Additionally, blower manufacturer/supplier is to certify the equipment has been properly assembled, lubricants have been properly installed, electrical connections have been properly made, protective set points have been properly adjusted, and that the equipment is ready for service.

3.3 DEMONSTRATION AND TRAINING

A. Manufacturer's representative will provide both operational and maintenance instruction of Owner's personnel.

B. Training will be given at times convenient to the operations and maintenance teams being trained considering operational shifts and duties while on shift. Training services is required to be recorded. Upon completion of training, provide digital videography to Owner.

1. Operational training to include the following at a minimum:

a. Theory of operation.
b. Troubleshooting guidance.
c. Recognizing normal and abnormal operating conditions.
d. Step-by-step startup and shutdown procedures.
e. Discussion of operational limitations.

2. Maintenance training to include the following at a minimum:

a. Replacement part identification and ordering procedures.
b. Lubrication procedures, including drain-down and refill procedures.
c. Recommended routine preventive maintenance procedures.
d. Troubleshooting and diagnostic procedures.
e. Adjustment and calibration of all temperature, pressure, level, flow amperage, speed, and vibration instrumentation.

3. Contractor is responsible for requesting and coordinating services of manufacturer's representative, including coordination with all affected trades. Contractor is also responsible for documenting the delivery of all manufacturer/vendor on site services.
4. Instruction of Owner's personnel is to be scheduled at least 10 days in advance with Owner and take place prior to acceptance by Owner.

END OF SECTION 431118

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SECTION 432513 - SUBMERSIBLE SOLIDS HANDLING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submersible Solids Handling Pumps and their respective motors for the Dove Springs WWTP Filtrate Lift Station.

    a. Mounting Configuration
        1) On-Site Filtrate Lift Station: Wet pit.

2. Manufacturer Supervisory and Support Services: During installation and field testing, of each unit and instruction of the regular operating personnel in the proper care, operation and maintenance of the equipment.

B. Related Requirements:

1. Section 017300 “Execution”.
2. Section 055000 “Metal Fabrications” for fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.
3. Section 099676.23 “Wastewater Preliminary Treatment Coatings”.
4. Section 099679 “Atmospheric Protection and Plant Service Areas Coatings”.
5. Section 260519 “Low-Voltage Electrical Power Conductors and Cables” for connections and terminations.
6. Section 260523 “Control-Voltage Electrical Power Cables” for connections and terminations.
7. Section 400593.23 “Low Voltage Motor Requirements for Process Equipment.” For electric motors, features and accessories normally supplied as part of equipment assemblies.
8. Section 406100 “Process Control and Enterprise Management Systems General Provisions”.
9. Section 406121.20 “Process Control System Testing”.
10. Section 406126 “Process Control System Training”.
11. Section 406196 “Process Control Descriptions”.
12. Section 407000 “Instrumentation for Process Systems”.

1.3 COORDINATION

A. Coordinate installation and startup of Work of this Section with Owner’s operations.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer’s product data for system materials and component equipment, including weight, electrical characteristics, and connection requirements.

1. Total Weight of Equipment: Include weight of single largest item.
2. Materials List: For equipment specified.
3. Bill of Materials: For equipment specified.
4. Manufacturer's Recommended Spare Parts List:

    a. Manufacturer's current price for each item.
    b. Include gaskets, seals, etc.
    c. List bearings by bearing manufacturer's numbers only.

B. Shop Drawings:

1. Dimensional drawings showing details of pump construction and auxiliary apparatus.
2. Hatch Openings: Demonstrate sufficient clearance for pump. Hatch access shown on drawings is maximum opening allowed for concrete sawcut.
3. Pump Supports: Design details, anchor bolt locations, sizing information, and installation requirements.
4. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between all system components, motors, sensors, control panels and related systems.
5. Complete Motor Data: Including, but not limited to the following.

    a. Type of enclosure design.
    b. Rated horsepower.
    c. Rated voltage.
    d. FLA.
    e. Starting current.
    f. LRA.
    g. LR KVA.
    h. NEMA starting code letter and insulation code letter.
    i. RPM.
    j. Input power in kW at nameplate rating.
    k. Starting calculations.
    l. Cable size.
    m. Efficiency: At 100 percent load.
    n. Power Factor: At 100 percent load.
    o. Winding temperature rise.
    p. Vibration design limits.
    q. Speed torque curves.
    r. Recommended trip and alarm settings for temperature and vibration protective devices.

s. Power and control cable size and materials of construction, details of cable sealing method, description and type of motor thermal protection, description of insulation system and service factor.

C. Manufacturer's Certificate:

1. Manufacturer's certification of installation meeting Manufacturer’s installation, operation and maintenance manuals and as specified in PART 3.
2. Manufacturer's field report as specified in PART 3.
3. Certify installation is completed according to manufacturer's instructions.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Instructions: Detailed instructions on installation, requirements, storage and handling procedures.

B. Field Quality-Control Submittals: Identify the entity and qualified individual who will inspect the installation in accordance with “Inspection and Testing” Article in Part 3.

C. Qualifications Statement: Submit qualifications for Manufacturer.

D. Complete description of surface preparation and shop painting for pumps and motors.

E. Design Data, Characteristics and Performance:

1. Guaranteed performance curves per ANSI/HI 11.6.

a. Grade 1U for specified (intermediate) design point.
b. Grade 1E for other specified points.
c. Actual factory tests results of similar units, showing they met specified requirements for total head (TH), flow rate, overall efficiency, guaranteed maximum net positive suction head required (NPSH3), submergence, and horsepower.

2. Submit curves on 8-1/2 by 11-inch sheets, as large a scale as practical. Plot from zero flow at shut-off head to pump flow rate at minimum specified total head (TH).
3. The preferred operating range (POR) and (acceptable operating range) AOR per ANSI/HI 9.6.3 shall be clearly shown on the curves.
4. Catalog sheets showing a family of curves are not acceptable.

F. Warranty Information: Demonstrate conformance to “Warranty Article.”

1. Authorized Warranty Center: Within a 3-day shipping radius of job site; fully staffed with factory trained mechanics, and equipped with stock of strategic spare parts for each pump model furnished for Project. Document warranty center location prior to delivery of equipment.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Document actual locations and final orientation of equipment and accessories.

B. Operation and Maintenance Data Manual:

1. Prepare for this project installation. Include cuts, drawings, equipment lists, descriptions, etc. required to instruct operating and maintenance personnel unfamiliar with equipment.
2. Include trouble shooting data, full preventative maintenance schedules, and complete spare parts lists with ordering information.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Manufacturer to Furnish the Following:

1. Special tools and test equipment required for proper servicing of equipment. Furnish in a steel tool chest with lock and duplicate keys. No special tools to be required to service or repair pump.
2. List of recommended spare parts, gaskets, lubricants, sealants, and heat transfer medium necessary for the first five years operation of each pumping system.
3. Furnish the following spare parts for each size pump:

    a. One impeller matching installed impellers with lock nut or lock washer.
    b. Repair kit to include all bearings, seals, o-rings and mechanical seals necessary for a complete overhaul.

1.8 QUALITY ASSURANCE

A. Manufacturer:

1. Coordination Responsibilities: Pumps, motors, guide rails, access hatches, and other auxiliary equipment as depicted on the Drawings.
2. Equipment Furnished: New, unused, and standard. Furnished with accessories required and meeting specified requirements.
3. Service Record: Successful five-year record servicing equipment and systems similar to that specified.
4. Certified to ISO 9001 Standard: For design and manufacture of submersible solids handling pumps.

B. Both Contractor and Manufacturer: Share responsibility for satisfactory installation and operation of entire pumping systems including pumps, motors, and accessories.

C. Equipment Specified in this Section:

1. To be standard pumping equipment of proven ability.
2. Manufactured by companies experienced in production of equipment used in system applications as stated in the “System Description,” Article in Part 2.

    a. Manufacture per Hydraulic Institute Standards, unless otherwise specified.

3. Furnish from single manufacturer.
4. Must operate satisfactorily when installed as shown on Drawings, as specified, and as approved by Engineer.

1.9 DELIVERY, STORAGE AND HANDLING

A. Protect equipment and parts against damage during shipment.

B. Store equipment per Manufacturer's recommendations.

C. Long Term Storage: Protect and store parts so no damage or deterioration occurs during prolonged delays from time of fabrication to installation; per Manufacturer’s requirements.

1. On-Site Long-Term Storage: Follow Manufacturer's detailed long term storage requirements.

D. Factory Assembled Parts and Components: Do not dismantle for shipment without written permission from Engineer.

E. Finished Surfaces; Exposed Pump Openings: Protect with blank flanges of rigid wooden or equivalent material. Secure with bolts or other manufacturer approved means.

F. Unpainted Finished Iron or Steel Surfaces: Protect to prevent rust and corrosion.

G. After Hydrostatic or Other Tests: Drain entrapped water prior to shipment. Protect to prevent entrance of water and moisture during shipment, storage and handling.

H. Box or Package Markings: Contents and net weight.

I. Engineer’s Approval: Do not ship until given written approval by Engineer.

1.10 EXISTING CONDITIONS

A. Special Requirements:

1. Contractor required to make or verify field measurements prior to start of work.

B. Field Measurements: Verify prior to fabrication. Document on Shop Drawings.

1.11 WARRANTY

A. Manufacturer Warranty: Pump and motor for period of 2-Years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Dove Springs WWTP On-Site Filtrate Lift Station:
   1. System will be comprised of pumps that pump domestic sewage, belt filter press filtrate and process drain water from the Filtrate Lift Station to the Headworks Facility as shown on the civil and process mechanical drawings.
   2. The equipment to be furnished includes two submersible pumps, motors, guide rails, access hatches, control panels and control systems, and accessories.

B. Refer to Section 406196 “Process Control Descriptions” for overall system description and control loop descriptions control narratives and functional control description.

C. Contractor to coordinate and be responsible for proper operation and compatibility between items in this scope of work and items in Division 40 scope.

D. Pump Motors, Cables, and Appurtenances: Rated for operation in a Class I, Division 1, Group D hazardous environment, as approved by Factory Mutual.

E. Pumping Units: Totally submersible, solids handling, rotodynamic with submersible close coupled motors. Each unit to be aligned and balanced. Designed to pump raw, screened wastewater, filtrate and drain water. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the work to be done. Ample room shall be provided for inspection, repairs, and adjustments.

   1. Wet Pit Applications: Pumping units to be automatically connected to discharge piping when lowered into place on discharge connection, providing a water tight seal.

      a. Pumps: Easily removable from discharge connections and wet well for inspection or service. Lifting pumps from discharge connections and wet well is not to require removal of fasteners or fastenings or require personnel to enter the pump well.

F. Base Elbows for Pumps: Rigidly and accurately anchored in position.

   1. Anchor Bolts, Plates, Nuts and Washers: Furnished as specified herein and installed by the Contractor and conform to the recommendations and instructions of the Manufacturer.

G. Nameplates: Stainless steel. Permanently attached to each pump and/or motor.

   1. Give name of manufacturer, rated flow rate, head, speed, and other pertinent data.
   2. Wet Pit Applications: Contractor to install additional stainless steel nameplates on termination cabinet enclosures other above grade locations as instructed by Engineer. Orient and locate so pumps do not need to be moved to gather information.

2.2 CONDITIONS OF OPERATION

A. Manufacturers and Products: Provide pump units from one of the following:

1. Dove Springs WWTP On-Site Lift Station

    a. Wilo
    b. Pentair (Hydromatic / Myers)

    c. Or equal substitution product meeting detailed requirements of this specification. Substitution must be submitted to design Engineer two weeks before the bid date for pre-approval.

2. Pumps Within Each Service Type: Identical in every respect. All parts interchangeable.

B. Pumps: Designed for conditions of service tabulated as follows and operate within the system head curve envelope as appended.

1. Specific Speed Less Than 4,500 (US units): Continuously rising head performance curve, from runout toward shutoff. For stable pump operation from minimum head operating point to shut-off head.
2. Specific Speed Greater Than or Equal to 4,500: The intersection of pump head and system head curves to be used to demonstrate stable operation.
3. Pumps Operation Throughout Operating Range: Within vibration limitations specified in “Dynamic Vibration Analysis” Paragraph in the “Quality Assurance” Article in Part 1.
4. Pumping Units and Driving Equipment: To withstand maximum turbine run-away speed due to back flow through the pump.

C. Each pump is to be designed for the conditions of operation tabulated as follows.

Item Description	Design Conditions
Service	Filtrate, Process Water, and Sewage from Admin/Lab Building
Tag Number	PMP-1001-1 and PMP-1001-2
Number of Pumps (operating/standby)	2 (1/1)
Maximum Motor Full Load Speed (FLS) (rpm)	1,800
Maximum Allowable Motor Size (non-overloading throughout operating range) (HP)	7.5
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	90
Minimum Pump Discharge Size (inches)	4
Pump Shut-Off Head at Motor FLS Acceptable Range (minimum/maximum) (feet)	55 (max) 20 (min)
Design Point Flow Rate - 1 Pump Running (gpm)	400
Design Point TH (minimum/maximum) (feet)	34
Minimum Overall W/W Efficiency at Design Point (percent)	40
Maximum NPSH3 at Design Point TH (feet)	10
BEP Location Relative to Primary Design Point	Right
Minimum Submergence Above Pump Casing (feet) / Maximum Duration at Min. Submergence (minutes)	1 / 2 height of motor housing

2.3 PUMP CONSTRUCTION

A. Overall Pump Design: Combine high efficiency and low required NPSH3.

1. Wastewater Applications: Handle high solids concentrations effectively.

2. Impellers/Casings: Must have passage surfaces to which solid or fibrous materials cannot adhere. Capable of passing fibrous and nonwoven materials found in domestic wastewater. Permit low liquid velocities, gradual acceleration, and change of flow direction of pumped media.

B. External Pump and Motor Parts: Close grained cast iron, ASTM A48 Class 35B construction, with all parts in contact with wastewater protected by corrosion resistant coatings.

1. External Bolts and Nuts: Type 304 or 316 stainless steel.

C. Impellers:

1. Construction: ASTM A48 Class 35 B or Class 30 minimum gray cast iron. Dynamically balance impellers as specified below.
2. Rotodynamic: Two-plane dynamically balanced per ISO 1940-1 quality grade G2.5 standard to provide smooth, vibration free operation.

a. Wastewater Applications with Flushable Fibrous and Non-Woven Material:

1) Semi-open or enclosed, solids handling type.
2) Capable of passing solids due to internal clearances or other features facilitating solids processing including a wear plate with groove.

3) Wear Plate to Impeller Clearance: Easily externally field adjustable without pump disassembly or the need to add or remove shims.
4) Impeller may include pump out vanes on upper shroud reducing axial thrust and minimize clogging due to debris accumulation around the mechanical seal.

D. Casing Wear Ring or Plate: Provides efficient sealing between casing and impeller. A stationary stainless steel ring fitted to casing inlet or stainless steel wear plate installed in lower half of casing.

1. Semi Open Impeller Designs: Stationary wear ring or wear plate to have minimum 50 points Brinnell hardness greater than rotating wear ring or semi-open impeller vane tip hardness.
2. Enclosed Impeller Designs: Stationary wear ring or wear plate to have minimum 50 points Brinnell hardness greater than rotating wear ring or semi-open impeller vane tip hardness.
3. Alternative Materials and Design Approaches: Approved by Engineer.

E. Balanced Tandem Mechanical Shaft Seal System.

1. Upper (Inner) Tandem Seal Set:

a. Operate in seal lubricant chamber located just below the stator housing.
b. One Stationary Ring: Silicon carbide.
c. One Positively Driven Rotating Ring: Carbon.
d. Function: Independent secondary barrier between pumped liquid and stator housing.

2. Lower (Outer) Tandem Seal Set:

a. One Stationary Ring: Tungsten carbide or silicon carbide.
b. One Positively Driven Rotating Ring: Tungsten carbide or silicon carbide.
c. Function: Primary barrier between pumped liquid and stator housing.
d. Each Interface: Held in contact by its own Hastelloy-C® or Elgiloy® spring system.
e. Seal Body: Type 316 stainless steel.
f. O-Rings: FKM (Viton).
g. Must require no maintenance and adjustment, but be easily inspected and replaced.
h. Provide pressure applied to outside diameter of face.
i. Not Acceptable: Conventional double mechanical shaft seals containing either a common single or double spring, acting between the upper and lower units.

F. Minimum Pump Discharge Size:

1. Wet-Pit Application: Minimum allowable nominal diameter of discharge connection provided for attachment to discharge piping, as shown on Drawings. Unless otherwise noted, the diameter of the opening at the connection between the pump and the discharge should normally be the same as the minimum specified discharge size.

G. Pump Seal Against Discharge Connection:

1. Wet-Pit applications: Pump must tightly seal against discharge connection. Accomplish with simple linear downward motion of pumping unit guided by two guide rails. No portion of the pump is to bear directly on the wet well floor.

    a. Sliding Guide Bracket: An integral part of or bolted to the pumping unit.
    b. Pump Casing Machined Connection System: For attachment of the ASTM A48, Class 35, cast iron discharge connection.
    c. Sealing System: Positive leak proof system providing easy pump removal. Two machined metal-to-metal flanges or flanges with a replaceable rubber seal, form fitted to the machined discharge coupling.
    d. Discharge Connection:

        1) Rigidly and accurately anchored to floor of wet well.
        2) Precisely leveled and aligned.
        3) Completed Installation: Free from stress or distortion with Type 316 stainless steel sleeve cast-in anchor bolts, monel nuts and accessories.
        4) Must receive the pump connection without need of any bolts or nuts.

H. Lifting Cable for Wet-Pit Applications:

1. Lifting Chain: Type 316 stainless steel cable and short piece of suitably sized Type 316 stainless steel chain between bail and cable.

    a. Rating: Five times pump weight; minimum.
    b. Combined Length: Equal to wet well depth; top slab finished grade to wet well bottom, plus six feet to permit raising pump for inspection and removal.

2. Attach lifting cable to a lifting bail on the pump.
3. Eyebolts are not an acceptable alternate to a lifting bail.

2.4 SUBMERSIBLE MOTORS

A. Pump Motors: Inverter duty rated, housed in an air filled or oil filled, water-tight casing.

1. Insulated Windings: Class H or better, non-hygroscopic and moisture resistant.
2. Suitable for use with solid-state starters.
3. Motor Stator: Dipped and baked three times in VPI process and heat shrunk fitted into stator housing.

    a. Alternative: Trickle impregnation method may be used for motor stator windings.
    b. No penetrations of stator housing, such as bolts, pins or other fastening devices.

4. NEMA Design B;

    a. Service Factor: Minimum 1.15 as defined in NEMA MG1, based upon nameplate horsepower rating for across-the-line service.

5. Insulation System: Rated at 155 degrees C or better.
6. Capable of continuous operation at ambient 40 degrees C continuously with Class A temperature rise, and 15 starts per hour without affecting bearing and winding design life.

7. NEMA Starting Code G or H, or better.
8. Non-overloading. Capable of fifteen starts per hour.
9. Minimum Power Factor at Full Load: 0.80.
10. Motor Efficiency: minimum 90 percent at full load to meet wire-to-water efficiency specified in "Conditions of Operation" Article in Part 2.

B. Pump Motor Cooling Characteristics:

1. Permit continuous operation in partially submerged condition.
2. Three overheat, self-resetting sensing devices: One in each motor winding. Trip at 140 degrees C**.** Wire devices into controls. If a device activates, pump must shut down. The temperature device shall be self-resetting.

C. Non-overloading within range of operation between shutoff and low head run-out conditions shown on pump conditions of operation data table above.

1. Where specific speed is 4,500 or greater, the range from the pump head and system head curves intersection point and low-head run out conditions shall be used to demonstrate non-overloading over the range of operating conditions.
2. Wet Pit Applications: Capable of running continuously in totally dry condition under full load without damage for a cleaning cycle; 15 minutes maximum.

D. Pump/motor shaft: Type 420 or 431 stainless steel.

1. Operating at Pump Design Point:

a. Shaft Deflection at Lower Seal Face: 0.2 mm maximum
b. Shaft Deflection at Wear Ring Area: 0.45 mm maximum.

2. Permanently lubricated ball bearings sized to withstand axial and radial forces.
3. Bearing Life: ABMA Minimum L-10: 100,000 hours rated at pump BEP.

E. Pump motor, its Appurtenances, and Cable: Capable of continuous submergence underwater without loss of watertight integrity to depth of 65 feet. Mating surfaces: Machined, fitted with O-rings for watertight sealing.

F. Power and Control Cable Entry System: Design precluding specific torque requirements ensuring a water tight and submersible seal.

1. Certified by UL or FM to have passed pull-testing requirements.
2. Chamber and motor: Separated by a stator lead, sealing gland or terminal board, which isolates the motor interior from foreign material gaining access to pump motor top.
3. Field serviceable.
4. Entry Into Lead Connection Chamber: Epoxy encapsulated for positive moisture sealing.
5. Cable Grommet: BUNA-N, in addition to epoxy sealed leads.

G. Power Cables, Conduits and Accessories:

1. Supply pumps with power and sensor conductors.
2. Pump motor cables: Sized to meet applicable NEC requirements.
3. Cables: Exceed industry standards for oil, gas and sewage resistance.

a. Type SPC or SEOW insulated cables with double jacketed protection system.

1) Outside: Neoprene or chlorinated polyethylene.
2) Inside: Synthetic rubber.

b. Individual conductors: Type RUW.
c. Sufficient length so cables are continuous between pump and disconnect. No splices allowed.
d. If more than one cable is provided per pump: Contractor must furnish and provide for installation of additional conduits, etc. as required for each additional cable.
e. One cable per conduit allowed at pump station.
f. Conduit: Sized per manufacturers recommendations. Not smaller than 3/4-inch.

4. Contractor: Furnish required stainless steel conduit hardware and fittings.
5. Water tight connectors equal to Crouse-Hinds Type "CGB", with neoprene lands to be furnished and installed in control panel enclosure or disconnect to terminate each conduit and seal each cable entry.
6. Conduit Seals: Equal to Crouse-Hinds Type "EYS".
7. Coordinate the installation of the above materials with the Manufacturer.

2.5 PUMP/MOTOR PROTECTION SYSTEM

A. Pump/Motor Protection System: To monitor machine temperature and moisture.

1. Warning and shutdown protection.
2. UL listed.
3. Protective and Monitoring Sensors: Connected to electronic module which provides a signal from the pump/motor sensors to motor starter in Motor Control Center.

B. Relay Modules:

1. Provide relay modules manufactured by Benshaw, or equal to Section 262419 “Motor Control Center Supplier”.

C. Protection and Monitoring Sensors:

1. Over Heating Protection:

a. Motor Winding Bi-Metallic Thermal Switches or Thermistors: Quantity of three.

1) One installed in each motor stator phase winding. Connect in series to monitor and protect winding from over temperature operation.
2) Upon a High Temperature Event: Thermal switches shall open, activating an alarm and stopping the motor.

2. Water Intrusion Detection:

a. Motor Stator Chamber: Float-type moisture leakage sensor (stator FLS). If activated, FLS to activate an alarm.

b. Motor Electrical Connection (Cable Junction) Chamber: Float-type moisture leakage sensor (electrical connection FLS). If activated, FLS to activate an alarm.
c. Mechanical Seal Lubrication Chamber; Between Inner and Outer Mechanical Seals: Water-in-oil or water-in-air capacitive type moisture sensor. If activated, to activate an alarm.

2.6 GUIDE RAILS AND PUMP LIFTING DEVICE

A. Pumping Station: Furnish with necessary, stainless steel upper guide holder and level sensor cable holder.

B. Lower Guide Holders: Integral with discharge connection.

1. Dual guide rails: Schedule 40, welded 2 inch minimum diameter, Type 316 stainless steel pipe of length as required by Drawings.
2. Single guide rails and guide cables are not acceptable.

C. Intermediate Guide Brackets: Furnished and installed.

1. Unsupported Guide Rails: No longer than 20 feet, Type 316 stainless steel.

D. Cable Holders Including Cable Hooks: Fabricated from Type 316 stainless steel plate.

1. No sharp corners or edges that would abrade or cut electrical cable insulation.
2. Cable Holders: Sufficient length and strength to support each separate cable.
3. Pump power and lift cables may use the same hook position, provided cables do not foul one another and lift cable is easily accessed from hatch opening.

E. Chain and Latch Device: To facilitate pump removal from wet well without a series of incremental lifts. Design device to be lowered along guide rails and remotely latch to pump lifting bail without requiring wet well entry.

2.7 SHOP PAINTING

A. Pump and Associated Equipment: Shop-primed and finished-coated per Manufacturer's standard practice prior to shipment. Color: Manufacturer’s standard.

B. Interior and Exterior Pump Surfaces, Motor Enclosure: Supplied with Manufacturer’s standard epoxy coatings. Cleaned, dry, free of rust, mill scale, grease, dirt, and other foreign matter.

C. Nameplates: Protect during painting.

2.8 ACCESS HATCHES

A. Single leaf or double leaf doors as indicated by the Drawings. Dimensions indicated on drawings depict the overall hatch dimension which include the opening and the hatch frame width and length. The hatch dimensions shown on the Drawings are the maximum length and width permitted for the entire hatch + hatch frame.

1. Material: 1/4-inch aluminum diamond pattern plate with welded stiffeners, as necessary, to withstand a 300 psf live load.
2. Angle Frame: 1/4 inch aluminum with perimeter anchor flange or strap anchors for concrete embedment around the perimeter.
3. Pivot torsion bars for counterbalance or spring operators;. For easy operation along with automatic door hold open; unless otherwise noted on Drawings.
4. Hardware: Durable and corrosion resistant Type 316 stainless steel hardware used throughout.
5. Removable lock handle.
6. Finish: Factory mill finish for aluminum doors and frames. Bituminous coating on exterior of frames in contact with concrete.
7. Manufactured by Bilco Company, New Haven, CT or Halliday, or equal.

2.9 SOURCE QUALITY CONTROL

A. General:

1. The Engineer has the right to inspect any equipment furnished under this Section prior to shipment from place of manufacture and may choose to witness the factory pump performance test.
2. Notify Engineer in writing ten working days prior to the factory performance test, so arrangements can be made for inspection by the Engineer.

B. Factory Pump Testing: Performed by Manufacturer.

1. Test pumps as described in ANSI/HI 11.6, American National Standard for Rotodynamic Submersible Pumps for Hydraulic Performance Acceptance Tests, as specified.

2. Perform hydrostatic test on pressure-containing components per ANSI/HI 11.6 on pumps prior to shipment.
3. Examine cast surfaces of components by visual inspection per MSS SP-55.
4. Factory pump tests are the basis of acceptance of hydraulic performance of pumps.

    a. Factory test pumps prior to shipment per Hydraulic Institute standards.
    b. Test and Record: Flow rate, total head, overall efficiency and input KW for at least five points on pump performance curve.

        1) Perform test to demonstrate pumps meet ANSI/HI 11.6, acceptance grade 1U for specified (intermediate) design point and acceptance grade 1E for the other specified points except that maximum pump power input at any point on the pump curve is to be limited to the nameplate Brake Horsepower rating of the motor size specified in “Conditions of Operation” Article in Part 2.
        2) Include the points specified in “Conditions of Operation” Article in Part 2.

    c. Pumps failing to meet specification requirements are required to be modified to meet specification requirements. If reasonable attempts to correct inefficiencies are unsuccessful, replace pumps with units meeting specified requirements.

5. Certified Pump Performance Curves: Submit test data to Engineer for approval prior to shipment. Include total head, flow rate, overall efficiency and total brake horsepower for each pump supplied.
6. If Manufacturer does not have historical test records for NPSH3 at specified design pump speed, test one pump to demonstrate NPSH3 versus flow rate.
7. Meters, Gauges, and Other Test Instruments: Calibrated within manufacturer's established time period prior to scheduled test.

    a. Provide calibration certification data.
    b. If Manufacturer has no ISO standard calibration period, Hydraulic Institute Standards governs.

8. Test pumps at 100 percent of design speed.
9. Test pumps through specified range of flow, and head/flow rate/ efficiency curves plotted at maximum output speed.

    a. During each test, run pumps at each head condition for sufficient time to accurately determine flow rate, head, power input, and efficiency.
    b. Determine the overall efficiency at each test point.
    c. Modify pumps under test until specified conditions are met or replace with pumps meeting specified conditions.

10. All pumps are to receive a non-witness factory test.
11. Manufacturer to perform the following test pumps prior to shipment from factory:

    a. Megger motors and pumps for insulation breaks or moisture.
    b. Prior to submergence, pumps to be run dry and checked for correct rotation.
    c. Run pumps for 30 minutes in a submerged condition.
    d. Pump shall be removed from test tank, metered immediately for moisture. Check upper and lower seal units for water intrusion.
    e. Submit for Approval Prior to Shipment: A written certified test report regarding above tests.

PART 3 - EXECUTION

3.1 PREPARATION

A. Take necessary field measurements. Determine exact dimensions for Work and required sizes of equipment under this Contract. Verify all pertinent data and dimensions.

3.2 INSTALLATION

A. Install equipment per Manufacturer’s instructions and recommendations in locations shown on Drawings.

B. General: Unless instructed otherwise by Manufacturer’s instructions.

    1. Oil and Grease for Initial Operation: Supplied by Contractor.

2. Base Elbows for Pumps: Installed by Contractor conforming to Manufacturer recommendations and instructions.
3. Anchor Bolts: Set per Manufacturer's recommendations.
4. Pump Seal Against Discharge Connection:

    a. Baseplate and Associated Accessories: Installation requirements.

        1) Sole Plates: Install, level and grout per API RP 686, Chapter 5 – Mounting Plate Grouting.
        2) Jacking Bolts: Back off after grouting so they do not support any of the load.
        3) Jacking Bolt Bearing Disks: Placed under each jack bolt.
        4) Plastic Vent Tubes: Spaced as recommended by manufacturer.
        5) Grout: Mix and apply according to manufacturer's directions.
        6) Manufacturer Representative Presence: Is mandatory during pouring of epoxy grout as well as use of rigid non-absorbing formwork and a head box.
        7) Surface of formwork in contact with epoxy grout must be covered with a layer of paste wax to facilitate removal.
        8) Clearance between the concrete surface and bottom surfaces of sole plates to be per Manufacturer's recommendation.
        9) Concrete surface in contact with epoxy grout:

            a) Chipped to present a slightly rough surface and remove the laitance.
            b) The surface must then be cleaned of all dust, moisture and oil.
            c) Place thin layer of leveling grout under jacking bolt bearing discs.
            d) Place Plastic Vent Tubes: Sized and spaced per manufacturer's recommendation, under sole plates to vent air during grouting and prevent voids in epoxy grout.

        10) Annular Space Between Anchor Bolts and Anchor Bolt Sleeve: Filled with expanding urethane foam.

            a) Threads of anchor and jack bolts in contact with grout to be covered with paste wax and a layer of duct tape.
            b) After alignment tolerances are met: Tighten anchor bolts snug to prevent movement during the pour.
            c) Epoxy grout is not to extend above the top edge of the sole plates.
            d) After the epoxy grout has fully cured, within 24 to 48 hours after pouring, remove jack bolts and tighten anchor bolts tightened to torque levels recommended by Manufacturer.

        11) Threaded Jack Bolt Holes: Coat with grease. Clean jack bolts of paste wax and duct tape then reinsert and secure in position with a lock nut to within 1/4 inch of bottom of hole.
        12) After grouting, chip and patch edges to present a smooth finish.

C. Upon Completion of Each Pump Application: Manufacturer shall inspect installation.

1. Satisfactory Inspection: Submit certificate stating equipment installation is satisfactory and meets Manufacturer's installation, operation and maintenance manuals. State equipment is ready for operation, and operating personnel have been suitably instructed in operation, lubrication and maintenance of each unit.

D. Ensure Proper Installation: If Contractor does not provide qualified installation staff during installations, the Engineer may require Contractor to provide services of Manufacturer's factory representative to give necessary instruction and supervision.

3.3 INSPECTION AND TESTING

A. General:

1. Prior to Shipment from Place of Manufacture: Engineer reserves right to inspect furnished equipment meeting this Section's specified requirements. Include the phrase regarding witness testing if pump performance test to be witnessed.

2. Field Tests: Not be conducted until pumping system, including controls, is complete and ready for testing.

B. Field Pump Test:

1. Manufacturer to furnish services of a representative having complete knowledge of proper operation and maintenance to inspect final installation and supervise test run of equipment.

    a. Pump Pricing: Include minimum eight hours of representative's time for field pump testing.

2. Written Test Procedures: Submit to Engineer for approval 30 days prior to testing.
3. Contractor to furnish water, power, facilities, labor, materials, supplies and test instruments required to conduct field testing.
4. Final Acceptance Tests: Demonstrate these Specification requirements have been met by equipment as installed.

    a. Contractor to, at a minimum, verify the following:

        1) Quick Release Lift Out: Functions properly allowing pump to be raised and lowered without draining pit.
        2) Pumping units are properly installed and in correct alignment.
        3) Correct lubrication per manufacturer's instructions.
        4) Correct direction of rotation of motors and reverse connections, if necessary.
        5) Pump units operate without overheating or overloading and without objectionable vibration.
        6) No mechanical defects in any of the parts.
        7) Pump units deliver specified total head and flow rate to demonstrate units generally meet requirements specified. Factory performance test is basis of pump acceptance.
        8) Sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations, and proper level alarm functions.

5. If pump unit performance does not meet specifications, take corrective measures or remove and replace with pumps which satisfy conditions specified.

6. Continuous Operating Period: A five-day period of pump units' operation is required before acceptance. Pump units failing during this period shall be repaired or replaced. Continuous operating period shall then be restarted; resetting run time to zero.

3.4 MANUFACTURER SERVICES INCLUDING OPERATING INSTRUCTIONS

A. Installation Inspection and Startup:

1. Contractor to include in bid price, providing services of Manufacturer's factory representative having complete knowledge of proper operation and maintenance.

    a. Representative to instruct Owner representatives and Engineer on operation and maintenance.
    b. Instruction may be conducted in conjunction with inspection, installation and start-up of pump units.
    c. If there are difficulties in equipment operation due to design or fabrication, additional service to be provided until performance is as specified.
    d. Listed Service Requirements: To be exclusive of travel time, and will not limit or relieve Contractor of obligation to provide sufficient service necessary to place equipment in satisfactory and functioning condition.

2. Installation Inspection: Complete review of installation.

    a. Written Installation Certification: Installation is complete and operable in all respects, per Manufacturer's information and instructions and no conditions exist which may affect warranty.
    b. Manufacturer to supply installation inspection services of experienced Manufacturer's factory representative to verify proper pump installation.
    c. Qualified supervisory services, including Manufacturers' Factory representatives, to be provided to ensure installation is done in a manner approved by Manufacturer.
    d. Manufacturer's factory representative to supervise and approve**:**

        1) Installation and alignment of pumps with motors.
        2) Grouting.
        3) Alignment of connecting piping and installation of field installed packing or mechanical seal.

    e. Start-Up or Operation Difficulties due to Manufacturer's Design or Fabrication:

        1) Manufacturer to provide additional service until performance is as specified.

    f. Services of Manufacturer's factory representative and training to be provided when first pump unit is started, with follow-up visits upon start-up of each subsequent pump unit.
    g. Minimum Time On-Site: One 8 hour day per pump.

3. Start-Up:

a. Written Field Report. Summarize test procedures and results. Include tested and measured variables. Show installation meets performance requirements of this specification and project.
b. Tested and Measured Variables: Including but not limited to the following.

1) Flow rates.
2) Total heads.
3) Shaft-speed.

c. Minimum Time On-Site: One 8 hour day per pump.

B. Training:

1. Field and classroom instruction on operation and maintenance of the equipment.

a. Include start-up, shut-down troubleshooting, lubrication, maintenance, and safety.

2. Manufacturer to provide detailed manuals to supplement training courses.

a. Include specific details of equipment supplied and operations specific to project.
b. If required, make use of teaching aids, slide/video presentations, etc.

3. After Completing Training Services: Deliver training materials used by Manufacturer to Owner.
4. Minimum Time On-Site: One 8 hour day per group of identical pumps.

C. Contractor is solely responsible for the following:

1. Requesting inspection and training services
2. Coordinating requests with other relevant trades.
3. Ensuring effectiveness of Manufacturers' service.
4. If lack of coordination by Contractor results in need to recall Manufacturer’s factory representative, time lost will not be counted against above days.

END OF SECTION 432513

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SECTION 460200 – TANK AND STRUCTURE CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cleaning and removal of settled wastewater solids, grit, sand, debris, and sludge from the following concrete structures which have a top of wall that is above-grade:
   a. Aeration basins.

2. Cleaning and removal of settled wastewater solids, grit, sand, debris, and sludge from the following below-grade concrete structures:
   a. Filtrate lift station wet wells.

1.3 UNIT PRICES

A. Unit price per ton of grit/debris/solids and sludge removed and disposed.

1.4 ACTION SUBMITTALS

A. Disposal Methods: Details.

B. Transport and Sludge Disposal Forms: Copies of forms generated within ten (10) days.

C. Dewatering Operations Approval: Submit request Fourteen (14) days before start of operations.

1.5 QUALITY ASSURANCE

A. Landfill Site: Approved to accept Resource Conservation and Recovery Act (RCRA) wastes.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify condition of each structure and its contents.

3.2 PREPARATION

A. Provide adequate protection of persons and property. Executed work to avoid hazards to persons and property.

B. Furnish signs, lights, barricades, and other equipment for safe prosecution of this work. Remove protection when work is completed.

C. Deactivate electrical power connected to the tank or its ancillary equipment and dismantle wiring at the circuit breaker.

D. Provide positive ventilation of tanks or structures when interior type work is being performed.

3.3 TANK CLEANING

A. General:

1. Structures will be taken out of service at time of draining and cleaning.
2. Include material removal from structures, down to the concrete slab and walls.
3. Dispose of residue, fluid, sludge, cleaning material, and rinse waters from tanks at approved waste disposal facility.
4. Maintain traffic while sludge removal is in process.

B. Remove mixed liquor, grit, and sludge in a two-step process: Draining and Cleaning.

1. Draining:
    a. Owner shall remove majority of tank contents through normal facility processing operations and drain structure to greatest extent possible.
    b. Allow the following time durations to drain structures:
        1) Each Treatment Unit Aeration Tank will take 14 days.
        2) Filtrate Lift Station will take 1 day.
    c. Obtain dewatering operations approval prior to start.
    d. Further drain tank until either completely empty or until Owner deems remaining material in tank unsuitable for introduction into the liquid treatment process.

2. Cleaning:
    a. Remove remaining unsuitable material following draining stage.
    b. Remove material from tank and dispose of off-site.
    c. Obtain approval of removal method when quantity and nature of material is revealed during draining stage.

END OF SECTION 460200

SECTION 464315 – PECAN BRANCH MAINTENANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Leveling Existing Weir Plates at Pecan Branch WWTP
   a. Adjust existing Aeration Basin 3-4 Influent Channel weirs to the elevations as shown in Attached Exhibit.

2. Pipe Cleanout of Existing 10” Return Activated Sludge Pipeline at Pecan Branch WWTP.

   a. Provide temporary piping as shown on the Exhibits to maintain Owner’s operation of at least four RAS pumps during pipeline cleaning.
   b. Flush and clean any settled solids, grit, and debris in the 10” RAS line, as detailed in the Attached Exhibit.

1.3 ACTION SUBMITTALS

A. Shop Drawings:
   1. Submit shutdown plan and anticipated schedule for removal and leveling of existing weirs at each aeration basin one at a time.
   2. Submit temporary piping plan, sequence of construction, and anticipated schedule for RAS pipe cleanout work.
   3. Submit for Owner’s information temporary water and or pumps required to pig or clean the piping.

1.4 DELEGATED DESIGN SUBMITTALS (NOT USED)

1.5 INFORMATIONAL SUBMITTALS

A. Field Quality Controls: Indicate results of Contractor-furnished inspections and survey results.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION
1.

B. Weir Plates:
1. Carefully align and level to the elevations shown on the attached exhibits. No variation greater than 1/8-inches.
a. Provide survey measurements at a minimum of 2 evenly spaced locations at each aeration basin weir for acceptance of work.

C. 10-inch RAS Cleanout:
1. Prior to pipeline pigging, Contractor shall CCTV the line and report results to Owner and Engineer.
2. Submit, for engineer review and approval, materials as well as means and methods for pipeline pigging.

3.2 FIELD QUALITY CONTROL

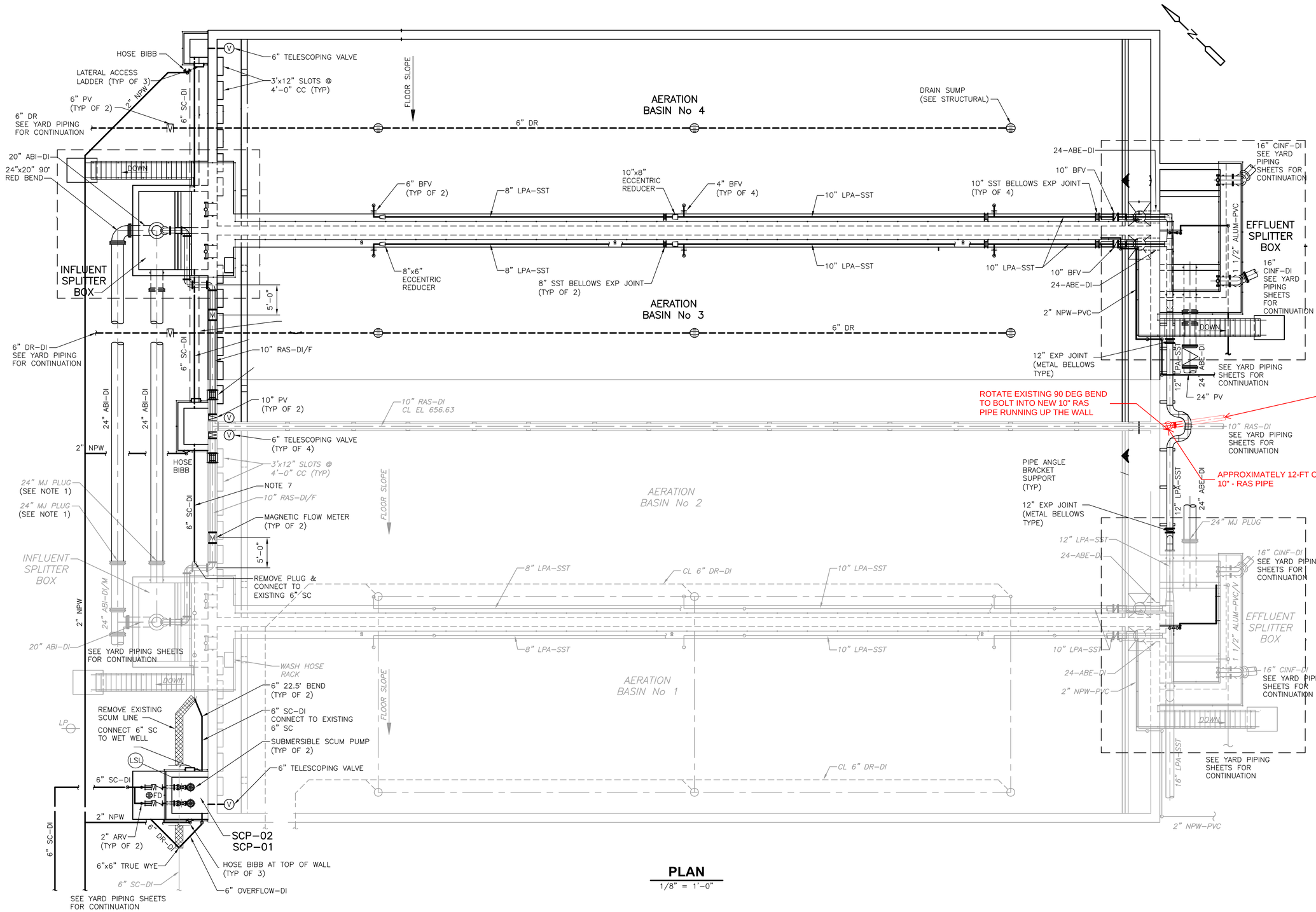
A. Submit inspection reports to Owner and Engineer.

3.3 ADJUSTING

A. Adjust and correct defects in fabrication and installation allowing proper operation of system and related components.

3.4 SEE ATTACHED FOR EXHIBITS

END OF SECTION 464315



PLAN
1/8" = 1'-0"

NOTES:

1. TEMPORARY RAS PIPING FOR CLEANING WORK SHOWN IN EXHIBIT PAGES 1-4 IS SHOWN IN RED.

2. 10" - RAS PIPE MATERIAL TO BE SUBMITTED FOR APPROVAL.

3. CONTRACTOR TO REFER TO THE FOLLOWING SPECIFICATIONS FOR INSTALLATION OF 10" - RAS PIPE:

   SECTION 400506 FOR PIPING APPURTENANCES.

   SECTION 400507 FOR PIPE SUPPORT REQUIREMENTS

   SECTION 400551 FOR PROCESS VALVES.

   SECTION 400519 FOR DUCTILE IRON PROCESS PIPE

4. PIPE SUPPORTS ARE DELEGATED DESIGN. REFER TO SECTION 400507 FOR REQUIREMENTS.

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TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

PECAN BRANCH
WASTEWATER TREATMENT PLANT

AERATION BASINS
TEMPORARY RAS PIPING PLAN

EXHIBIT
464315-1

1" = 10'

0+45.62
DEF ANG 56.25° RT
16" 11.25° BEND
16" 45° BEND
N 10219423.30
E 3150642.87

0+17.52
DEF ANG 45° RT
16" 45° BEND
N 10219385.66
E 3150674.55

0+99.25
DEF ANG 45° RT
16" 45° BEND
N 10219384.10
E 3150679.47

0+81.59
DEF ANG 45° RT
16" 45° BEND
N 10219338.83
E 3150718.27

16" CINF-DI

16" CEFF-DI

0+94.73
DEF ANG 45° RT
16" 45° BEND
N 10219325.70
E 3150717.82

0+05.75
(2) 16" 90° BENDS
SEE SHEET MD-3

CLARIFIER No 3

CLARIFIER No 4

GOOSENECK LADDER
(TYP FOR EACH CLARIFIER)

F
MD-3

0+01.87
DEF ANG 56.25° LT
16" 90° BEND
16" 45° BEND
SEE SHEET CP-5

AERATION BASIN
No 4

0+10.02
16" 45° BEND

2" NPW-PVC

1/2" SHC-PVC

3-45° BENDS

MH No E-2

1+18.09
20"x16" REDUCER
20"x16" TEE
16" 90° BEND

1-45° BEND

1+36.01
20"x20" TEE

20" CEFF-DI

36" EFF DI

TIE INTO THE EXISTING
10" - RAS -DI PIPE.

AERATION BASIN
No 3

0+09.59
16" 45° BEND

0+01.87
DEF ANG 23.7374° LT
16" 90° BEND
16" 45° BEND
SEE SHEET CP-5

SEE SHEET MD-4

RAS PUMP STATION

INSTALL 4" MH
N 10219349.55
E 3150644.68
(SEE NOTE 1)

1 1/2" ALUM-PVC/V

24" PV

2" NPW-PVC/V

MATCH LINE SEE SHEET CP-3

16" CINF-DI/P

10" RAS-DI/P

1/2" SHC-PVC

TEMPORARY
10" - RAS PIPE

SEE SHEET EXHIBIT
PAGE 3 FOR
CONTINUATION

4"x4" TEE
(2) 4"x2" REDUCERS

24" ABE-DI

4" NPW-PVC/P

1 1/2" ALUM-PVC/V

RAS PUMP STATION

TERTIARY TREATMENT FACILITY

LP

20" CEFF-DI

16" CEFF-DI

4" NPW-PVC

MH

MH No 9

1/2" SHC-PVC/V

16" NPW-PVC/V

AERATION BASIN
No 2

CLARIFIER No 1

CLARIFIER No 2

4" NPW-PVC/V

2" NPW-PVC/V

EMH-2

16" CEFF-DI

MATCH LINE SEE SHEET CP-2

Exhibit
464315-1

16" CINF-DI/P

6" SC

8" DR-PVC

MH No 8

4" NPW-PVC/V

10" DR-PVC

1/2" SHC-PVC/V

2" PW-PVC/V

METER VAULT

EMH-3

EMH-1

4" DR-PVC

1/2" PW-PVC/V

MH No 4

16" CEFF-DI

10" DR-PVC

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CITY OF GEORGETOWN, TEXAS

PECAN BRANCH
WASTEWATER TREATMENT PLANT

YARD PIPING
TEMPORARY RAS PIPING PLAN

EXHIBIT
464315-2

CLARIFIER No 1

CLARIFIER No 2

CLARIFIER No 3

10" SL-DI/P

6" DR-DI/P

6" WAS-DI/P

WAS MAGNETIC FLOW METER

SEE YARD PIPING SHEETS FOR CONTINUATION

4' DIA MH

RESTRAINED FLANGE COUPLING ADAPTER (TYP OF 2)

2 1/2" NPW-GS/T

6" DR-PVC/P

2" NPW-PVC/N

6" SC-DI/P

6" DR-DI/P

10" SL-DI/P

3 MD-5

SEE YARD PIPING SHEETS FOR CONTINUATION

TEMPORARY 10" - RAS FORCEMAIN ROUTE ON GRADE

(2) 90 DEG BENDS

10" - RAS - DI CL EL 652.52

6" X 10" X 10" DI TEE (TYP OF 5)

16" CINF-DI/P

14'-0"

RASP-01

RASP-02

RASP-03

RASP-04

RASP-05

RASP-06

6" RAS-DI/F

4" DR-PVC/P

8" RAS-DI

PI

PSH

FD

2" SEWAGE TYPE ARV (TYP OF 3)

6" DR (TYP)

BURIED VALVE (TYP)

RAS PUMP STATION

RESTRAINED PLUG

1 MD-5

6" DR-DI/P AT 1.00% SLOPE

28'-0"

4 MD-5

6" PV (TYP)

6" CV (TYP)

8" PV (TYP)

SEE NOTE 2

1/2" DR-PVC ROUTE TO DRAIN

10" SL-DI

SEE YARD PIPING SHEETS FOR CONTINUATION

16'-10"

6" DR-DI

6" SC-DI

4' DIA MH
IE (OUT) 632.86
IE (6" DR IN) 632.86
IE (6" SC IN) 641.00

2" NPW-PVC

1" SHC-PVC

2-45° BENDS

6" PV (TYP OF 2)

BURIED VALVE (TYP)

N

NOTES:

1. RASP-06 WILL BE OUT OF SERVICE AS THE PIPE CLEANING EFFORT IS TAKING PLACE. USE CONNECTION POINT AT RASP-06 AS THE ACCESS POINT FOR PIPELINE CLEANING.

2. PRIOR TO COMMENCEMENT OF WORK, DRAIN 10" FORCEMAIN HEADER TO NEARBY 4'-DIA MH. CLOSE RASP-06 8" SUCTION PLUG VALVE AND 6" DISCHARGE PLUG VALVE TO ISOLATE THE LINE FROM BOTH THE CLARIFIER AND THE 10" FORCEMAIN. REMOVE 6" DISCHARGE CHECK VALVE AND CONNECT A 6" FLEX HOSE AND ROUTE TO MANHOLE FOR DRAINING OF LINE. WHEN READY TO DRAIN, OPEN 6" PLUG VALVE.

3. MINIMIZE DOWNTIME OF RAS PUMPS TO CONNECT TO TEMPORARY FORCEMAIN PRIOR TO CLEANING WORK AND TO RETURN PIPING TO ORIGINAL ORIENTATION AFTER CLEANING WORK IS ACCEPTED BY OWNER. PERFORM BOTH SHUTDOWNS DURING LOW FLOW PERIOD. SUBMIT PLAN OF CONSTRUCTION TO ENGINEER FOR REVIEW.

PLAN

3/8" = 1'-0"

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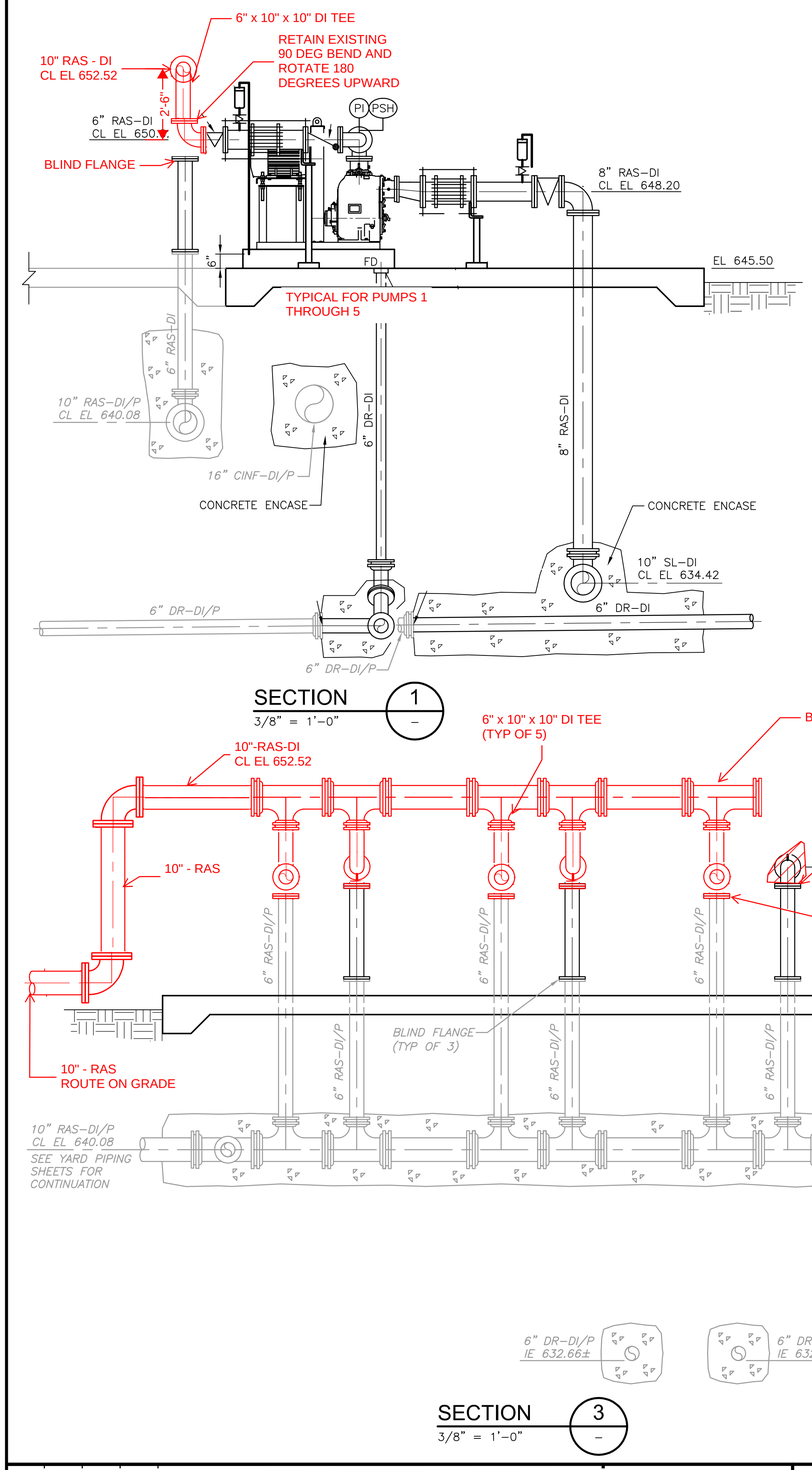
CITY OF GEORGETOWN, TEXAS

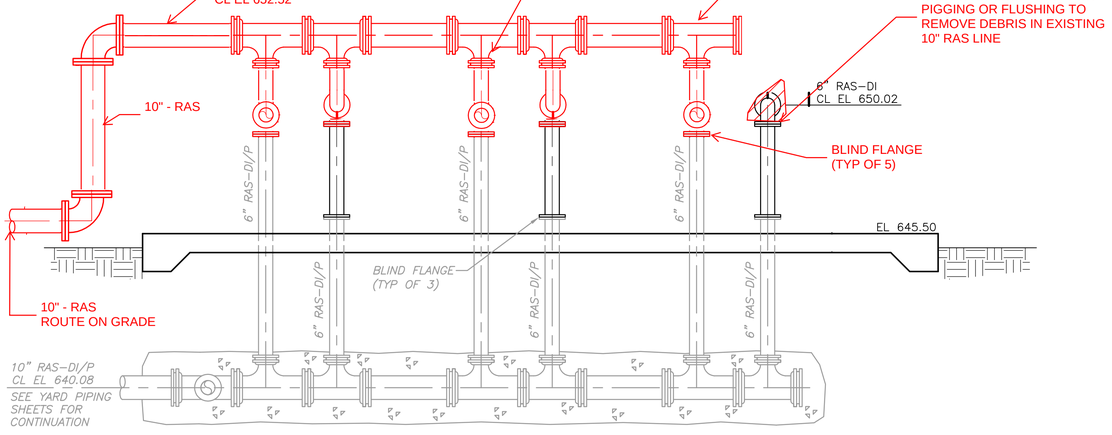
PECAN BRANCH
WASTEWATER TREATMENT PLANT

RAS PUMP STATION
TEMPORARY RAS PIPING PLAN

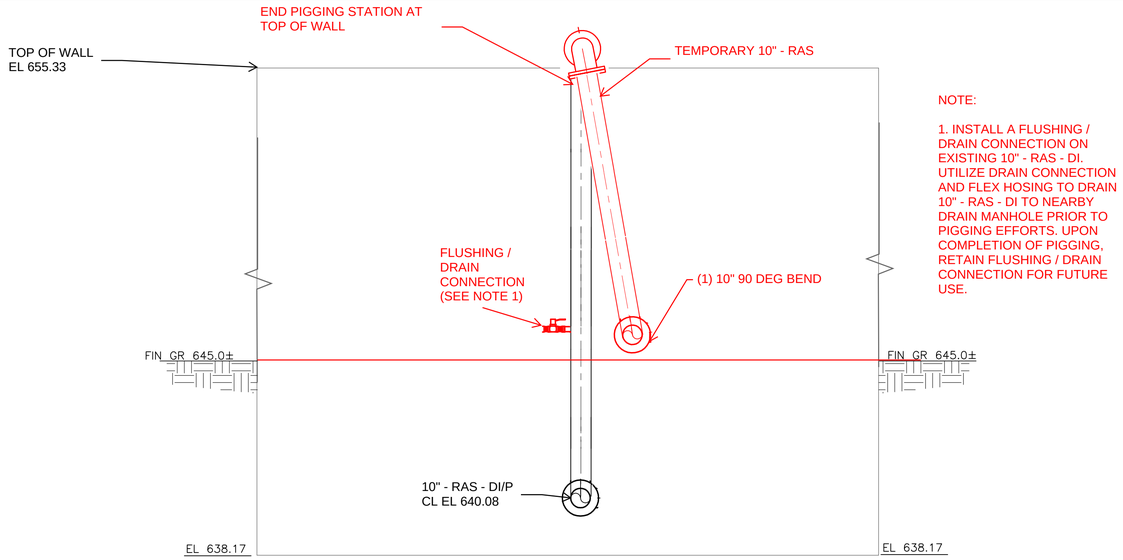
EXHIBIT
464315-3



SECTION 1
3/8" = 1'-0"



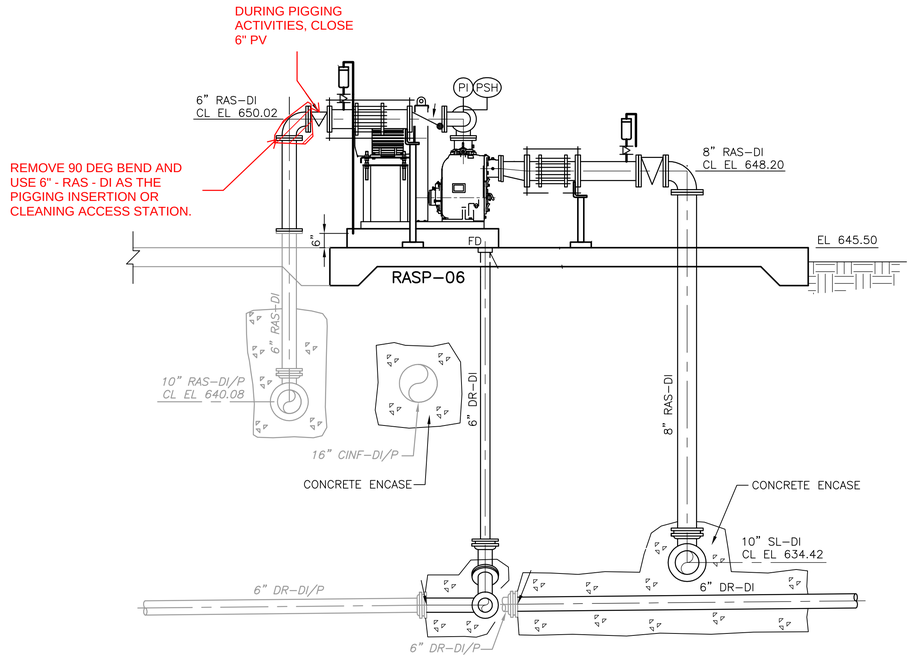
SECTION 3
3/8" = 1'-0"



NOTE:

1. INSTALL A FLUSHING / DRAIN CONNECTION ON EXISTING 10" - RAS - DI. UTILIZE DRAIN CONNECTION AND FLEX HOSING TO DRAIN 10" - RAS - DI TO NEARBY DRAIN MANHOLE PRIOR TO PIGGING EFFORTS. UPON COMPLETION OF PIGGING, RETAIN FLUSHING / DRAIN CONNECTION FOR FUTURE USE.

PIPE ROUTING UP AERATION BASIN WALL



SECTION 4
3/8" = 1'-0"

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CITY OF GEORGETOWN, TEXAS

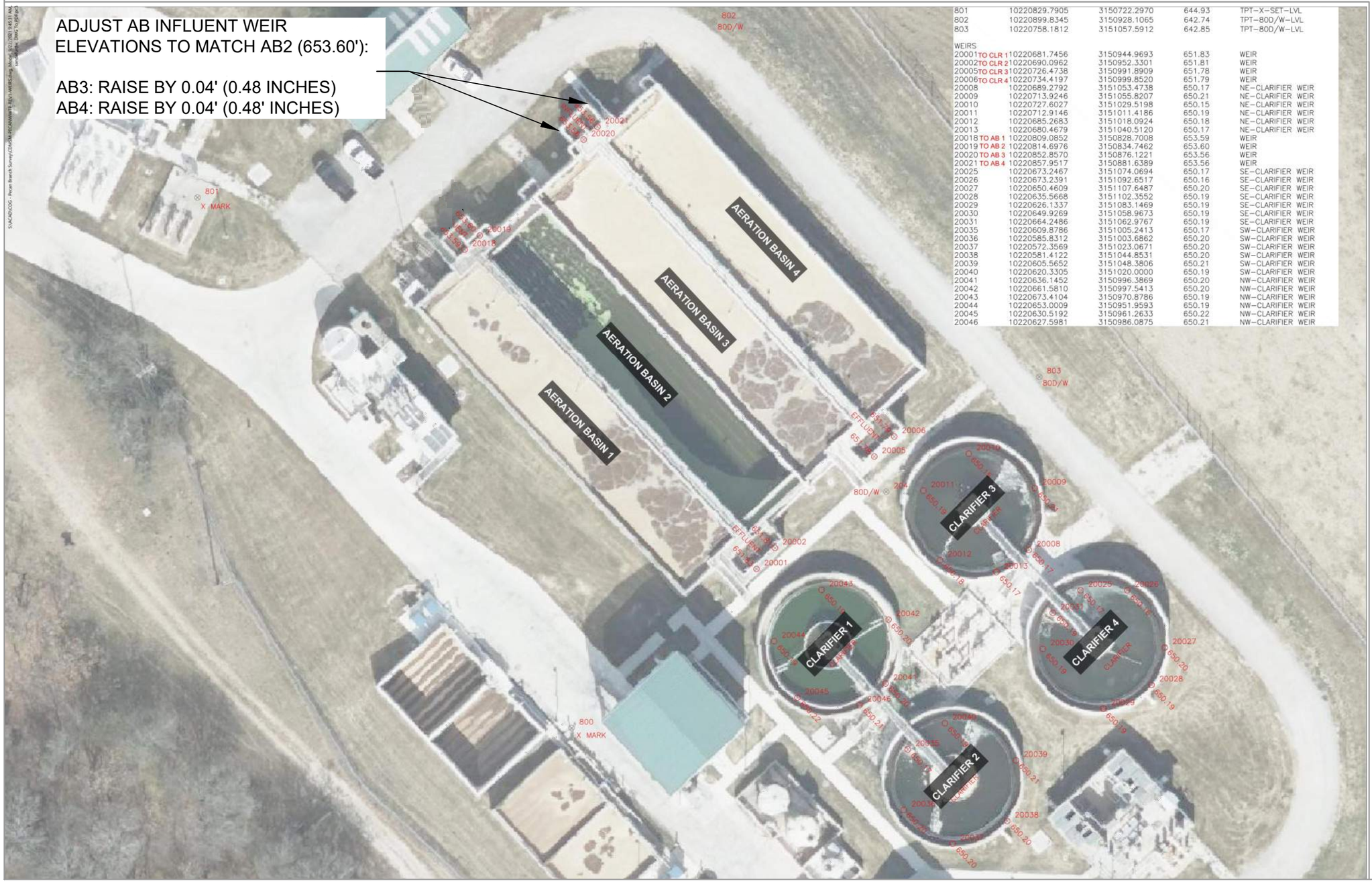
PECAN BRANCH
WASTEWATER TREATMENT PLANT

RAS PUMP STATION
TEMPORARY RAS PIPING PLAN

EXHIBIT
464315-4

ADJUST AB INFLUENT WEIR ELEVATIONS TO MATCH AB2 (653.60'):

AB3: RAISE BY 0.04' (0.48 INCHES)
AB4: RAISE BY 0.04' (0.48' INCHES)



801	10220829.7905	3150722.2970	644.93	TPT-X-SET-LVL
802	10220899.8345	3150928.1065	642.74	TPT-80D/W-LVL
803	10220758.1812	3151057.5912	642.85	TPT-80D/W-LVL
WEIRS				
20001 TO CLR 1	10220681.7456	3150944.9693	651.83	WEIR
20002 TO CLR 2	10220690.0962	3150952.3301	651.81	WEIR
20005 TO CLR 3	10220726.4738	3150991.8909	651.78	WEIR
20006 TO CLR 4	10220734.4197	3150999.8520	651.79	WEIR
20008	10220689.2792	3151053.4738	650.17	NE-CLARIFIER WEIR
20009	10220713.9246	3151055.8207	650.21	NE-CLARIFIER WEIR
20010	10220727.6027	3151029.5198	650.15	NE-CLARIFIER WEIR
20011	10220712.9146	3151011.4186	650.19	NE-CLARIFIER WEIR
20012	10220685.2683	3151018.0924	650.18	NE-CLARIFIER WEIR
20013	10220680.4679	3151040.5120	650.17	NE-CLARIFIER WEIR
20018 TO AB 1	10220809.0852	3150828.7008	653.59	WEIR
20019 TO AB 2	10220814.6976	3150834.7462	653.60	WEIR
20020 TO AB 3	10220852.8570	3150876.1221	653.56	WEIR
20021 TO AB 4	10220857.9517	3150881.6389	653.56	WEIR
20025	10220673.2467	3151074.0694	650.17	SE-CLARIFIER WEIR
20026	10220673.2391	3151092.6517	650.16	SE-CLARIFIER WEIR
20027	10220650.4609	3151107.6487	650.20	SE-CLARIFIER WEIR
20028	10220635.5668	3151102.3552	650.19	SE-CLARIFIER WEIR
20029	10220626.1337	3151083.1469	650.19	SE-CLARIFIER WEIR
20030	10220649.9269	3151058.9673	650.19	SE-CLARIFIER WEIR
20031	10220664.2486	3151062.9767	650.19	SE-CLARIFIER WEIR
20035	10220609.8786	3151005.2413	650.17	SW-CLARIFIER WEIR
20036	10220585.8312	3151003.6862	650.20	SW-CLARIFIER WEIR
20037	10220572.3569	3151023.0671	650.20	SW-CLARIFIER WEIR
20038	10220581.4122	3151044.8531	650.20	SW-CLARIFIER WEIR
20039	10220605.5652	3151048.3806	650.21	SW-CLARIFIER WEIR
20040	10220620.3305	3151020.0000	650.19	SW-CLARIFIER WEIR
20041	10220636.1452	3150996.3869	650.20	NW-CLARIFIER WEIR
20042	10220661.5810	3150997.5413	650.20	NW-CLARIFIER WEIR
20043	10220673.4104	3150970.8786	650.19	NW-CLARIFIER WEIR
20044	10220653.0009	3150951.9593	650.19	NW-CLARIFIER WEIR
20045	10220630.5192	3150961.2633	650.22	NW-CLARIFIER WEIR
20046	10220627.5981	3150986.0875	650.21	NW-CLARIFIER WEIR

NOTES:

1. PROVIDE BULKHEAD IN FRONT OF EACH WEIR SO THAT ONLY ONE AERATION BASIN IS TAKEN OUT OF SERVICE AT A TIME TO PERFORM LEVELING WORK.

PHOTOGRAPH OF AERATION BASIN INFLUENT WEIRS TYPICAL FOR AERATION BASINS 1/2 AND 3/4

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CITY OF GEORGETOWN
PECAN BRANCH
WASTEWATER TREATMENT PLANT

EXHIBIT 434315-5

INFLUENT SPLITTER BOX WEIR ELEVATION ADJUSTMENTS

DECEMBER 2023

DWG: C:\pw_pl1\fletcherjb\d2742323\EXHIBIT 1.dwg USER: FletcherJB
DATE: Sep 28, 2021 2:08pm XREFS:

SECTION 465136 - CERAMIC DISC FINE BUBBLE DIFFUSERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ceramic disc fine-bubble diffused aeration system, lateral piping, and pipe support/anchoring system for:

a. Dove Springs WWTP Treatment Units (Aeration Tanks) #1 and #2.

1.3 ABBREVIATIONS

A. DWP: Dynamic wet pressure.

B. EFR: Effective flux ratio.

C. PVC: Polyvinyl chloride.

D. SCFM: Standard cubic feet per minute.

E. SOTE: Standard oxygen transfer efficiency.

F. UPVC: Unplasticized polyvinyl chloride.

G. UV: Ultraviolet.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer's information describing system materials of construction, fabrication, and protective coatings.

B. Shop Drawings: System materials and component equipment, connections, and other installation details for:

1. System materials and component equipment, connections, and other installation details for:

a. Diffuser elements, diffuser element holders, retainers, gaskets, and orifices.
b. Piping, fixed joints, guide joints, expansion joints, piping supports, and pipe taps.
c. Anchoring system for manifolds and distribution laterals for aeration system.
d. Equipment weights including the weight of largest item or component.

e. Layout drawings.
f. Complete bill of materials for all equipment.
g. Complete details of each air header system showing number, location, type, and details of supports, length of header sections, materials and details of construction, anchor bolt size, number, and location.

1.5 DELEGATED DESIGN SUBMITTALS

A. Calculations and Drawings: Demonstrate entire system, including manifolds, laterals, drain lines, and moisture purge system meet requirements for expansion and contraction.

1. Show how system will expand and contract under range of conditions specified.
2. Demonstrate manifold headers, lateral pipes, pipe fittings, expansion joints, piping supports, etc., for entire system comply with requirements specified.
3. Calculate maximum amount of deflection that will occur and compare deflection to maximum allowable for type of joint used. Confirm that joints will not leak, and that expansion and contraction are acceptable for specified condition.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate:

1. Products meet or exceed specified requirements.
2. Installation is completed according to manufacturer’s instructions.

B. Manufacturer Instructions: Detailed instructions on installation requirements, storage and handling procedures, including:

1. Certified erection drawings showing material details of construction, dimensions, anchor bolt locations, and other details required for a proper installation.
2. Description of Contractor's proposed method for ensuring a level installation of equipment and methods of tightening bolts, diffuser hold-down rings, and similar items.

C. Operating and Maintenance Instructions: Prepared specifically for installation, including all required cuts, drawings, equipment lists, descriptions, etc. required to instruct operating and maintenance personnel unfamiliar with such equipment. Include trouble shooting data and full preventative maintenance schedules.

D. Source Quality-Control Submittals: Results of factory tests and inspections.

E. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

F. Manufacturer Reports: Equipment has been installed according to manufacturer instructions.

G. Spare Parts List: Manufacturer’s recommended spare parts, including gaskets, packing, etc.

H. Design Data:

1. Complete data on air flow head losses through droplegs, headers, and diffusers.
2. Complete oxygen transfer calculations based on guaranteed performance.
3. Complete calculations and drawings demonstrating that the entire system meet requirements for expansion and contraction as specified herein.

I. Test Reports:

1. Descriptions of test procedures.
2. Certified copies of results of tests specified.

J. Qualifications Statements:

1. Qualifications for manufacturer and installer.
2. Manufacturer’s approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and final orientation of equipment.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Tools: One set required for normal operation and maintenance.

1. Package tools in a steel case. Clearly and indelibly marked on exterior of case indicating equipment for which tools are intended.

B. Spare Parts:

1. Spare Diffusers: Equal to three percent of total number of installed diffusers.

a. Include diffusers, gaskets, replaceable air flow control orifices and required bolts, hold-down rings, and nuts.

2. Material to repair five percent of expansion joints supplied under this Contract.
3. Material to replace three percent of pipe supports including nuts and bolts.
4. For each type of diffuser density: One 20-feet section of complete lateral distribution pipes for spacing of diffusers supplied, including diffuser holders.
5. One complete air purge system.
6. Suitable pack and protect items for long periods of storage.

1.9 QUALITY ASSURANCE

A. Furnish diffusers by a single manufacturer regularly engaged in manufacture of diffused aeration systems for wastewater treatment. The equipment shall be manufactured and installed in accordance with best practices and methods.

B. Provide manufacturer's service representative, trained on installation of specified equipment.

1. Submit qualifications for approval.
2. Instruction requirements listed are exclusive of travel time, and do not relieve Contractor of obligation to provide sufficient service to place equipment in satisfactory operation.
3. Operation and maintenance instructions: One 8-hour day.

C. Furnish equipment specified in this Section by a manufacturer of diffusers who has sole responsibility for designing and fabricating parts and components required for a complete and operable system. Equipment need not be manufactured by a single manufacturer.

D. Quality Control Tests:

1. Prior to initiation of production, submit for Engineer's review sampling and testing plans to ensure consistently good quality and uniformity of diffuser production.
2. Testing and Sampling Plans: Follow procedures in "EWRI/ASCE 35-01 Guidelines for Quality Assurance of Installed Fine-Pore Aeration Equipment."

    a. After testing, mark diffusers with their test results.

3. Engineer may witness quality control sampling and testing at manufacturing facility.
4. Submit to Engineer a certified test report within two weeks of testing.
5. Include following tests and measurements:

    a. DWP at minimum, design average, and maximum air flow rates.
    b. EFR: At design average air flow rate.
    c. Uniformity: Visual evaluation of air flow pattern across entire diffuser surface.
    d. Permeability: At 70 degrees F plus or minus 5 degrees F and 10 to 50 percent relative humidity.
    e. Strength: Test by applying a vertical load of 750 lbs to center of 1 inch diameter when supported as in a diffuser element holder.
    f. Diffuser diameter.
    g. Diffuser weight.
    h. Diffuser thickness: At center and edge.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 10 years' documented experience.

B. Professional Engineer: Person legally qualified to practice and who is registered in State where Project is located.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's packaging; include application instructions.

B. Inspection: Accept materials on site in manufacturer's original packaging and inspect for damage.

C. Store diffusers according to manufacturer instructions.

D. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

1. Do not make shipment until approved by Engineer in writing.
2. At Time of Shipment: Deliver in triplicate to Engineer shipping list, original bill of loading, shipping memorandum and shipping invoice.

    a. Shipping Lists: Provide description and net weight of each item, and gross shipping weight.
    b. Shipment will not be accepted until list has been received.

E. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended. Mark boxes or packages to show their net weight.

F. Properly protect components so no damage or deterioration occurs during a prolonged delay between time of shipment and installation, including any prolonged period at site.

1. Wrap components at factory for protection from sunlight, snow, rain, drippings of any sort, dust, dirt, mud, flood, and condensed water vapor.

a. Protective coverings to remain in place until work areas are ready for installation.
b. Submit details of proposed protection for Engineer's approval prior to shipment.

2. Finished surfaces of exposed parts: Protect against adverse conditions that may prevail from time of shipment until ready for operation.

G. Protect finished surfaces of exposed flanges with wooden blank flanges or plastic inserts, strongly built and securely bolted.

H. Arrange and mark lateral piping and diffuser holders for tank and grid which they are intended.

I. Protection: Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

1. Provide additional protection according to manufacturer instructions.

1.12 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

A. The manufacturer shall guarantee that air diffusion equipment shall perform in accordance with the specifications when operated at the specified design conditions.

B. Provide an unconditional extended warranty for a period of 2 years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide equipment by one of the following or equal:

1. Sanitaire (Xylem), Milwaukee, WI.
2. Aquarius Technologies LLC, Saukville, WI.
3. Environmental Dynamics International, Inc, Columbia, MO.

2.2 CERAMIC DISC DIFFUSER SYSTEMS

A. General:

1. Supply equipment complete.

   a. Proportion parts to have liberal strength, stability and stiffness and adapted for intended service.
   b. Provide ample room and facilities for inspection, repairs, and adjustments.

2. Furnish equipment suitable for:

   a. Operation submerged in wastewater with biomass concentration ranging from 3,000 mg/L to 6,000 mg/L.
   b. Long term exposure to compressed air at temperatures up to 250 degrees F when submerged in water or wastewater.

3. Drawings show a schematic configuration of piping, valves, and diffusers. The aeration system manufacturer/supplier to provide detailed design of the system to meet the performance requirements specified herein.

B. System Description – Dove Springs WWTP Treatment Unit Aeration Tanks No. 1 and 2:

1. Temperature range of Mixed Liquor:

   1) Maximum, degrees (F) 85.
   2) Minimum, degrees (F) 60.

2. Basin Liquid Depth:

   1) Maximum: 15.51 feet.

3. Available air pressure at top of each dropleg: 8.0 psig.
4. Manifolds and laterals: Capable of carrying 150 percent of design average required airflow rates.
5. Provide diffuser design with uniform density suitable for providing the following minimum standard oxygen transfer rate (SOTR) in pounds per hour (lb/hr) in the number existing of grids and droplegs as shown on Drawings:

   a. Tank 1: Six diffuser grids with uniform diffuser density.

      1) Average SOTR: 613 lb/hr.
      2) Maximum SOTR: 853 lb/hr.

   b. Tank 2: Four diffuser grids with uniform diffuser density.

      1) Average SOTR: 613 lb/hr.
      2) Maximum SOTR: 853 lb/hr.

C. Performance and Design Criteria:

1. Design Air Flow Rates per Diffuser:

   a. Minimum: 0.5 scfm.
   b. Average: 1.0 scfm.

c. Maximum: 2.5 scfm.

2. SOTEs in Clean Water: 0 mg/L Dissolved Oxygen, at 1.00 atm which equals 14.7 psia, at 68 degrees F, 36 percent Relative Humidity:

a. At minimum design air flow rate per diffuser: 2.0 percent per foot submergence.
b. At average design air flow rate per diffuser: 2.0 percent per foot submergence.
c. At maximum design air flow rate per diffuser: 1.8 percent per foot submergence.

3. Maximum Head Loss: 12 inches water column WC, based on 15 feet submergence.

D. Design Requirements Applicable to all Grids:

1. Provide 5 percent additional blank diffuser saddle/base plates per grid.

a. Minimum Blanks: Based on number of diffusers required to satisfy specified SOTE percent in addition to active diffusers specified.
b. Uniformly distribute blanks throughout each grid.
c. Mounting saddles, diffuser base/holders, and retaining rings of the type to be assembled, installed, and plugged at each blank site.

1) Future Diffuser Installations: Only require diffuser placement and plug removal.
2) Blanks and Diffusers: To be in place prior to performing acceptance tests.

2. Arrange diffusers such that each diffuser is easily accessible for manual removal and replacement and for in place diffuser cleaning.

a. Provide a clear walking space of 18 inches, measured between lateral piping.
b. Clear walking space may be between every lateral or alternate laterals, provided access to laterals and diffusers is achieved from one side or the other of the walking space.
c. Base maximum spacing between diffusers on lateral pipes and laterals on manufacturer's recommendations to meet the requirements of this Section and to prevent deposition of solids.
d. Spacing Between Diffusers: Do not exceed 48-inch center to center of diffusers or 2 feet from center of diffuser to any tank wall, unless otherwise indicated on Drawings.

3. Allow for expansion and contraction in the entire system, which includes the manifold, laterals, drain lines, and moisture purge system, under following conditions:

a. Winter conditions, empty aeration tanks: 0 degrees F.
b. Summer conditions, empty aeration tanks: 125 degrees F.
c. Operation with air supply at 225 degrees F and aeration tanks full.
d. Operation with air supply at 225 degrees F and water level in aeration tanks 2 feet above diffusers.

2.3 PVC MATERIALS AND FABRICATION

A. PVC Moldings and Extrusions: Produced from PVC compound per ASTM D1784.

1. Compound cell classification 12454-B with a minimum tensile strength of 7,000 psi.
2. PVC parts to be suitable for long term exposure to compressed air at temperatures up to 200 degrees F.

B. Blend PVC resins and limit quantity of fillers to achieve:

1. Minimum K-Value for Fittings: 58.
2. Minimum K-Value for Pipes: 64.

C. Distribution Headers: Hydrostatic design stress rating of 2,000 psi, as shown on Drawings per ASTM D1785 or ASTM D3034.

D. PVC Fittings: As shown on Drawings per ASTM D2466.

E. Solvent Welding: With solvent cements specifically formulated for use with PVC.

1. PVC joints welded in factory in per ASTM D2855 except edges need not be chamfered.
2. Solvent Welding: With solvent cements formulated for use with PVC per ASTM D2564.
3. Field solvent welding not permitted.

2.4 PIPING

A. Furnish connections to stainless steel droplegs and manifolds of minimum sizes shown on Drawings.

B. UV Protection of PVC Piping and Parts: Manufactured of UPVC with a minimum of 1.5 parts by mass of rutile titanium dioxide (TiO_2) per 100 parts of PVC resin for ultraviolet protection.

1. TiO_2 Particle Size: 0.2 micrometer) to 0.3 micrometers (microns)). Include a certificate from raw material supplier confirming this requirement.

C. UPVC piping: suitable for use in wastewater.

1. Dropleg connections and air manifolds to be Schedule 40 UPVC.
2. Lateral pipe: minimum SDR26 with hydrostatic design stress rating of 2,000 psi. Lengths not to exceed 20 feet.

D. Dropleg Connections and Manifolds: Supply with flexible couplings, expansion joints, pipe supports, etc. as shown on Drawings, and as required by Manufacturer for alignment of system and to meet expansion/contraction requirements as specified.

E. Air Diffuser Distribution Laterals: Include piping, diffuser element holders, joints, expansion joints and air purge-drainage system.

1. Distribution laterals connect to side centerline of manifold by flange connections or by fixed joint union-type connections.
2. Provide for Flange Connections: Type 304 stainless steel nuts, bolts, gaskets, backing flange, and other accessories.
3. Fixed Joint Couplings: For airtight connection between distribution lateral and manifold and with positive locking joint and anti-rotation feature. Joints relying on friction as anti-rotational feature is not acceptable.
4. System to meet expansion/contraction requirements as specified.

F. Fixed Joints: Factory solvent welded to distribution laterals. Factory assemble and test solvent welds prior to shipment. Field solvent welding is not permitted.

G. Pipe Support Systems Factor of Safety: 4 or greater against calculated buoyant forces when installed.

H. Anchor Bolts Factor of Safety: 10 or greater against calculated buoyant forces when installed.

I. Level diffusers to plus or minus 1/4 inch. Diffuser piping and diffusers must be capable of being leveled to this tolerance and remaining level under all conditions of operation whether aeration tanks are full, partially full, or empty.

J. Lateral Piping: Include an expansion-contraction system consisting of fixed joints and guide supports.

K. Guide Supports:

1. Allow longitudinal expansion and contraction movement of lateral piping.
2. Provide proper bracing and means for accurate field alignment and adjustment of diffuser piping vertically and longitudinally.
3. At least two supports per pipe section. Support spacing not exceed 90 inches. Join sections of lateral piping with fixed joints which prevent blow-apart and rotation of one pipe section with respect to another.
4. Provide for specified range of expansion or contraction of diffuser piping resulting from temperature change.
5. Do not use expansion joints for joining pipe sections.

L. Expansion Couplings: Operate at average force of 50 lbsf.

M. Piping Gaskets: butyl rubber, neoprene, or a composition suitable for air to 230 degrees F and suitable for long term immersion in wastewater.

N. One drain line, sump, and air lift purge systems for each grid:

1. One in-line manifold purge sump and air lift purge system to drain entire submerged aeration piping system for each aeration grid.
2. Sump: Integral with manifold. Its bottom elevation lower than invert of air distribution laterals and manifold.
3. Connect drain sump to 3/4 inch diameter airlift line extending from sump invert elevation.

    a. Extend airlift line to point above tank water level and terminate with a horizontally mounted PVC ball valve accessible from finished grade.
    b. Air lift line will utilize a flexible connection between drain sump and vertical pipe run at aeration tank wall.

2.5 SUPPORTS

A. Manifold Supports:

1. Material: Type 304L stainless steel. Space as specified. Anchor supports to tank floor with Type 304, 3/8 inch diameter wedge anchors.
2. Supports include manifold hold down and supporting structure.

3. Design stands to resist following uplift without exceeding 24,000 psi design stress:

    a. Manifold Diameter: 4 inches. Uplift Force per Support: 102 lbs.
    b. Manifold Diameter: 6 inches. Uplift Force per Support: 325 lbs.
    c. Manifold Diameter: 8 inches. Uplift Force per Support: 325 lbs.
    d. Manifold Diameter: 10 inches. Uplift Force per Support: 543 lbs.
    e. Manifold Diameter: 12 inches. Uplift Force per Support: 543 lbs.

4. Provide supports with a mechanism to provide plus or minus 2 inch vertical and 1/2 inch lateral adjustment for alignment of manifold in field.

B. Air Distribution Lateral Supports:

1. Material: Type 304L stainless steel. Spaced as specified.
2. Fixed Supports: Consist of a hold-down mechanism and self-limiting clamp device.

    a. Provide a wide contoured bearing surface for air distribution lateral.
    b. Clamping Device: Self-limiting to prevent over-stressing lateral if clamp is over-tightened.

3. Intermediate Guide Supports: Consist of self-limiting hold-down and sliding mechanism.

    a. Hold-Down and Sliding Mechanism: Contoured bearing surface with chamfered leading edges to minimize binding of air distribution lateral.
    b. Sliding Mechanism: Provide minimum resistance to movement of air distribution lateral under full buoyant uplift load. Provides 1/8 inch clearance around lateral and is self-limiting if mechanism is over-tightened.
    c. Horizontal Thrust: 20 lbs or less. Sufficient to initiate movement of lateral relative to mechanism under full buoyant uplift load.

4. Supports provided with a mechanism providing plus or minus 2 inch vertical adjustment for alignment of air distribution lateral in field.

    a. Adjusting and Aligning Mechanism: Infinitely adjustable within its limits allowing precise leveling of air distribution lateral and diffuser assemblies to within plus or minus 1/8 inch of a common horizontal plane without removing lateral from support.

5. Anchor supports to tank floor. Type 304L stainless steel 3/8 inch diameter wedge anchor bolts. Anchors designed to withstand 450 lbs of withdrawal force.

    a. Anchorage bolts and support rods: 1/2 inch diameter.
    b. Anchorage bolts and support rods for guide supports: 5/16 inch diameter.

2.6 EXPANSION JOINTS

A. Expansion Joints: As required to prevent thermally induced stresses due to expansion and contraction over temperature range specified and consisting of a plain end, EPDM O-ring, and threaded union type connection.

1. Airtight.
2. Material: UPVC.
3. Permit free and easy movement of plain end of lateral within coupling barrel.

4. Expansion barrel to accommodate movement over temperature ranges specified.
5. Provide positive means to prevent joint blow-apart.

2.7 ANALOG DIFFUSER PRESSURE MONITORING SYSTEM

A. Monitoring equipment to measure DWP and operating air flow rate of a typical diffuser in each aeration grid.

1. One portable monitoring panel in a NEMA 4X fiberglass enclosure with Type 304 stainless-steel handrail mounting bracket and carrier column assembly per grid.
2. Monitoring Panel:

    a. Differential pressure gauges; orifice and diffuser.
    b. PVC ball valves.
    c. Quick disconnect couplings.
    d. One set of calibration curves.

3. Connections to Measure Following:

    a. Air distributor pressure.
    b. Flow control orifice differential pressure.
    c. Diffuser element operating differential wet pressure (DWP).

4. Flexible tubing from connection box to air distribution lateral pipe, diffuser element holder, and bubbler line.

    a. Install flexible tubing in a single 1-1/2 inch NPS Schedule 40 UPVC carrier pipe with Type 304 stainless steel supports at 5 feet maximum center-to-center spacing.

2.8 GAS CLEANING SYSTEM

A. Pipe manifold for chemical cleaning system for in-situ maintenance of diffused aeration equipment.

1. Cleaning: Defined as ability of system to decrease diffuser head loss or DWP by removal of mineral scale from diffuser (pores/perforations). Time-dependent physical changes which may result in increased DWP are considered to be part of diffuser life cycle.
2. System Description: Gas cleaning with Monel piping. Piping will run from the top of the tank down to the PVC lower drop pipe, and diffuse into the lower drop, upstream of the manifold. Gas must be fed at the drop leg, so the gas goes to each diffuser, not bypassing any laterals.
3. Complete System: Defined as inclusion of mechanical components to provide an acid flow path including:

    a. Valve and hose assembly for connections.
    b. Drop pipe and valve assembly.
    c. Acid feed connection to dropleg.
    d. Associated piping and appurtenances included on Detail E on drawing MZ-7.

4. Capabilities:

a. Distributing an equal amount of cleaning agent throughout aeration grid for maximum cleaning effect.

5. Cleaning System Materials: Compatible for use with hydrochloric acid.

2.9 SYSTEM FABRICATION

A. Diffuser assemblies consisting of ceramic diffuser, gasket, diffuser holders, air flow control orifice, and retaining device.

B. Diffuser Materials and Fabrication: Ceramic disc type. Guaranteed for oxygen transfer efficiencies specified.

1. Material Characteristics:

a. Fused crystalline alumina grains thoroughly joined together with ceramic bonding materials forming a strong, uniformly porous, and otherwise homogenous structure.
b. Not deformed. Uniform throughout entire structure.
c. Free of cracks, soft spots, chipping, spalling, or other structural defects.
d. No loose, unbonded material that may affect normal and proper operation.
e. Free of materials soluble in wastewater carrying household or industrial wastes of any character.
f. Free of holes and impervious material which may cause unequal air distribution.
g. Specific Permeability Rating: 20 to 30 scfm. Permeable over entire surface.

1) Permeability Rating: Cubic feet of air per minute at 70 degrees F and 25 percent relative humidity, which will pass through one square foot of diffuser one-inch thick when tested dry under an equivalent pressure differential of two-inches of water column.

2. Outside Diameter: 9 inches.
3. Do not exceed following dimensional tolerances:

a. Diameter: Plus or minus 1/8 inch.
b. Height: Plus or minus 1/16 inch.
c. Thickness of active section: Plus or minus 1/16 inch.

C. PVC or fiber reinforced polypropylene diffuser element holders with an air plenum chamber below diffuser support plate.

1. Element Holders: Provide complete peripheral edge support for diffuser element.

a. Attach holders to distribution laterals to resist following torque values.
b. About polar axis of holder: 150 ft-lbs.
c. About longitudinal axis of holder: 100 ft-lbs.

D. Retaining device to securely hold and seal diffuser to holder.

1. Diffuser elements will be secured to diffuser holder assemblies in a manner that will not allow passage of air at gasket.

E. Screw-on Retainer Rings: With positive O-ring seat. 2-1/2 inch complete threads for engagement.

1. Minimum thread cross section: 1/8 inch.

F. Flow Control Orifice: Sized ensuring even air distribution throughout each grid at specified air flow ranges.

1. Air release entering diffuser assembly evenly distributed under horizontal surface of diffuser element when submerged in water. Orifice sized to meet specified requirements of system head losses.
2. Orifice plugs for diffuser assembly blank spaces specified herein. Airtight under all operating conditions.

2.10 SOURCE QUALITY CONTROL

A. Provide shop testing of completed assembly.

B. Owner Inspection: Make completed diffuser assemblies available for inspection at manufacturer's factory prior to packaging for shipment.

1. Notify Owner at least seven days before inspection is allowed.

2.11 FACTORY/SHOP OXYGEN TRANSFER TEST

A. General:

1. Prior to shipment of equipment to site: Conduct performance tests on fine bubble fixed-grid aeration system.

a. Demonstrate clean water transfer efficiency.
b. Test lateral spacing, diffuser densities, and maximum and average airflow rates for each grid as specified.

2. Testing Notification: Forwarded to Engineer least 2 weeks before scheduled test date.

a. List of test equipment, and test procedures.

3. Certified calibration Data: For meters, gauges, and other test instruments.
4. Costs:

a. Factory oxygen transfer testing: At expense of Contractor.
b. Cost of Retesting: If required, will be borne by Contractor.

5. At least three tests will be conducted, along with additional tests as required to establish performance and repeatability criteria specified.
6. Performance Tests: Conducted by clean water, unsteady-state method.

a. Testing performed in a manner acceptable to Engineer and follow procedures set down in ASCE/EWRI 2-06 Measurement of Oxygen Transfer in Clean Water.
b. Provide support facilities including, but not limited to:

1) Chemical storage tanks.

2) Mixing equipment and chemicals as required.
3) DO probes, instruments, and recorders.
4) Scales and such other equipment.
5) Personnel and facilities as may be necessary.

c. Submit with shop drawings, proposed testing procedures including equipment details, sketches, and supplies.
d. Provide personnel as are required to set-up and conduct tests.
e. Authorized representative of diffuser manufacturer must be present for tests.

1) Authorized representative must be familiar with operation of equipment furnished.

f. Perform tests and record data using qualified personnel.
g. Test Results: Required calculations and report preparation must be done by equipment manufacturer and approved by Engineer.
h. Use information collected as a basis for determining acceptability of equipment.
i. In case of conflict, interpretations and calculations by Engineer will govern.

7. Air Measurement: Measure air flow during testing with two types of devices, each with test flow at mid-range of scale.

a. Flow Measurement: With sharp-edge orifice plate, flow tube or similar device.
b. Air Flow Meter: Calibrated prior to use. Submit certified calibration to Engineer.
c. Locate device in a location compatible with accurate measurement.
d. Utilize a direct reading manometer to measure system pressure drop accurate to within one-half inch of water column.
e. Measure in-line pressure upstream of flow measurement with a manometer accurate to within one-half inch of water column.
f. Measure in-line temperature upstream of flow measurement device temperature sensor accurate to within plus or minus 5 degrees F.
g. Measure atmospheric temperature, pressure, and relative humidity on site during testing.
h. Document air rate cubic feet per minute scfm using calibration curves and correction factors for device.
i. Measure air flow rate at least two times during each test.

1) Air flow Rate: Within 0.05 scfm per diffuser element of that to be tested.
2) Any single observation will be within 2.5 percent of mean for that test run.

8. Water and power for operation of air blowers provided by equipment manufacturer.
9. Test and verify tank size is appropriate to eliminate potential interference resulting from wall effects.

a. Extraneous piping and other materials in test tank to be minimized.
b. Diffuser placement, density, and submergence to be identical to those specified for full scale installation.

10. Airflow rate per diffuser, airflow rate per unit volume and area, power input per unit volume, and flow control orifice sizes to be identical to those specified for full scale installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify items provided by other Sections of Work are ready to receive Work of this Section.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install equipment per manufacturer's instructions and as shown on Drawings.

B. Clean air mains, blowers, filters, and droplegs prior to installing diffuser elements.

1. Do not install diffuser elements until entire system, including blowers provided under Section 431118 “Vertically Split Multistage Centrifugal Blowers” have been thoroughly flushed with air for a minimum of 24 hours.
2. Coordinate cleaning operation with blower manufacturer.

C. Protect diffuser elements from freezing.

D. Protect diffuser elements from un-pressurized submergence in wastewater.

3.3 ADJUSTING

A. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

B. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 FIELD QUALITY CONTROL

A. Testing:

1. Test for proper operation.
2. Energize system equipment and test operation under supervision of manufacturer's representative and in presence of Engineer.

B. Manufacturer Services: Furnish services of manufacturer’s representative experienced in erection, installation, operation, and maintenance of equipment.

1. Representative must be present during initial installation of diffusion equipment.
2. Ensure satisfactory procedures are followed.
3. Provide a minimum of 2 visits supporting following efforts:

a. Periodic installation supervision.

b. Periodic installation inspection.
c. Field testing.
d. Startup.
e. Instructing Owner’s personnel in operation and maintenance of system.
f. Any other assistance to Contractor necessary to guarantee satisfactory performance of equipment.

C. Provide services of factory representative per specified requirements for a minimum of one day per tank.

D. If there are difficulties in operation of equipment due to manufacturer's fabrication or Contractor's installation, provide services to make required modifications for proper operation.

3.5 FIELD ACCEPTANCE TESTS

A. After installation of aeration system equipment in one aeration tank, equipment to be subject to field acceptance tests as specified.

B. Mounting Tests. Test support and tie-down provisions of UPVC piping ensuring they have a factor of safety of four against calculated buoyant forces. Test anchor bolts for UPVC piping ensuring they have a factor of safety of ten against calculated buoyant forces.

1. After installation of supports and before installation of piping, supports of each type and anchor bolts must be tested.
2. Testing includes ten percent of each support type, chosen at random, and witness tested by Engineer.

a. Supports chosen for test to be attached to lever which will be placed on a fulcrum.
b. Apply a static load to opposite end, producing a vertical extracting force equal to four times calculated maximum buoyant force to which support tie-downs will be subjected in normal operations.
c. Test anchor bolts to a vertical extraction force, ten times calculated maximum buoyant force.
d. Application of test loads must be such that entire pipe support, including pipe hold down strap and anchor bolts are tested.

C. Inspection of Piping. For proper joints, supports, tie-downs, end plugs, and drain relief valves.

D. Level Test. Flood aeration tanks with clear water to top of ceramic diffusers.

1. Check level of diffusers. Verify they are at same elevation, plus or minus 1/4 inch.
2. Correct diffuser elevation, if necessary, prior to proceeding further.

E. Uniformity and Leakage Test:

1. Flood aeration tanks with protected water to a depth of 1 foot above diffusers.
2. Turn on air flow to air flow rates as approved by Engineer and verify air is supplied evenly to headers.
3. Visibly inspect surface of water to see that air flow is uniformly distributed across tanks and no air leaks are present within piping system.

a. If in opinion of Engineer, there are areas of consistently low or high air quantity release, or leaks within piping system, make necessary adjustments to correct these deficiencies.

F. Cost of Testing: Field tests, including filling, dewatering, restoration, and cleaning of aeration tanks, to be conducted at Contractor’s expense. Costs of retesting: If required, at Contractor’s expense.

G. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.6 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

B. Demonstration services provided by Supplier is required to be recorded. Upon completion of training and demonstration, provide digital videography to Owner.

3.7 PROTECTION

A. Protect diffusers from traffic or falling objects until placed into service.

END OF SECTION 465136

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SECTION 466657 – ULTRAVIOLET TREATMENT EQUIPMENT CONTROL PANEL REFURBISHMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Modification of the existing Power Distribution and Data Center for the existing Ozonia Aquaray ultraviolet treatment disinfection system at the Dove Springs WWTP to replace an obsolete programmable logic controller (PLC).
2. Furnish all necessary and ancillary equipment and auxiliaries, whether specifically mentioned in this Section or not, include supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.

B. Related Requirements:
1. Section 406733 – Panel Wiring.
2. Section 407856 – Isolators, Intrinsically Safe Barriers, and Surge Suppressors.
3. Section 406100 “Process Control and Enterprise Management Systems” for instrumentation and control wiring, except for factory wired equipment and lockout stop pushbutton stations.
4. Section 406343 “Programable Logic Controllers”.
5. Section 406263 “Operator Interface Terminals”.
6. Section 406121.20 “Process Control System Testing”.
7. Section 406126 “Process Control System Training”.

1.3 PREINSTALLATION MEETING

A. Convene minimum 4 weeks prior to commencing Work of this Section.

B. Meeting may be virtual, or in-person as determined by the Owner.

C. Contractor, Owner, Engineer, and Manufacturer shall be present at the meeting.

D. Meeting Topics:

1. Condition of Existing Equipment
2. Sequencing of installation/ Installation requirements
3. Delivery/ Installation schedule
4. Field service for hardware replacements

5. Other coordination items between Contractor, Manufacturer, and Owner's Operation Staff

1.4 ACTION SUBMITTALS

A. Product Data: Submit bill of materials and manufacturer's information for all manufactured items, including control system components, highlighted to show actual items being provided.

B. Shop Drawings:

1. Size, location and configuration of assembly, mountings, enclosures, weights, and accessory connections, including anchor bolt sizes and locations.
2. System materials, component equipment, and equipment and enclosure ratings.
3. Wiring diagrams, interconnections and interface requirements, dimensions, locations of major elements of the UV system including critical clearance requirements.

C. Instrumentation and Controls

1. Instrumentation and Controls information is to be provided at least 1 month prior to the Operation Readiness Test to allow the AESS enough time to program the SCADA HMI.
2. Instrumentation, control, logic and power wiring diagrams. Sufficient detail to allow installation of the instrumentation, controls, and electrical components. Include the following:
   a. Control descriptions explaining system operation in manual and automatic modes.
   b. Screenshots of all OIT graphics
   c. PLC tag database that includes all setpoints, alarms, calculated values, and other remote control functions needed for the PCSS to implement remote monitoring and control from SCADA.
3. Master power and control wiring diagrams, elementary or control schematics, suitable outlining drawings of the control schematics and suitable outline drawings of the control panel. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering.
   a. Field device wiring shall include the device ISA-tag and a unique numeric identifier. Diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the UV Manufacturer. I/O wiring shall be numbered with rack number, slot number, and point number.
   b. Two-wire and four-wire equipment shall be clearly identified and power sources noted. Submit final wire numbering scheme.
4. Control Panels:
   a. Detailed control panel drawings including I/O wiring diagrams.
   b. Panel heat load calculations, if heat loads from new equipment will be higher than the equipment being replaced. Assume a maximum ambient temperature of 110 degrees F.
   c. 24V DC power supply sizing calculations.
   d. Complete bill of materials.

D. Additional Information:

1. Memory map of PLC registers and OIU screens to the Process Control System Supplier (PCSS) no less than 30 days prior to scheduled shipment of equipment to the site.
2. Control narratives and graphic screens.
3. Test plans and procedures that satisfy requirements in PART 3 no less than 30 days before the proposed start of testing.

1.5 INFORMATIONAL SUBMITTALS

A. Source Quality-Control Submittals: Plans and results of factory tests and inspections.

B. Field Quality-Control Submittals: Plans and results of field tests and inspections.

C. Manufacturer Reports:

1. Conduct inventory, condition, and functionality assessment of the existing UV PDDC equipment prior to any alterations of the UV PDDC. Report to include suitability of equipment for future use and identify necessary maintenance items. This assessment shall be submitted at least 5 days before the Pre-installation meeting.
2. Certify equipment is installed according to manufacturer instructions. Statement will include the following:
    a. Installation of equipment is satisfactory.
    b. Units are satisfactorily tested, and ready for operation.
    c. Operating personnel have been suitably instructed in the operation and care of the units.

1.6 CLOSEOUT SUBMITTALS

A. Updated Operation and Maintenance Manuals for the refurbished components.

B. Machine Readable Documentation:

1. UV Manufacturer: Provide two sets of documented as-built electronic PLC and HMI files on USB drives in native machine-readable format for all programs and configurations developed under this Contract.
2. Documentation files including logic and annotation files using standard programming language developed by the PLC manufacturer on USB drives.
3. Changes made during or after factory acceptance test must be incorporated in final documentation and the O&M manual at no additional cost to Owner.

C. Software Licenses: Following installation, testing, satisfactory completion of Part 1 performance testing, transfer all software licenses for the program files to the Owner. For all non-transferable licenses, provide a listing of all subscription-based licenses to the Owner. A copy of the PLC programming shall be provided to the Owner electronically in the form of a removable hard drive or USB drive.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on-site in manufacturer's original packaging and inspect for damage prior to unloading. Inspection will be performed jointly by the Contractor, manufacturer and Owner.

B. Store materials according to manufacturer instructions.

C. Protection: Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

1. Provide additional protection according to manufacturer instructions.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Document field measurements on Shop Drawings.

1.9 WARRANTY

A. Equipment Furnished Under This Section: Free of defects in materials and workmanship, including damages that may be incurred during shipping, storage, and installation for a period of 24 months from the date of acceptance for Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Existing ultraviolet treatment disinfection system:

1. Ozonia Aquaray 40 HO as manufactured by Veolia
2. One channel with three Aquaray 4HO modules

B. Control Panel Refurbishment: Existing Power Distribution Data Center to be modified to replace obsolete components including but not necessarily limited to the following:

1. Programmable logic controller
2. Operator Interface Terminal - touchscreen display
3. Power supplies and circuit breakers
4. Ethernet switch
5. Data cables
6. On-site programming

2.2 ULTRAVIOLET TREATMENT EQUIPMENT CONTROL EQUIPMENT

A. Manufacturers:

1. Programmable Logic Controller: Provide products by the following:
   a. Allen-Bradley.
   b. Substitutions: Not permitted.

B. Operation:

1. Electrical Characteristics:
   a. All electrical equipment shall be UL rated and NRTL certified.
   b. All overcurrent protection devices, wiring, raceways and electrical equipment shall be sized and installed per the latest edition of NFPA 70, National Electrical Code.
2. Replacement PLC and OIT:
   a. Description: PLC-based controls and Operator Interface Terminal (OIT).
   b. Replacement of the existing with an Allen-Bradley PV+7, 12" OIT
   c. OIT**:**
      1) Update colors for operating, off, and alarm graphics based upon requirements stated in Section 407816 "Indicating Lights."
      2) Display: Menu driven with color graphics and text format.
      3) Automatic fault messages when alarm conditions are annunciated.
      4) Green: On / operating.
      5) Red: Off /.
      6) Amber: Fault.
      7) In the event of a fault:
         a) Alarm / Graphic Color Display: Change from red (operating) to amber (alarm), until the alarm has been manually or automatically acknowledged or cleared.
         b) Graphics continue to flash during alarm until alarm has been acknowledged.
         c) Once acknowledged, graphic remains solid amber until alarm has cleared.
         d) Once alarm has cleared, graphic color returns to original state.
         e) HMI graphics requirements will be supplemented by Division 40 specifications in the General Contractor bid documents.
      8) If any of the following are currently monitored by existing OIT, the new OIT Main Screen Shall Simultaneously Display the following:
         a) Flow rate.
         b) UV transmittance.
         c) Communication link status.
         d) System flow pace mode (Hand or Auto).
         e) UV lamp status.
   d. Power: 120 VAC, single phase, 60-Hz.
   e. PLC to communicate with each UV module and PDCs via Ethernet link.
3. Controls: Automatic flow- paced PLC control system energizes and de-energizes lamps to maintain required UV dosage, and adjusts UV intensity in proportion to flow rate. PLC allows operator to operate the UV system in manual or automatic modes.
   a. Input Signals:
      1) 4 to 20 mA dc for flow
   b. Furnish programming to perform operations.
   c. Lamp Status Indicators: ON-OFF; Cycles and operating hours.
      1) Reset lamp cycles and hours via a password-protected screen.
   d. Automatic Cleaning System: Controlled by PLC.
      1) Automatic Control of Wipers: Based on an operator adjustable software timer.
      2) Provide manual control of wiper system.
   e. MPE: Include capability for remote monitoring by means of an Ethernet data highway connection to the plant instrumentation and control system.
      1) Incorporate remote monitoring of the alarms listed.

2) Duplicate MPE operator interface control and monitoring functions in the facility's SCADA system.

f. Provide data-exchange as follows:
1) Access to monitor all signals remotely.
2) Access to control all setpoints required for daily operation.
3) Access to view all setpoints available at the OIT.

4. Lamp Monitoring System:
a. Indicate location and operating status of each lamp.
b. Annunciate remote alarm upon lamp failure.

5. Alarms to include, but not be limited to:
a. Critical Alarms:
1) PDDC run on UPS.
2) PDDC high temperature shutdown.
3) Module not in place.

b. Major Alarms:
1) Low UV dose.
2) Flow meter fault.
3) High flow.
4) Controller fault.
5) PDDC to wiper system communication fault.
6) Multiple lamp failure.
7) Wiper group jammed.
8) Wiper travel time exceeded.

c. Minor Alarms: As recommended by Manufacturer, including but not limited to:
1) System power on reset.
2) Power restored.
3) UPS fault.
4) Remote wipe inhibited.
5) Lamp failure.
6) Lamp lifetime exceeded.
7) Ballast communication failure.
8) Ballast failure.
9) Wiper not in remote.
10) Wiper position unknown.
11) Lift attempted with lamps energized.

C. Operation Sequences:

1. The manufacturer-provided PLC-based PDDC will receive an effluent flow signal from the plant SCADA system. That signal will be utilized by the PDDC to determine how many lamps and channels need to be in operation.
2. The flow signals shall be inputs to the Manufacturer PLC via existing fiberoptic communication cabling.

2.3 ACCESSORIES

A. Environmental Controls for Panels:

1. Heat sinks, or air conditioning units as required to prevent temperature buildup inside of panel.

a. Internal Temperature of Panels: 45 to 104 degrees F under all conditions. Panel cooling or heating equipment must never compromise the NEMA rating of the panel.
b. Heat Dissipation Calculations: Submit for new PLC and OIT.

2. Air Conditioner: Provide if new PLC and OIT heat loads cannot be adequately dissipated with natural convection and heat sinks.
3. Temperature Control Switch: Reports high temperature alarm to SCADA by means of a normally closed contact.
4. Temperature Setting: Adjustable with a default of 90 degrees F.
5. Manufacturer: Hoffman ATEMNC or Engineer-approved equivalent.

B. Anchor Bolts, Nuts, and Washers: Type 316L stainless steel.

1. Anchor hardware sized by UV manufacturer and furnished by Contractor.

2.4 SOURCE QUALITY CONTROL

A. Provide manufacturer’s standard shop inspection and testing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. According to manufacturer instructions and as described herein.

B. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

C. Identify and install electrical work in accordance with Division 26 requirements.

3.2 FIELD QUALITY CONTROL

A. Functional Demonstration Testing (FDT):

1. Contractor and Manufacturer to coordinate with Owner to schedule testing to minimize impact to existing operation.
2. Testing shall be conducted when field service for refurbishment is complete.

B. Inspection and Functional Demonstration Testing:.

a. Ensure devices or programming computers Owner will use to maintain the system can do the following:
1) Monitor the control processors online.
2) Make online changes.
3) Upload and download the processors and operator interface panels to ensure proper communication has been set up.
4) Confirm programming software versions are compatible with the equipment provided.

b. Ensure PLC and HMI addresses (IP addresses, if an Ethernet network) are configured to be compatible with and in accordance with the plant's SCADA system network hierarchy.
   1) If a System Integrator is working on the project, perform this testing in their presence.

3.3 MANUFACTURER'S SERVICES

A. Provide the services of a factory-certified service engineer who has complete knowledge of proper installation, startup, PLC and OIT programming, testing, operation, and maintenance of specified equipment.

B. Submit qualifications of service representative for approval who is a direct, full-time employee of the manufacturer.

1. Services shall be provided for not less than the days required for installation, inspection, startup, field testing, and instructing Owner’s personnel in maintenance of equipment.

2. Man-hour requirements listed below are exclusive of travel time and do not relieve the manufacturer of the obligation to provide sufficient service to place equipment in satisfactory operation.

   a. On-site Installation and Testing: One Trip for Three (3) days

3. Any additional time required by manufacturer to achieve successful installation and operation due to Contractor or scheduling to be at expense of Contractor.

END OF SECTION 466657

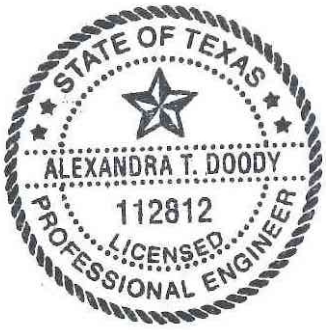
CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

CITY OF GEORGETOWN

DOVE SPRINGS WWTP REHABILITATION PROJECT

ADDENDUM NO. 1

Date Issued: December 18, 2023



Prepared by Alexandra T. Doody, PE 112812
CDM Smith Inc Texas Registration No. F-3043

Proposers on this project are hereby notified that this addendum shall be attached to and made a part of the above-named Contract Documents and Technical Specifications, dated November 2023.

The following items are issued to add to, modify, and clarify the Contract Documents and Technical Specifications and Drawings. These items shall have full force and effect as the Contract Documents and Technical Specifications, and cost involved shall be included in proposal prices. Proposals to be submitted on the specific proposal date shall conform to the additions and revisions listed herein.

Acknowledge receipt of this addendum by designating receipt of the addendum on the first page of the Proposal. Failure to do so may subject proposer to disqualification.

ADDITIONAL INFORMATION

1) The Meeting Summary and Presentation from the non-mandatory Pre-Proposal meeting held on December 7, 2023 are attached.

2) Anticipated dates for the Pre-construction Meeting and NTP are as follows:
   - Pre-construction Meeting: February 28 or 29, 2024
   - Notice to Proceed: March 1, 2024

QUESTIONS AND ANSWERS:

Below are questions received and their associated responses:

1) **Question:** On sheet DS-C-6, note 9 calls out for a magnetic flow meter & plug valve but the call out says gate valve. Please see below & advise on which valve is required. Also, what does the dotted line represent near the Operations Building and Lab?

Answer: *A gate valve shall be provided and installed. See REVISIONS TO DRAWINGS in this Addendum for clarification. The dotted line shows an electrical connection. See DS-E-1 for clarification.*

2) **Question:** Sheet DS-C-6 calls for Yelo-Mine pipe, but there are no specs provided for this pipe. Please advise.

Answer: *Refer to Note 8 on Drawing DS-C-6 which specifies certa-lok yelomine restrained joint PVC pressure piping supplied by Westlake Pipe.*

3) **Question:** On sheet DS-C-6 the sludge effluent is shown as 4" but on the pipe schedule below it's called out as 6". Please confirm correct size.

Answer: *The package plant sludge transfer line is to be 4" in diameter as shown on Drawing DS-C-6. See REVISIONS TO DRAWINGS below for clarification to the Process Pipe Schedule.*

4) **Question:** On Sheet DS-MB-1 the Header calls for SST and Galv Pipe. This can't be both, please clarify.

Answer: *The package plant blower header and distribution piping are to be Galvanized Pipe. See REVISIONS TO DRAWINGS below for clarification. Note that GS refers to Galvanized Steel per the Legend on Drawing M-1.*

5) **Question:** Is all the piping galvanized or just on DS-MB-1 & DS-MB-2?

Answer: *No, the only piping that is galvanized is the blower piping for the rental package plant blower discharge and header. The piping for the permanent blowers, as detailed on DS-MD-1 and DS-MD-2 are stainless steel.*

6) **Question:** On DS-C-6, there is an arrow pointing at an electrical line. Please advise on where the 6" ductile iron pipe is supposed to be?

Answer: *The leader arrow note is shown incorrectly. The 6" ductile iron pipe in reference is located just south of the electrical line, labeled as 6" – FM – DI. See REVISIONS TO DRAWINGS below for clarification.*

7) **Question:** Are there any AIS or Domestic requirements? I do not see anything in the specs, but I did see a few items that are to be Domestic made like Portland Cement.

Answer: *There are no AIS or Domestic requirements on the piping material and associated equipment.*

8) **Question:** Is there any other pipe you would allow in lieu of Yelo-Mine pipe for the 4", 12" and 14" that is called out on Sheet DS-C-6?

Answer: *Alternative pipe material such as PVC or HDPE will be considered for Engineer approval. Alternative pipe material must match or exceed the inner diameter of Yelo-mine pipe. Because the majority of the pipe will be exposed, alternative pipe material must be restrained and either be painted or contain sufficient UV inhibitors to provide similar UV resistance.*

9) **Question:** The PVC Yelo-mine is hard to track down and obtain. Can we use HDPE DR9 in place of the Yelo-mine piping?

Answer: *HDPE DR9 is not approved, however HDPE DR17 (125 psi) is acceptable and meets the requirements of both the pressure rating and the minimum inside diameter needed for the design. UV resistance documentation shall be provided prior to Engineer approval.*

10) **Question:** In regards to supports – can you provide details as to how you want the above ground pipe anchored to the ground? We need a detail sheet as to type and how you want the product installed.

Answer: *The majority of the pipe will be run at grade, sitting on the grass. Pipe Supports will be required at the vertical runs and their associated 90 deg bends as well as the Gate Valve, as detailed on DS-C-6, note 9. The General Contractor shall follow delegated design requirements of Specification Section 400507 for package plant piping support design which includes the 12" Package Plant Influent, 14" Package Plant Effluent, 4" Package Plant Sludge Transfer, and Package Plant blower discharge and header piping. . For bidding purposes use Section 1 on Drawing DS-SD-4 for the concrete pads underneath the pipe supports. Loads from the supports shall be submitted for Engineer review and approval to confirm concrete pad design.*

11) **Question:** Please update the current spec: W2.04-A. The Class 150 DR 18 is out of date: AWWA revised the C900 Spec, it is now: AWWA C900 pressure class 165 psi (DR 25), 235 psi (DR 18), 305 psi (DR 14), 200 psi (DR 21), 125 psi (DR 32.5), 100 psi (DR 41), and 80 psi (DR 51). Thanks for correcting- the way it is written, DR25 would meet the spec class as 150 when you have always required DR 18.

Answer: *Refer to REVISIONS TO TECHNICAL DOCUMENTS below.*

REVISIONS TO TECHNICAL DOCUMENTS

SECTION W2 – POLYVINYL CHLORIDE (PVC) PIPE – WATER

a) Page W2-1, paragraph W2.04.A, REVISE the first sentence to read as "Polyvinyl chloride pipe for water lines, unless otherwise specifically shown on the Plans, or approved in writing, shall be AWWA C900 or C909 Class 150 psi with a dimension ratio of 25 (DR-25).

REVISIONS TO DRAWINGS

SHEET DS-C-6 – YARD PIPING PLAN

a) REVISE the first sentence of Note 9 to read as "MAGNETIC FLOW METER AND GATE VALVE TO BE SUPPORTED ON A CONCRETE PAD." The following sentences to remain the same.

b) RELOCATE the arrow from leader note "CONCRETE ENCASE 6" DI UNDERNEATH NEW PAVEMENT" to point to the 6"-FM-DI line. This existing 6" pipeline is located just to the north of Storage Shed next to the new Treatment Unit 1 blowers and it conveys filtrate from the Filtrate Lift Station to the Headworks.

SHEET DS-SB-1 – RENTAL PACKAGE PLANT FOUNDATION PLAN

a) SHIFT the package plant foundation plant 5'-0" east, as shown in the Attached REISSUED drawing.

SHEET M-1 – PROCESS MECHANICAL LEGEND

a) On the PROCESS PIPE SCHEDULE, REVISE the pipe diameter size of the package plant sludge transfer from 6" to 4".

SHEET DS-MB-1 – RENTAL PACKAGE PLANT AERATION BLOWER PLAN

a) REVISE the leader notes (typical of 5) to REMOVE reference to SST. Leader notes pointing to the blower discharge and header shall read "12" – LPA – GS" or "18" – LPA – GS", respectively.

SHEET DS-MB-2 – RENTAL PACKAGE PLANT AERATION BLOWER SECTIONS

a) REVISE the leader notes (typical of 4) to REMOVE reference to SST. Leader notes pointing to the blower discharge and header shall read "12" – LPA – GS" or "18" – LPA – GS", respectively.

SHEET DS-MC-3 – TREATMENT STRUCTURE #2 AERATION PIPING UPPER PLAN MODIFICTIONS

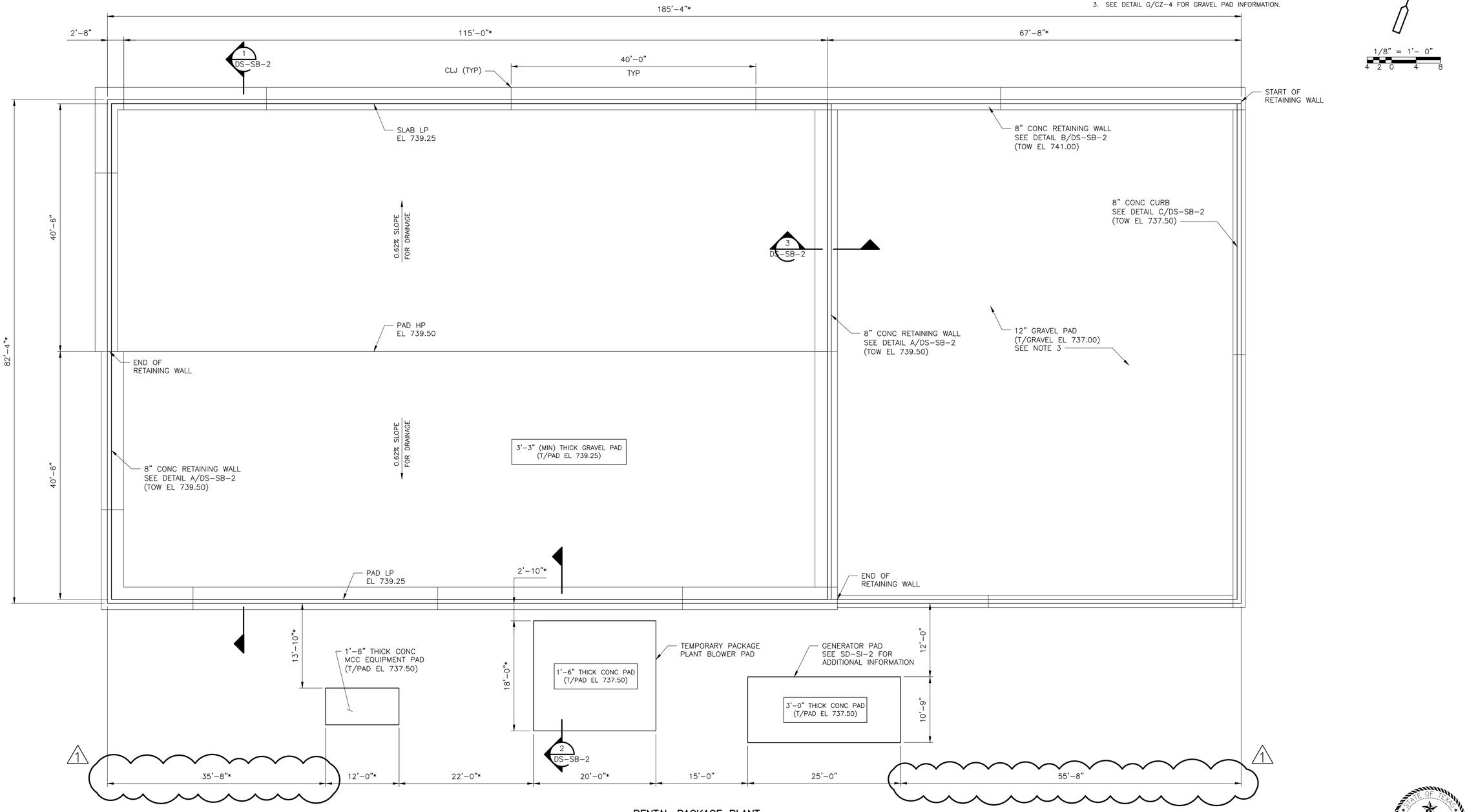
a) ADD as Note 2 – "ROTATE THE RAS AIRLIFT DISCHARGE DURING INSTALLATION SUCH THAT THE OPENING IS TOWARD THE ACCESS WALKWAY TO CONVEY THE RETURNED SLUDGE IN THE SAME DIRECTION OF FLOW IN THE AERATION BASIN."

b) REVISE leader note that reads "NEW RAS AIRLIFT. SEE NOTE 1" to read as "NEW RAS AIRLIFT. SEE NOTE 1 AND 2".

END OF ADDENDUM NO. 1

NOTES:

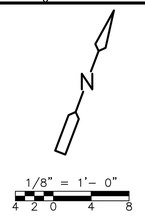
1. * INDICATES DIMENSION OR ELEVATION TO BE COORDINATED WITH THE APPROVED EQUIPMENT DRAWINGS AND PIPING PLAN.
2. SEE DS-MB AND DS-C-4 SHEETS FOR ADDITIONAL TEMPORARY PACKAGE PLANT INFORMATION.
3. SEE DETAIL G/CZ-4 FOR GRAVEL PAD INFORMATION.



RENTAL PACKAGE PLANT

PLAN

1/8" = 1'-0"



STATE OF TEXAS
CHUN FOR WONG
92069
LICENSED
PROFESSIONAL ENGINEER

Chun For Wong
12-08-2023

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	12/8/23	JNE	CFW	REVISION FOR ADDENDUM NO. 1

DESIGNED BY: J. EULL
DRAWN BY: M. SIDDIQ
SHEET CHK'D BY: C. WONG
CROSS CHK'D BY: J. EULL
APPROVED BY: C. WONG
DATE: OCTOBER 2023

CDM Smith
8310-1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

DOVE SPRINGS WWTP
RENTAL PACKAGE PLANT
FOUNDATION PLAN

PROJECT NO. 2048-264953
FILE NAME: S001RPPL.DWG

SHEET NO.
DS-SB-1

MEETING SUMMARY

Dove Springs Wastewater Treatment Plant Rehabilitation

DECEMBER 7, 2023

- **INTRODUCTION**

1. City of Georgetown Project Personnel (may not be present):

a.	Systems Engineering Director	Wesley Wright, P.E.
b.	Utility Engineer	David Munk, P.E.
c.	Water Utility Director	Chelsea Solomon, P.E.
d.	Wastewater Treatment Superintendent	Randall Swenson
e.	CIP Manager	Chris Pousson
f.	CIP Project Manager	Chris Logan and Larry Taylor
g.	Inspector	Nic Sanchez
h.	Instrumentation	Justin Breithaupt
i.	Buyer, Purchasing	Donna Cantwell

2. Engineer: CDM Smith, Inc.:

a.	Project Principal/Program Manager	Allen Woelke, P.E.
b.	Project Manager	Gerald Furrier, P.E.
c.	Design Manager/EOR	Alexandra Doody, P.E.
d.	Project Engineer	Josey Mayer

- **MEETING PURPOSES**

  - *Clarify the scope of work between this Proposal and the Package Plant Lease Solicitation that is currently issued for bidding:*

    - *This proposal is for the Dove Springs WWTP Rehabilitation Project where the awarded General Contractor will help with the installation of the package plant components not installed or procured by the Package Plant Supplier.*

    - *Separate but related is the solicitation for the Lease for a package plant and blowers that the City will issue as a purchase order.*

  - *Procurement Reminders:*

    - *In order to electronically submit a proposal, Proposers have to be a supplier in City of Georgetown's e-Bid system, IonWave. Recommend registering your firm in this system at least 48 hours in advance, if not already registered.*

    - *In addition to emailing your questions, Proposers can submit questions to IonWave. Please send any emails to Donna Cantwell and Alexandra Doody.*

    - *The bid opening will be held via teleconference on TEAMS.*

- **SCOPE / PROJECT INFORMATION**

  - ***Overview of Dove Springs Plant:***

    - *Alex Doody (CDM Smith) gave a brief discussion of the plant. Wastewater is pumped from a 12" pipe from an off-site lift station (Smith Branch LS) into the elevated headworks. The wastewater is screened, then split into the two aeration basins. Clarified effluent flows to UV Disinfection prior to a cascade aeration to the creek.*

  - ***Permanent WWTP Improvements Include:***

    Alex Doody (CDM Smith) presented the items that will be permanent improvements to the plant:

    - *Replacement of Filtrate Lift Station pumps. Retaining the discharge piping and valves.*

    - *Blower Improvements: Largest component of the project. The City currently has 3 multistage blowers adjacent to the belt filter press room. This project will have two blowers located next each treatment unit. The blower header is 14" – LPA – SST above-ground piping that will connect into the existing air header on the aeration basins.*

    - *Due to the larger horsepower associated with the blowers, a substantial portion of the project is a new Electrical House (E-house), standby generator, new MCCs, etc. The E-house will be feeding the entire plant, so the existing MCC located in the blower room will be decommissioned.*

    - *Replacement of the diffusers. Existing air piping to be retained, only PVC piping along the floor will be replaced.*

  - ***Lease for Package Plant:***

    Alex Doody (CDM Smith) presented temporary improvements, which includes the General Contractor's involvement in the temporary package plant.

    - *A package plant supplier is required, under a separate solicitation, to provide a temporary package plant to treat additional flow.*

    - *There is a specification for the package plant included in the technical documents, so Proposers can understand what will be supplied by the Package plant supplier vs the General Contractor. CDM Smith recommends to review this table in depth.*

    - *Once the Package Plant Lease Solicitation bids have been received and accepted, CDM Smith will provide more information on the details of the package plant via addenda.*

    - *Piping to the package plant will be routed on grade until being placed under the road, will connect into the package plant. Effluent piping will be routed on grade and up and over the wall to the UV Disinfection Basin.*

    - *Sludge Transfer pumps and 4" sludge transfer piping to be procured by the Contractor.*

- *Headworks: flow control to temporary plant will require headwork modifications. Plant shut-down to install the gate will need to be coordinated. CDM Smith recommends the Proposers to review Section CIP3 for contract documents to understand the constraints for shutdowns.*

- *Blowers for package plant:*
  - *Package plant suppliers as part of their bids will define the air requirements.*
  - *A shorter lease duration for the package plant blowers is specified because once the permanent blowers are installed and commissioned, Contractor shall work with a blower supplier to send the existing 3 blowers back to factory for refurbishment, including larger motors and skid baseplates and testing, and then re-install at the package plant.*

- *Pipe Supports:*
  - *All pipe supports for permanent plant have been designed by Engineer (CDM Smith).*
  - *For the package plant, any pipe supports will need to be designed by a qualified pipe support system engineer hired by the Contractor (delegated design).*
  - *Refer to Section 400507 for pipe support requirements.*

- **SCHEDULE:**
  - *There will be clarifications of the dates for the pre-construction meeting and notice to proceed forthcoming via addenda. The City's intent is to have the contract signed at City Council on Feb. 27th to proceed with pre-construction meeting and issue a NTP for March 1.*
  - *CDM Smith emphasized that the NEMA 3R electrical gear delivery is the most critical to make the start of the package plant possible for January 2025.*

- **PROPOSAL FORM:**
  - *Proposal should identify the Proposer's understanding of need to meet the City's schedule objectives.*

- **CLARIFICATIONS:**
  - *None*

- **ADDENDA**

1. Submit questions either:
   i. On https://gtowntx.ionwave.net/CurrentSourcingEvents.aspx
   ii. Email to Donna Cantwell, City of Georgetown Purchasing Department (Donna.Cantwell@georgetown.org) and please copy Alexandra Doody, CDM Smith (DoodyAT@cdmsmith.com).
2. Inquiries are permitted until January 4, 2024 at 5PM CDT. Replies will be issued via addendum.

- **QUESTIONS/COMMENTS**

N/A

List of Attendees:

Name	Company	Email
Chris Logan	City of Georgetown	Chris.logan@georgetown.org
Donna Cantwell	City of Georgetown	Donna.cantwell@georgetown.org
Chris Pousson	City of Georgetown	Chris.pousson@georgetown.org
Larry Taylor	City of Georgetown	Larry.Taylor@georgetown.org
Alex Doody	CDM Smith	DoodyAD@cdmsmith.com
Gerald Furrier	CDM Smith	Furrierg@cdmsmith.com
Josey Mayer	CDM Smith	MayerJA@cdmsmith.com
Shane Simpson	Associated Construction Partners	shane@acpartners.org
Beth Walker	Wharton Smith, Inc.	Bwalker@whartonsmith.com
Mike Uldrich	Keeley Construction	muldrich@keeleyconstruction.com
Travis Stivors	Keeley Construction	tstviors@keeleyconstruction.com
Michael Steffen	Keeley Construction	msteffen@keeleyconstruction.com
Tom Ellis	Ferguson Waterworks	tom.ellis@ferguson.com
Mike Aceves	Ferguson Water Works	Mike.ellis@ferguson.com
Kyle Barnes	T. Morales Company	kbarnes@moralescompany.com
Gilbert Cabeldue	T. Morales Company	gcabeldue@moralescompany.com
Thor Benson	Archer Western Construction	Awtxwaterbids@walshgroup.com
William Richards	Archer Western Construction	wrichards@walshgroup.com
Bruce Matous	Matous Construction	bruce@matousconstruction.com
Andrew Plumlee	Matous Construction	Aplumlee@matousconstruction.com
Kate Richter	Matous Construction	kate@matousconstruction.com
Josh Boardman	PGC General Contractors	Joshua.boardman@peabodygeneral.com
Rich King	Thalle Construction	rking@thalle.com

Adjourn

List of Attendees at Non-Mandatory Site Visit at 1:00pm:

Name	Company	Email
Chris Logan	City of Georgetown	Chris.logan@georgetown.org
Larry Taylor	City of Georgetown	Larry.Taylor@georgetown.org
Alex Doody	CDM Smith	DoodyAD@cdmsmith.com
Gilbert Cabeldue	T. Morales Company	gcabeldue@moralescompany.com
Tye Eldridge	T. Morales Company	teldridge@moralescompany.com
William Richards	Archer Western Construction	wrichards@walshgroup.com
Bruce Matous	Matous Construction	bruce@matousconstruction.com
Andrew Plumlee	Matous Construction	Aplumlee@matousconstruction.com
Don Schuch	Matous Construction	
Josh Boardman	PGC General Contractors	Joshua.boardman@peabodygeneral.com

Pre-Proposal Meeting

Dove Springs WWTP Rehabilitation Project

Gerald Furrier
Alexandra Doody
Josey Mayer

December 7, 2023

CDM Smith

WATER + ENVIRONMENT + TRANSPORTATION + ENERGY + FACILITIES

Meeting Purpose

- Non-mandatory Informational Meeting
- Provide clarity on scope
  - Lease under separate City solicitation (Bids due on 12/14/23)
  - Vs. Installing Contractor scope in this Rehabilitation Project (proposals due 1/11/2024)
- Provide opportunity to answer questions

Agenda

- Introduction and Meeting Purpose
- Project Description
- Schedule
- Proposal Requirements
- Addenda
- Procurement Reminders
- Q&A

Introductions

City of Georgetown Project Personnel (may not be present):		
a.	System Engineering Director	Wesley Wright, P.E.
b.	Utility Engineer	David Munk, P.E.
c.	Water Utility Director	Chelsea Solomon, P.E.
d.	Wastewater Treatment Superintendent	Randall Swenson / Tony Medlock
e.	CIP Manager	Chris Pousson
f.	CIP Project Manager	Larry Taylor / Chris Logan
g.	Inspectors	Nic Sanchez
h.	Instrumentation	Justin Breithaupt
i.	Buyer, Purchasing	Donna Cantwell

Engineer: CDM Smith, Inc.		
a.	Project Principal / Program Manager	Allen Woelke, P.E.
b.	Project Manager	Gerald Furrier, P.E.
c.	Design Manager / EOR	Alexandra Doody, P.E.
d.	Project Engineer	Josey Mayer

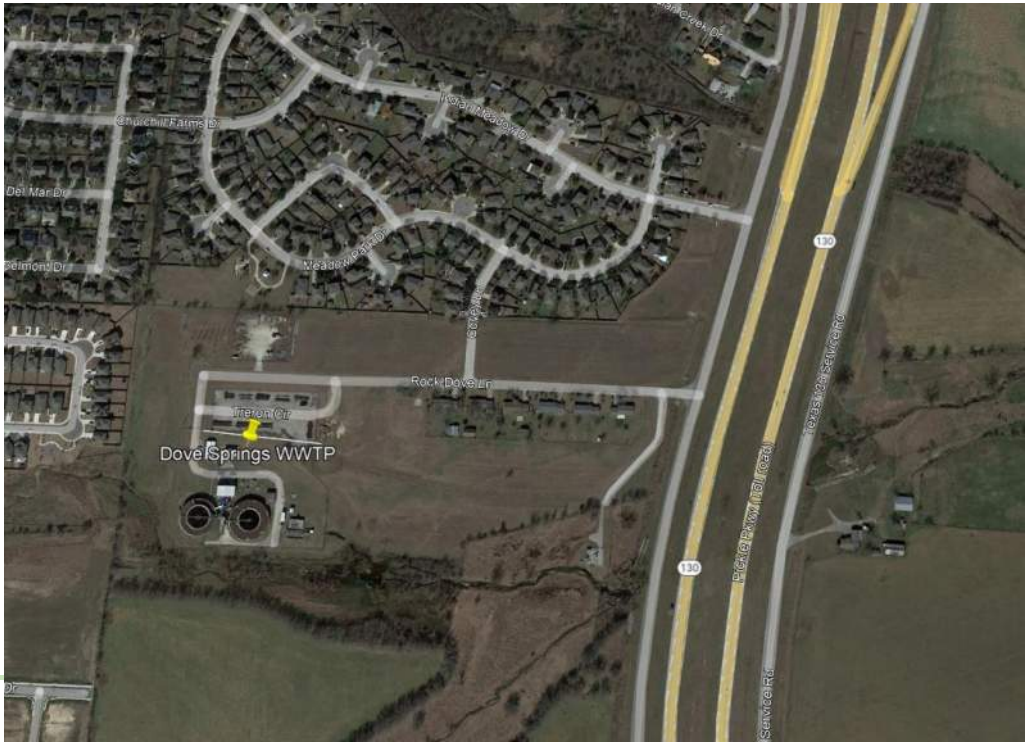
Dove Springs Wastewater Treatment Plant

- WWTP Address: Rock Dove Lane, Georgetown, TX 78626
- Site Rehabilitation
- Owner-funded project

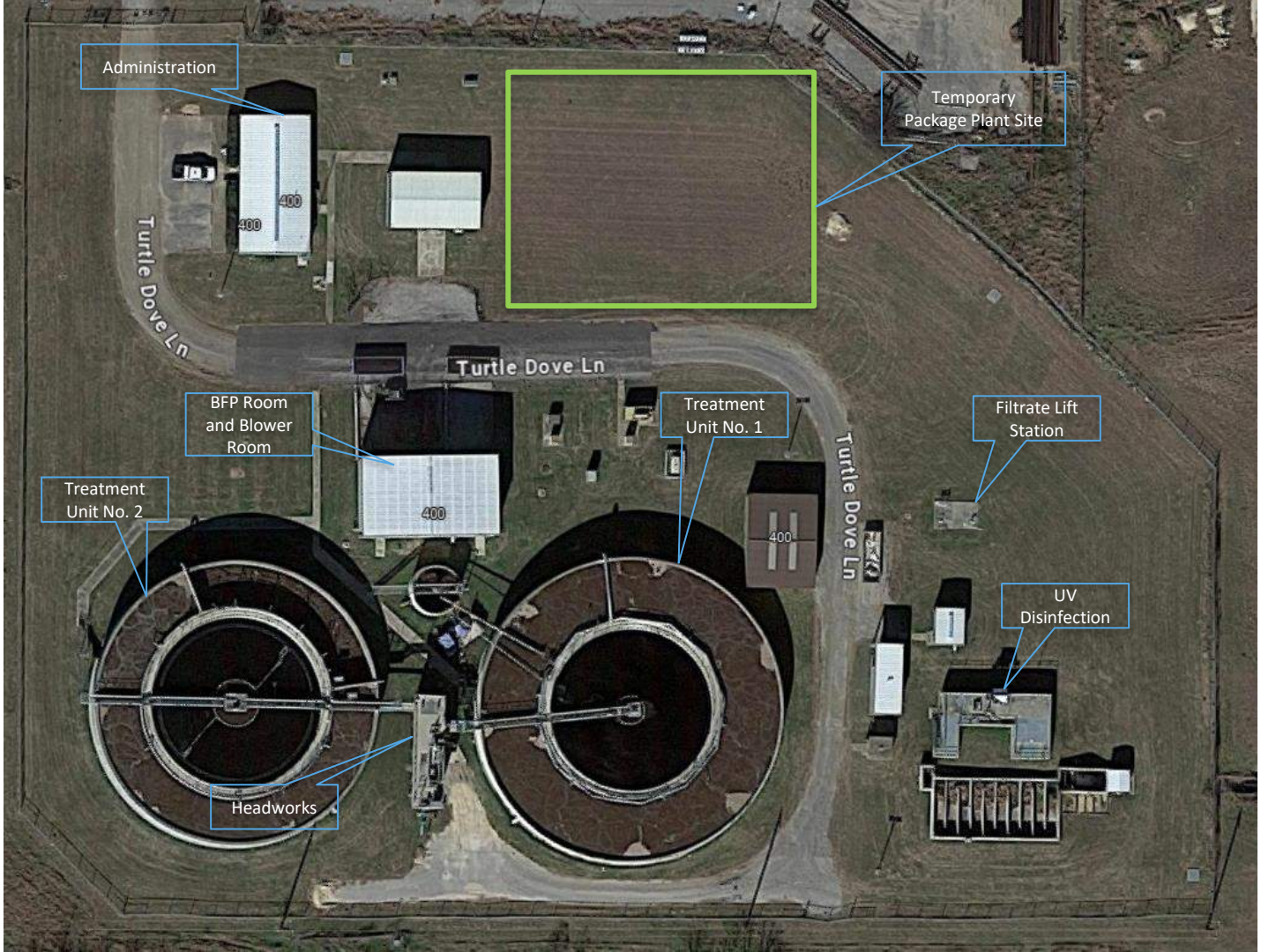
- City's procurement office address:

  510 W. 9th Street

  Georgetown, TX 78626

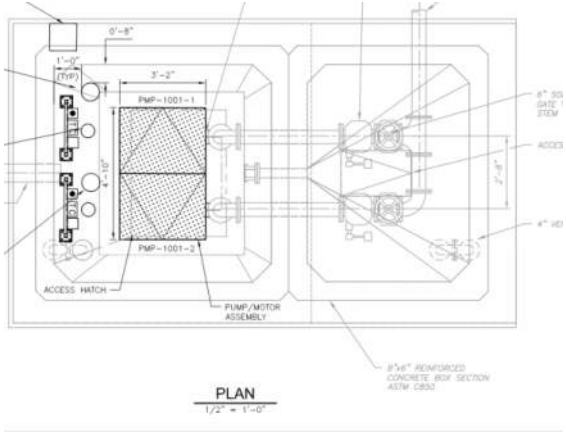


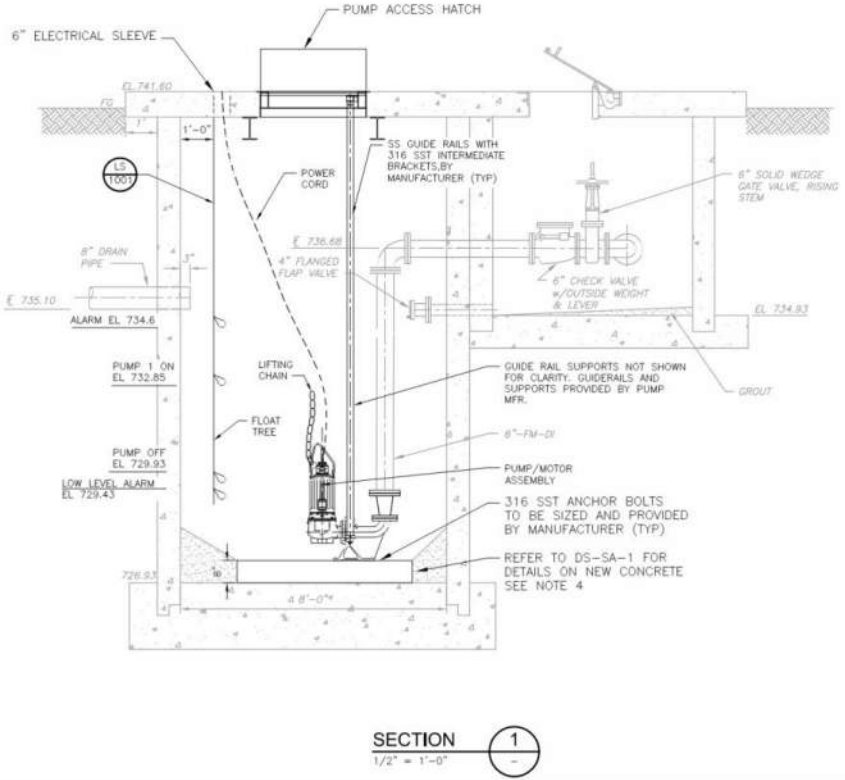
Project Description – Permanent Infrastructure


Administration
Temporary Package Plant Site
Turtle Dove Ln
Turtle Dove Ln
Turtle Dove Ln
BFP Room and Blower Room
Treatment Unit No. 1
Filtrate Lift Station
Treatment Unit No. 2
UV Disinfection
Headworks

Filtrate Lift Station Modifications

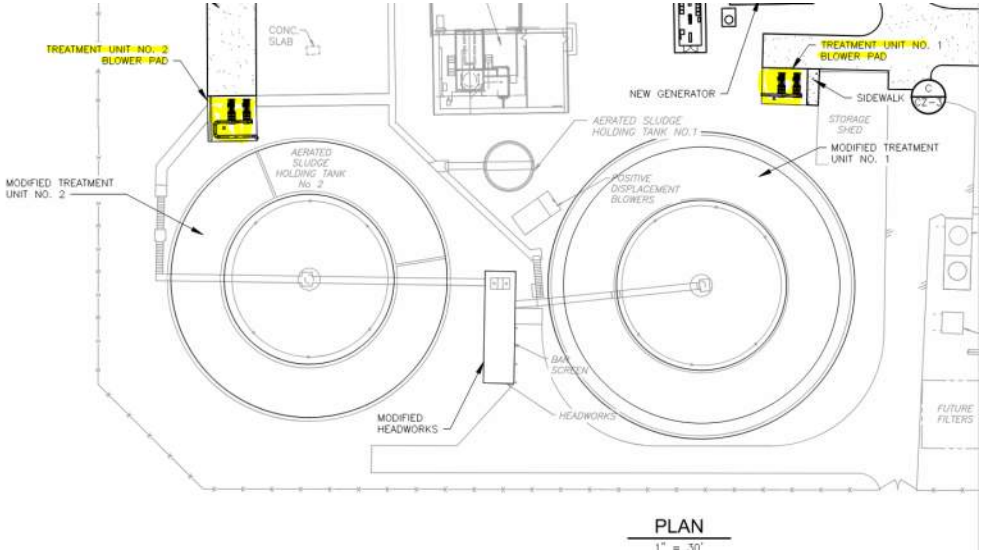
- Remove existing pumps
  - Retain existing 6” Discharge Line
- Replace with (2) 400 gpm, 7.5 HP pumps
- New Access Hatch, level elements, and electrical gear
- Bypass pumping





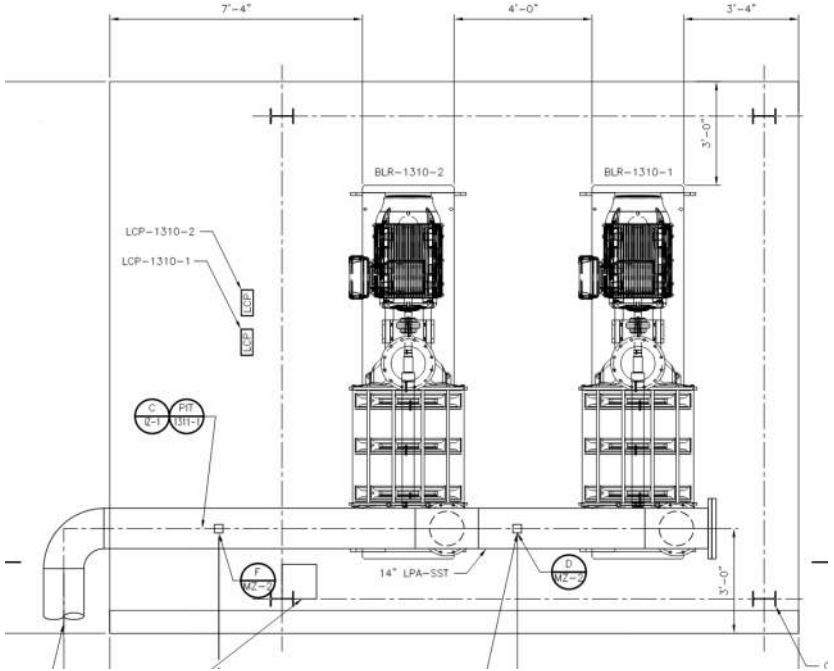
Blower Improvements

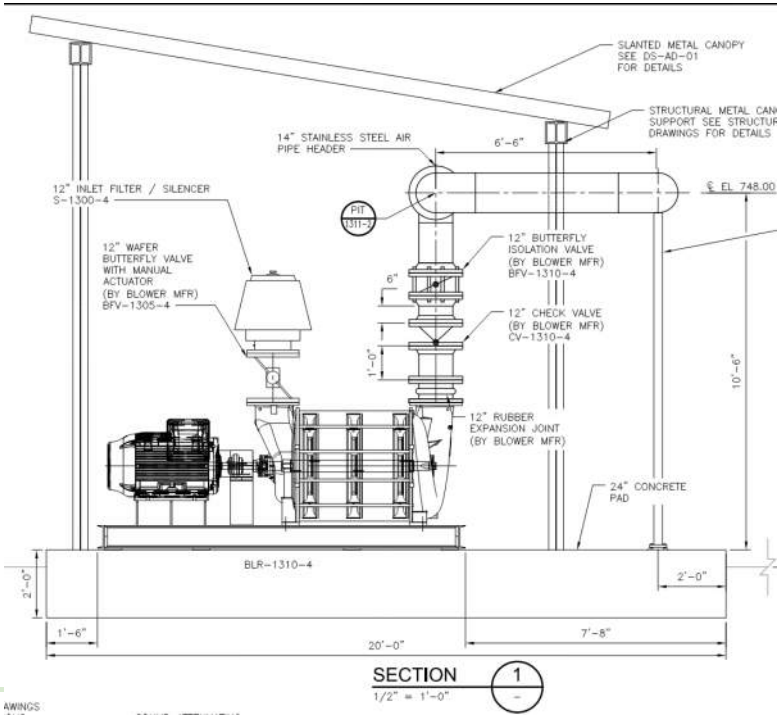
- Moving blowers to be located adjacent to each treatment unit
- (4) total 200 hp Multistage Centrifugal
  - 1 duty, 1 standby for EACH treatment unit
- Each blower pad is covered with a metal canopy
- Treatment Unit 2 Blowers have a sound attenuating wall



Blower Modifications

- 14” – Low Pressure Air – SST routed above-grade to tie into existing pipe on Treatment Units



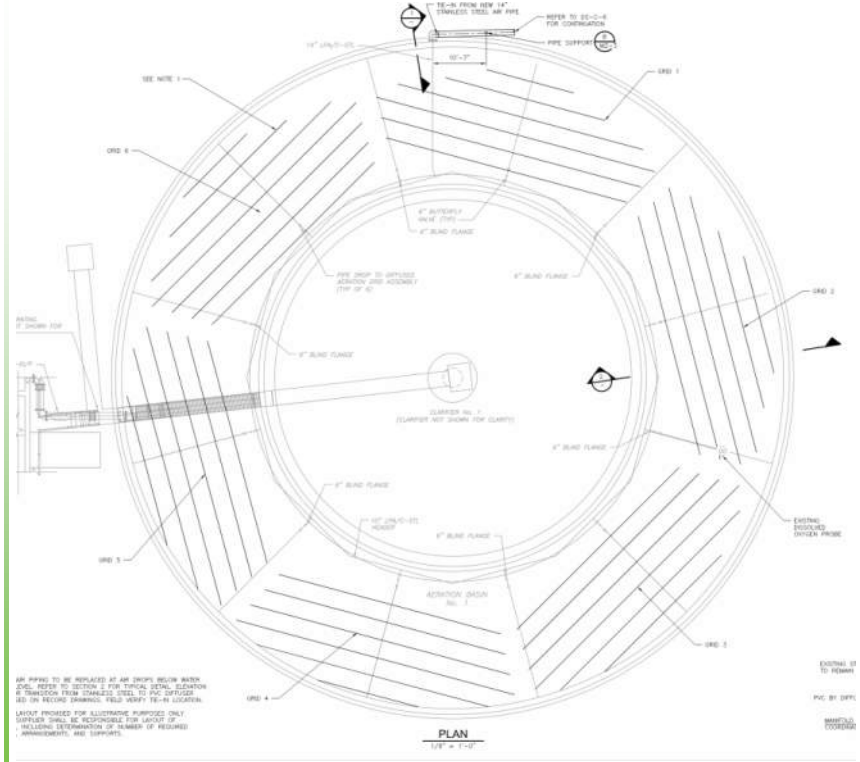


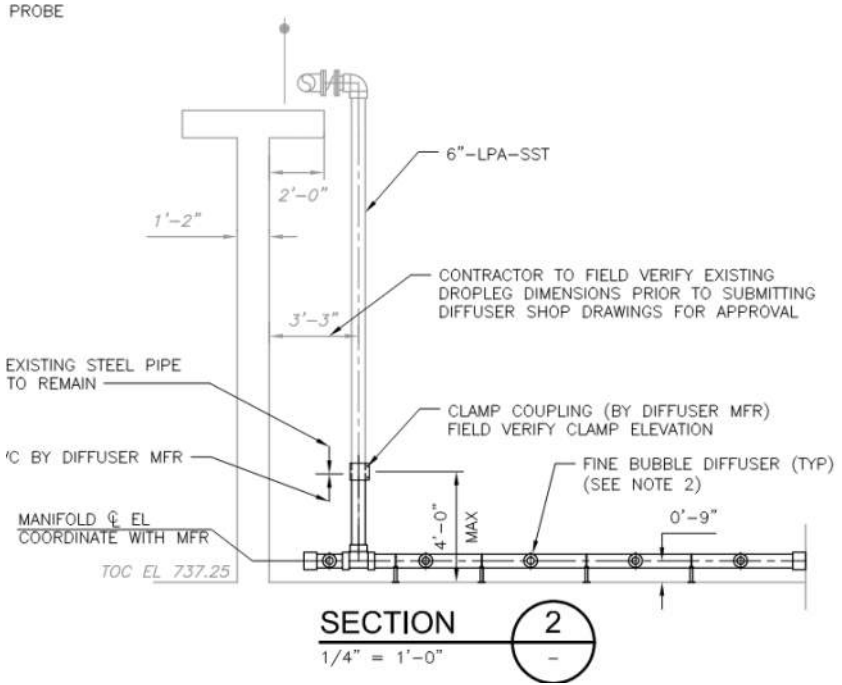
Treatment Unit Demolition

- Existing diffusers to be demolished
- Existing air header on basins to be retained. New 14” – LPA – SST to tie into piping outside of structure

Treatment Unit Modifications

- Fine bubble diffusers to be installed in each basin





Project Description – Temporary Plant

Temporary Package Plant

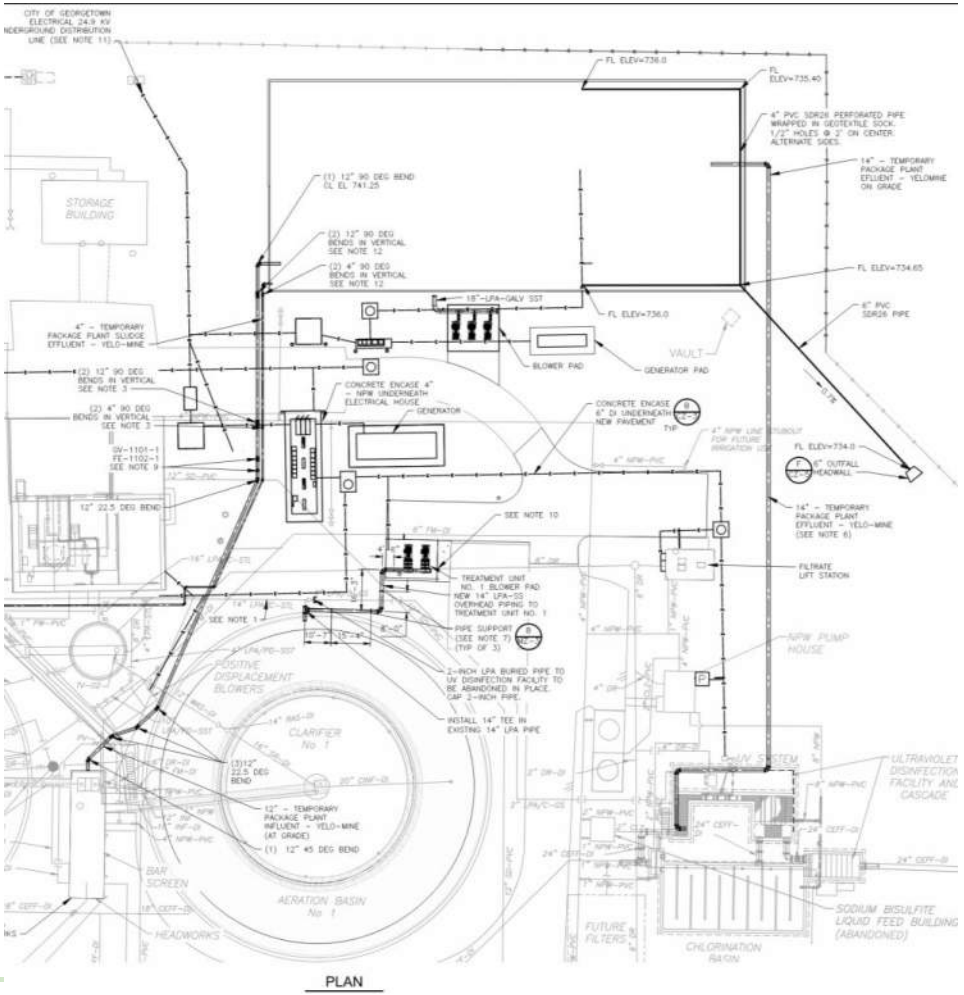
- Under separate solicitation, Supplier to construct and install a temporary package plant
  - Average Daily Flow = 1 mgd
  - Peak Hourly Flow = 2 mgd
- Bid proposals for the package plant lease to be opened on December 14 at 2pm
- General Contractor to coordinate with Supplier on Delineation of Scope of Work noted in Section 015353.

Package Plant Delineation of Scope of Work

	Package Plant Supplier	General Contractor
Treatment Unit Basins and Sludge Holding Tank	X	
Diffuser Assembly and System	X	
Clarifier Internal Components, Drive Unit, Motor Start, Local Control Panel,	X	
Internal Transfer Piping and Supports, 12” Influent Flange Connection, and 14” Effluent Flange Connection	X	
12” Influent Piping to Package Plant, 14” Effluent Piping to UV Disinfection, 4” Sludge Transfer Piping		X
Submersible Sludge Transfer Pumps		X
RAS, WAS, and Scum Airlift Assemblies	X	
Access Bridges, Air Bridges, Stairs + landing pads, handrails	X	
Site Preparation and Gravel Pads		X
Electrical and Instrumentation / Control Provisions		X
Delivery, Field Assembly, Coatings, Testing, Start-up and Training	X	

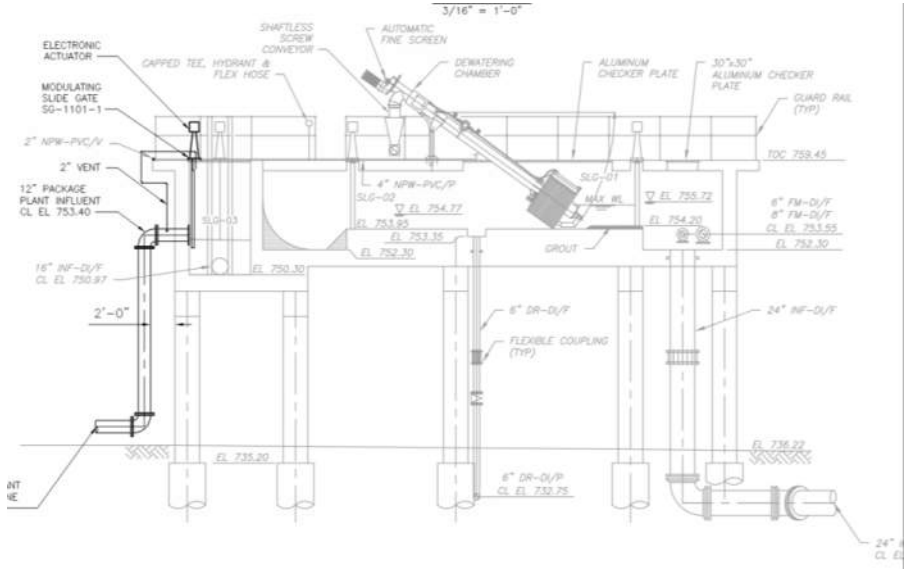
Piping To/From Package Plant (DS-C-6)

- Package Plant Influent
  - 12” Yelo-mine Pipe
  - On grade until buried under site access road from Headworks to Supplier provided flange
- Package Plant Effluent
  - 14” Yelo-mine Pipe
  - Route on grade to the UV Disinfection Basin
- Package Plant Sludge Transfer
  - 4” Yelo-mine Pipe
  - Route on grade until buried under site access road to the Aerated Sludge Holding Tank 2.



Headworks Modifications

- Install motor-actuated slide gate in headworks for flow control to temporary package plant
- 12” wall penetration in headworks to install piping
- Relocate ammonia analyzer as required for gate installation



Temporary Package Plant Sludge Transfer Pumps

- Convey sludge from package plant sludge holding tank to Aerated Sludge Holding Tank No. 2
- Pump to be supported and hard piped in basin

SLUDGE TRANSFER PUMPS	
NUMBER OF PUMPS	2 (1 duty, 1 shelf spare)
TYPE	Submersible, Constant Speed
DESIGN CAPACITY, gpm	130
DESIGN TDH, ft	21
DISCHARGE, in	3
MAX MOTOR, hp	5

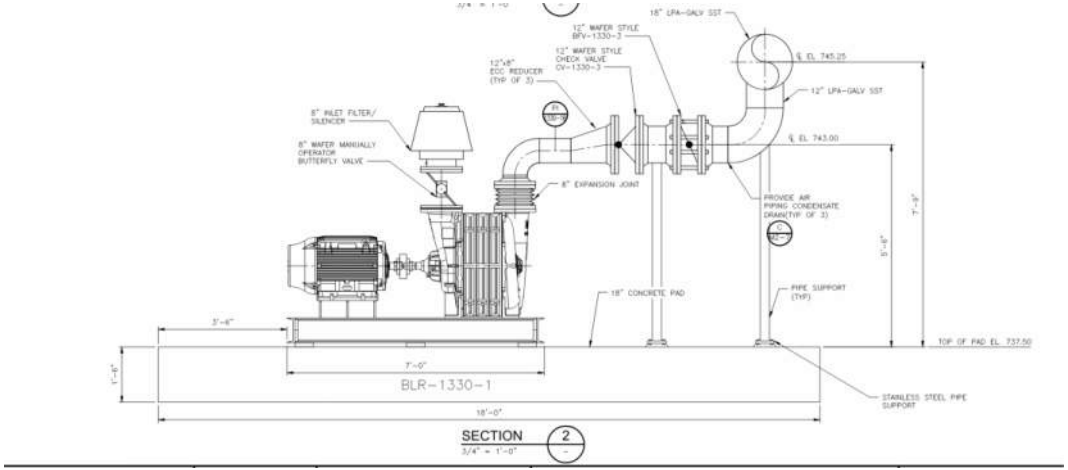
Temporary Package Plant Blowers

- Package Plant Supplier is responsible for calculating blower performance requirements and securing lease of blowers to meet treatment requirements at start of lease
- Type: (3) Multistage Centrifugal, Max of 150 HP

Delineation of Blower Scope of Work		
	Package Plant Supplier	General Contractor
Blower, Motor, Frame and Local Control Panel	X	
Inlet Air Filter / Silencer, Flanged Suction and Discharge Expansion Joints	X	
Discharge Check Valve and Isolation Valve		X
Blower Discharge Pressure Gauge		X
12-inch and 18-inch Blower Discharge Piping and Pipe Supports		X
Blower Concrete Pad		X
Provisions for Instrumentation and Control and Electrical		X

Blower Removal and Refurbishment

- Proposal Item No. 3 is for General Contractor to refurbish and relocate the three existing multistage blowers to the Temporary Package Plant.
  - Test each blower for mechanical integrity prior to motor replacement
  - Install larger, outdoor rated 150 HP motors
  - New PLC-based Local Control Panel



Pipe Supports

- All pipe supports for the permanent plant have been designed by Engineer.
- All pipe supports for the temporary package plant piping are delegated to a qualified pipe support design engineer (Texas PE) hired by the Contractor
- Refer to Section 400507 for the design requirements

Schedule

Bidding Schedule

Deadlines for Questions and Inquiries:	January 4, 2024 at 5PM CDT
Proposals Closing Date and Time:	**January 11, 2024 at 2PM CDT**
City Review of Proposals:	January 12, 2024 – February 2024
Award by City Council:	**February 27, 2024**
Preconstruction Meeting	**Feb 28 or 29, 2024**
Notice to Proceed	**March 1, 2024**
~~Earliest Award by City:~~	~~March 2024~~
Package Plant Mobilization:	November 2024
Temporary Package Plant Start of Lease:	January 2025

Proposal Requirements

Proposal Form

Unit Price Schedule

1. Mobilization/Demobilization
2. All improvements not included in other proposal items
3. Furnish and Install the refurbished blowers at the Package Plant
4. Clean and dispose of contents of debris and sludge from tanks
5. Owner-directed improvements allowance
6. Electric utility fees allowance
7. Fence relocation allowance

Alternate Bids - Deductive Cost:

1. Alternative Payment Terms

Proposer Evaluation Factors:

- Cost – 80 Points
- Contractor's Experience and Qualifications – 5 Points
- Key Personnel and Team Structure – 5 Points
- Project Approach and Understanding – 10 points

Schedule of Materials and Suppliers

- Proposers shall circle the manufacturers included in the Proposal table.
  - If nothing is circled, then it shall be the first manufacturer listed that is expected to be provided.
- If the Proposer desires to propose one or more alternate manufacturers/suppliers, the Proposer may write in the name of such alternates in the space provided on the attached schedule
  - Wherever an alternate manufacturer/supplier is proposed, the Proposer must insert the amount to be deducted from the Contract Price (either lump sum or unit price) if the alternate manufacturer/supplier is eventually approved.

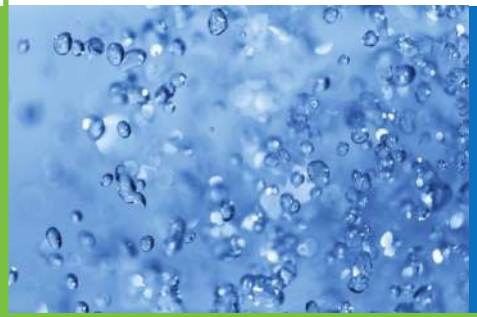
PROPOSAL EQUIPMENT

Equipment Item or Material	Spec Section	Manufacturer/Supplier
Lift Station Submersible Pumps	432513	a. Wilo b. Hydromatic c. Myers
New Multistage Centrifugal Blowers (for Treatment Units)	431118	a. Lone Star Blower b. Continental c. Hoffman Lamson Gardner Denver
Multistage Centrifugal Blower Refurbishment and Relocation (for Package Plant)	431117	a. Lone Star Blower b. Continental c. Hoffman Lamson Gardner Denver
Ceramic Disc Fine Bubble Diffusers	465136	a. ITT-Sanitaire Xylem b. Aquarius Technologies c. EDI
Programmable Logic Controllers	406343	a. Allen-Bradley

Schedule of Subcontractors

Proposer may change subcontractors after Proposal submittal only as approved in writing by the Engineer. The information provided will be used in the evaluation of the Proposer.

SUBCONTRACTOR	SPECIALTY
1.	Electrical
2.	Instrumentation
3.	
4.	
5.	



Final Items

Proposal Submission

- Proposals must be submitted electronically in accordance with Section 00100 at the City's E-bid system:
- https://gtowntx.ionwave.net/CurrentSourcingEvents.aspx

- **Must be submitted by January 11, 2024 at 2PM CDT**

Addenda

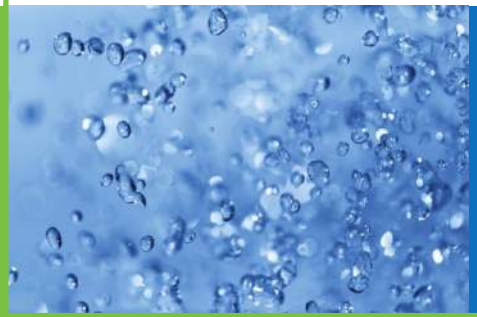
- Submit questions to Donna Cantwell, City of Georgetown Purchasing Department
  - Donna.Cantwell@Georgetown.org
- Please also copy Alexandra Doody, P.E.
  - DoodyAT@cdmsmith.com
- Inquiries are permitted until January 4, 2023 at 5PM CDT
- Necessary replies will be issued as addenda

Final Procurement Reminders

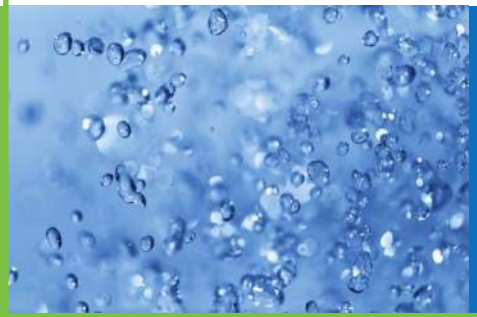
- Proposers must be registered in the City's system. Recommend at least 48 hours before the deadline.

Clarifications

- Notary does not have to be licensed in Texas, but must have an active, valid notary in their state of residence
- The project is tax exempt



Q&A



Adjourn

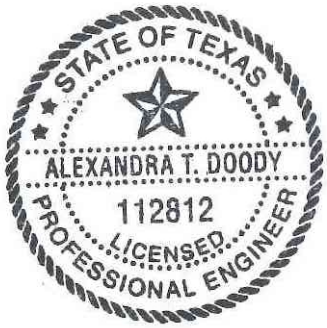
CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

CITY OF GEORGETOWN

DOVE SPRINGS WWTP REHABILITATION PROJECT

ADDENDUM NO. 2

Date Issued: December 28, 2023



Prepared by Alexandra T. Doody, PE 112812
CDM Smith Inc Texas Registration No. F-3043

Proposers on this project are hereby notified that this addendum shall be attached to and made a part of the above-named Contract Documents and Technical Specifications, dated November 2023.

The following items are issued to add to, modify, and clarify the Contract Documents and Technical Specifications and Drawings. These items shall have full force and effect as the Contract Documents and Technical Specifications, and cost involved shall be included in proposal prices. Proposals to be submitted on the specific proposal date shall conform to the additions and revisions listed herein.

Acknowledge receipt of this addendum by designating receipt of the addendum on the first page of the Proposal. Failure to do so may subject proposer to disqualification.

ADDITIONAL INFORMATION

1. The City has reviewed the proposals submitted under ITB No. 202408 for the Temporary Package Plant. Please note that the city capital improvements group is recommending to the Water Utility Board and City Council to award the project to the AUC Group. An additional addendum will be forthcoming to clarify electrical scope of work as well as an update to the proposal form for a line item for Contractor-provided air piping to be provided between the package plant blowers and the package plant basins.

2. Assistance with maintenance items at the Pecan Branch WWTP including provision of temporary piping, cleaning of a RAS force main, and leveling of two weirs to be added as an Additive Alternate to this project via Specification Section 464313 – PECAN BRANCH MAINTENANCE. Pecan Branch WWTP is located at 3500 FM971, Georgetown, TX 78626 and exhibits are attached to the specification to provide the detail needed to understand the scope of work. Revisions to the Proposal Form for this line item will be provided with the revisions for the package plant noted above.

QUESTIONS AND ANSWERS:

Below are questions received and their associated responses:

1. None in this addendum.

REVISIONS TO TECHNICAL DOCUMENTS

SECTION 099676.23 – WASTEWATER PRELIMINARY TREATMENT COATINGS

a) Page 099676.23-1, paragraph 1.2.A.1, REVISE to read as "Ductile iron pipes in Filtrate Lift Station Wet Well."

SECTION 099679 – ATMOSPHERIC PROTECTION AND PLANT SERVICE AREAS COATINGS

a) Page 099679-1, paragraph 1.2.A.1, REPLACE items a through d with the following:

" a. Ductile iron piping at Filtrate Lift Station Valve Vault"

SECTION 400519 – DUCTILE IRON PROCESS PIPE

a) ADD Section 400519, attached to this addendum, in its entirety. This is provided for the temporary ductile iron piping for the Pecan Branch WWTP Additive Alternate.

SECTION 406196 – PROCESS CONTROL DESCRIPTIONS

a) Page 406196-3, paragraph 3.1.B.1, REVISE to read as the following:

1. The following is a list of areas and the loop numbers associated with each area for Dove Springs WWTP:

Filtrate Lift Station (DS-IA-1), Electrical House, and Generator	1000-1099
Package Plant Influent and Slide Gate (DS-IB-1)	1100-1199
Treatment Structure No. 1 and 2 (DS-IC-1 and DS-IC-2)	1200-1299
Aeration Blowers (DS-ID-1, DS-ID-2, DS-IB-1, DS-IB-2) and Generator	1300-1399
Package Plant Clarifier, Sludge Transfer Pumps, and Circuit Breaker	1400-1499

b) Page 406196-12, paragraph 3.8, REVISE spelling error on LOOP 1101-1 to read as "PACKAGE PLANT INFLUENT SLIDE GATE".

c) Page 406196-12, paragraph 3.8, REVISE Appendix One to read as "750 kW Generator Startup Sequence"

d) Page 406196-12, paragraph 3.8, ADD the following after Appendix One. "Appendix Two: 350 kW Generator Startup Sequence"

e) Page 406196-20, LOOP 1330-X DOVE SPRINGS – PACKAGE PLANT AERATION BASIN BLOWERS
   a. REVISE A.1 to read as "There are three aeration blowers (BLR-1330-X). These blowers supply low-pressure air to the package plant treatment units. X denotes the blower number 1/2/3.
   b. REMOVE reference to Section 431118-C in A.2 and REPLACE with reference to Section 431117.

c. Paragraph B, Local Control Panel (Vendor PLC), AUTO: REMOVE reference to Section 431118 and REPLACE with reference to Section 431117.
d. Paragraph SCADA PLC/OWS, end of section REMOVE reference to Section 431118 and REPLACE with reference to 431117.

f) Page 406196-22, LOOP 1101 DOVE SPRINGS – PACKAGE PLANT INFLUENT SLIDE GATE
   a. In the title, fix spelling error of SLIDGE to SLIDE
   b. REVISE the first sentence in paragraph A.1 to read as "The plant influent flow control slide gate (SG-1101-1) is used to control the package plant influent wastewater flow in relation to the online permanent treatment units."
   c. Paragraph B: Control, Section SCADA PLC/OWS, DELETE the following sentence: "These setpoints shall be common for all the Blowers in the package plant."

g) Page 406196-24, LOOP 1102-1 DOVE SPRINGS – PACKAGE PLANT INFLUENT FLOW, Section B.2.a, DELETE the entire sentence and REVISE to read as "The flow measured (FIT-1102-1) is for operational knowledge and monitoring purposes so that operators may manually adjust the set points for gate operation."

h) Page 406196-24, LOOP 1450-1 DOVE SPRINGS – PACKAGE PLANT CLARIFIER DRIVE, General, DELETE the entire sentence and REVISE to read as "The clarifier drive (CF-1450-1) will be supplied by Package Plant Manufacturer under separate City solicitation".

i) Page 406916-26, LOOP 1401-1 DOVE SPRINGS – SLUDGE TRANSFER PUMP, paragraph A.1, REVISE to read as "There is a transfer pump (PMP-1401-1). The pump delivers sludge from the package plant sludge holding basin to aerated sludge holding tank No. 2."

j) Page 406196-30, LOOP 1216-1 DOVE SPRINGS – TREATMENT STRUCTURE AMMONIA, paragraph A.1, REVISE to read as "The headworks is equipped with an existing Ammonia Analyzer and shall be monitored by SCADA PLC/OWS under this contract."

k) Page 406196-40, Appendix One: 750 kW WWTP Generator Startup Sequence, paragraph B.2, REVISE the automatic start up sequence to as follows:
   a. Energize E-house Buildings (to ensure all PLCs and controls are functional before process equipment)
   b. UV System
   c. Treatment Unit Blowers
   d. NPW Pumps
   e. Headworks Fine Screen
   f. Clarifier Drives
   g. PD Blowers
   h. Filtrate Lift Station
   i. Belt Filter Press and Polymer System

<u>SECTION 464313 – PECAN BRANCH MAINTENANCE</u>

a) ADD Section 464313 and its associated exhibits, attached to this addendum, in its entirety.

REVISIONS TO DRAWINGS

SHEET DS-AI-1 – COORDINATED ELECTRICAL HOUSE LIFE SAFETY PLAN

a) Refer to REVISED Sheet DS-AI-1 attached to this addendum for building code changes.

SHEET DS-MA-1 – FILTRATE LIFT STATION PLAN AND SECTION

a) ADD a leader note pointing to the 6"-FM-DI existing piping that reads "SEE NOTE 5".

b) ADD Note 5, "5. CONTRACTOR TO RECOAT ALL EXISTING PIPING INSIDE THE WET WELL AND VALVE VAULT. REFER TO SECTIONS 099676.23 AND 099679."

c) ADD a leader note reading "4" x 6" INCREASER (TYP OF 2)" to the new increaser on Section 1.

SHEET DS-MB-3 – HEADWORKS MODIFICATION PLAN AND SECTIONS

a) REVISE the first sentence on Note 2 to read as "CONTRACTOR TO ROUTE YELO-MINE OR ENGINEER APPROVED EQUAL PIPING ON GRADE UNTIL UNDER THE ROAD".

SHEET DS-MD-1 – TREATMENT UNIT NO. 1 BLOWER AREA PLAN AND SECTIONS

a) REVISE the tag number "LI / 1311-1" at remote digital interface for PIT on the plan view TO READ AS tag number "PI / 1311-1".

SHEET DS-MD-2 – TREATMENT UNIT NO. 2 BLOWER AREA PLAN AND SECTIONS

a) REVISE the tag number "LIT / 1312-1" at remote digital interface for PIT on the plan view TO READ AS tag number "PI / 1311-2".

SHEET DS-D-100 – OVERALL SITE ELECTRICAL MODIFICATION PLAN

a) Refer to REVISED Sheet DS-D-100 attached to this addendum for changes.

SHEET DS-E-1 – OVERALL SITE ELECTRICAL NEW WORK PLAN

a) Refer to REVISED Sheet DS-E-1 attached to this addendum for changes.

SHEET EZ-4 – STANDARD DETAILS IV

a) Refer to REVISED Sheet EZ-4 attached to this addendum for changes.

SHEET DS-IB-1 – PACKAGE PLANT P&ID

a) REVISE Note No. 3 to read as "REFER TO SECTION 431118L UNDER SEPARATE CITY SOLICITATION FOR THE PACKAGE PLANT BLOWERS, ASSOCIATED MOTOR STARTER, AND SIGNALS TO PLANT CONTROL SYSTEM."

b) ADD a 3" x 4" increaser downstream of PMP-1401-1 and upstream of the aerated sludge holding tank no. 2.

c) REVISE the 8"–LPA—SST, 12"–LPA–SST, AND 18" – LPA – SST on the Temporary Package Plant Blowers to be galvanized steel material: 8" – LPA – GS, 12" – LPA – GS, and 18" – LPA – GS.

SHEET DS-IB-2 – PACKAGE PLANT P&ID (BLOWER RELOCATION)

a) REVISE General Note No. 1 to read as "REFER TO SECTION 431117 FOR DETAILS ON THE RELOCATION AND REFURBISHMENT OF EXISTING BLOWERS TO THE TEMPORARY PACKAGE PLANT BLOWER PAD."

b) REVISE Note No. 1 to read as "REFER TO SECTION 431117 FOR THE PACKAGE PLANT BLOWERS, ASSOCIATED MOTOR STARTER, AND SIGNALS TO PLANT CONTROL SYSTEM."

END OF ADDENDUM NO. 2

BUILDING CODE KEY DETERMINATIONS

OWNER	CITY OF GEORGETOWN
PROJECT NAME	DOVE SPRINGS WWTP
PROJECT NUMBER	2048-264953
BUILDING NAME	DOVE SPRINGS WWTP – COORDINATED ELECTRICAL HOUSE
CODES REVIEWED	2021 INTERNATIONAL BUILDING CODE WITH LOCAL AMENDMENTS 2021 INTERNATIONAL MECHANICAL CODE 2021 INTERNATIONAL FIRE CODE WITH LOCAL AMENDMENTS 2021 INTERNATIONAL ENERGY CONSERVATION CODE CITY OF GEORGETOWN CODE OF ORDINANCES 2012 TEXAS ACCESSIBILITY STANDARD (TAS) 2021 INTERNATIONAL EXISTING BUILDING CODE 2023 NATIONAL ELECTRICAL CODE

OCCUPANCY, CONSTRUCTION TYPE, BUILDING LIMITATIONS:

Occupancy:	GROUP F-1 (FACTORY INDUSTRIAL)		
Construction Type:	IIB	Manual Fire Alarm Required:	NOT REQUIRED
Sprinkler Required:	NOT REQUIRED	Max Allowable Sq Footage:	15,500 SF/STORY
Square Footage:	TOTAL = 275 SF	Max Allowable Height:	55 FT
Height:	LESS THAN MAXIMUM ALLOWABLE		
Number of Floors:	1 STORY	Handicap Accessible:	NO
Mezzanine:	NO		

FIRE RESISTANCE RATINGS:

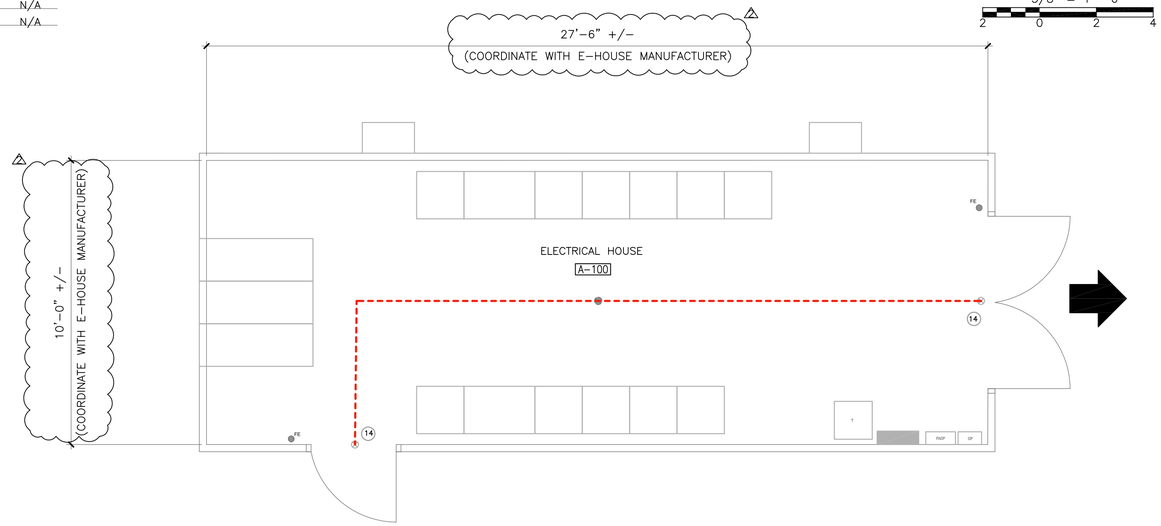
Rated Partitions:		Opening Protective Fire Resistance Rating:	
Corridors: TABLE 1020.2 (OCC LOAD IS LESS THAN 30)	0 Hour	Corridors: N/A	Hour
Stairwells: N/A	0 Hour	Stairwells: N/A	Hour
Electrical Room: N/A	0 Hour	Electrical Room: N/A	Hour
HVAC: N/A	0 Hour	HVAC: N/A	Hour
Occupancy Separation: N/A	0 Hour	Generator Rm: N/A	Hour

MEANS OF EGRESS:

Occupant Load Factor:	300 GROSS	Max Common Path of Egress Allowable:	75
		Max Exit Access Travel Dist Allowable:	200
Occupant Load:	ELECTRICAL ROOM = 294/300 = 1	Max Travel Dist Provided:	31 FT
	TOTAL OCC LOAD = 1	Exit Doors Provided:	ELECTRICAL ROOM = 2
Exit Doors Required:	1	Exit Width Provided:	36 (min)
Exit Width Required:	0.2 INCHES	Min Tread Depth:	N/A
Stairs: Max/Min Riser Height:	N/A	Rated Enclosure Required:	N/A
Min Clear Width:	N/A		
Open Risers Allowed:	N/A		

GENERAL NOTES:

1. PRE-FABRICATED ELECTRICAL HOUSE IS SPECIFIED UNDER SECTION 26 61 00.



DOVE SPRINGS WWTP – COORDINATED ELECTRICAL HOUSE LIFE SAFETY PLAN

3/8" = 1'-0"

N

3/8" = 1'- 0"

2 0 2 4

LIFE SAFETY LEGEND

- EXIT DISCHARGE
- AREA OR SPACE EXIT
- EXIT SIGN
- FE FIRE EXTINGUISHER
- EGRESS PATH
- (X) TRAVEL DISTANCE (FEET)
- [X] COMMON PATH OF TRAVEL (FEET)

REGISTERED ARCHITECT
CHARLOTTE A. THROOP
22340
STATE OF TEXAS
12.19.2023

REV. NO.	DATE	DRWN	CHKD	REMARKS
2	12/18/23	ZB	RD	REVISED FOR ADDENDUM NO.2

DESIGNED BY: DEGUZMAN FM
DRAWN BY: POOJA W
SHEET CHK'D BY: ANANDARAJ
CROSS CHK'D BY: DEGUZMAN FM
APPROVED BY: THROOP C
DATE: NOVEMBER 2023

CDM Smith
8310-1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

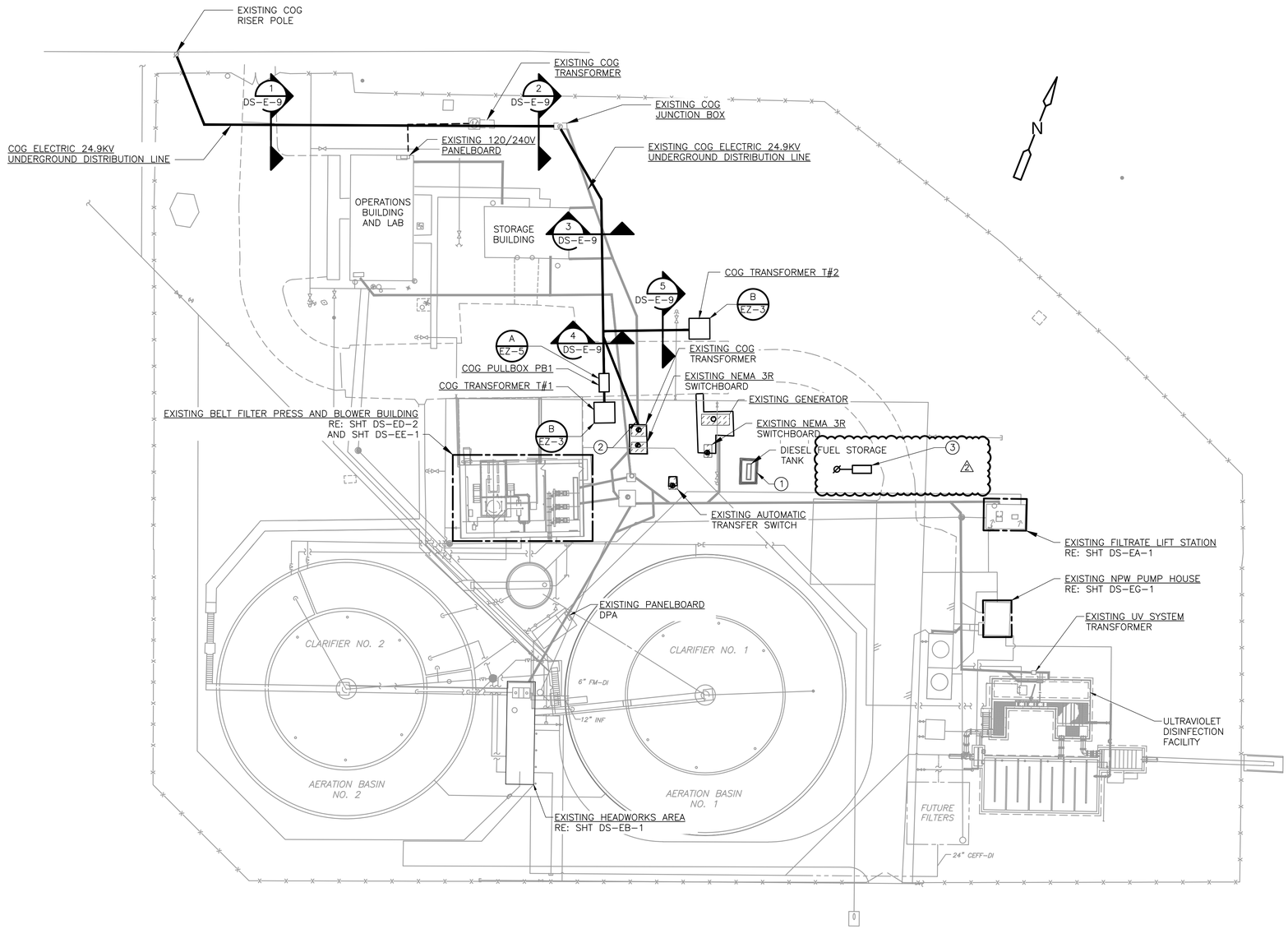
DOVE SPRINGS WWTP REHABILITATION

ARCHITECTURAL
COORDINATED ELECTRICAL HOUSE
LIFE SAFETY PLAN

PROJECT NO. 2048-264953
FILE NAME: AE-1
SHEET NO.
DS-AI-1

LEGEND:

CONTRACTOR TO REMOVE ELECTRICAL EQUIPMENT, CONDUIT, WIRE, AND SUPPORT MATERIAL UNDER THIS CONTRACT.



DOVE SPRINGS ELECTRICAL MODIFICATION SITE

PLAN

1" = 30'

15 0 30

GENERAL ELECTRICAL NOTES:

1. ELECTRICAL DRAWINGS ARE INTENDED TO SHOW THE GENERAL LAYOUT OF WORK TO BE INSTALLED UNDER THIS CONTRACT WITHOUT ATTEMPTING TO SHOW ALL DETAILS. FURNISH LABOR, MATERIALS, EQUIPMENT AND INCIDENTALS REQUIRED FOR A COMPLETE AND OPERATIONAL ELECTRICAL SYSTEM AS SHOWN ON THE CONTRACT DOCUMENTS.
2. COORDINATE WORK WITH OTHER TRADES AND THE OWNER.
3. FIELD VERIFY EXISTING UNDERGROUND ELECTRICAL CONDUIT, CONCRETE DUCT BANKS, MANHOLES, PULL BOXES, ETC. AND MECHANICAL PIPING. CONTRACTOR SHALL INCLUDE IN BID COSTS ASSOCIATED WITH RELOCATION OR REMOVAL OF UNDERGROUND EQUIPMENT AS REQUIRED BY THIS CONTRACT. USE DUE CARE IN CONGESTED AREAS TO AVOID DAMAGE TO EXISTING UNDERGROUND UTILITIES.
4. REPAIR, IN ACCORDANCE WITH SPECIFICATIONS, SIDEWALKS, WALLS, ROADWAYS, ETC. DISTURBED BY CONSTRUCTION ACTIVITIES WHETHER OR NOT SHOWN FOR REPAIR/REPAVING ON CIVIL DRAWINGS.

KEY NOTES:

(1) DIESEL FUEL STORAGE TANK TO BE REMOVED. COORDINATE WITH OTHERS.

(2) EXISTING CONDUITS TO BE INTERCEPTED. COORDINATE REQUIREMENTS WITH UTILITY.

(3) RELOCATE EXISTING LIGHT POLE FIXTURE TO NEW LOCATION, AS NOTED ON SHEET DS-E-1.

PHOTO 1

PLAN

NTS

Juan Carlos Saenz
STATE OF TEXAS
JUAN CARLOS SAENZ
138331
LICENSED PROFESSIONAL ENGINEER
12/21/2023

REV. NO.	DATE	DRWN	CHKD	REMARKS
2	12/19/23	LES	JCS	REVISION FOR ADDENDUM NO. 2

DESIGNED BY: S. KAMAL
DRAWN BY: S. KAMAL
SHEET CHK'D BY: M. CZACH
CROSS CHK'D BY: G. PRABHU
APPROVED BY: J. SAENZ
DATE: NOVEMBER 2023

CDM Smith
8310-1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

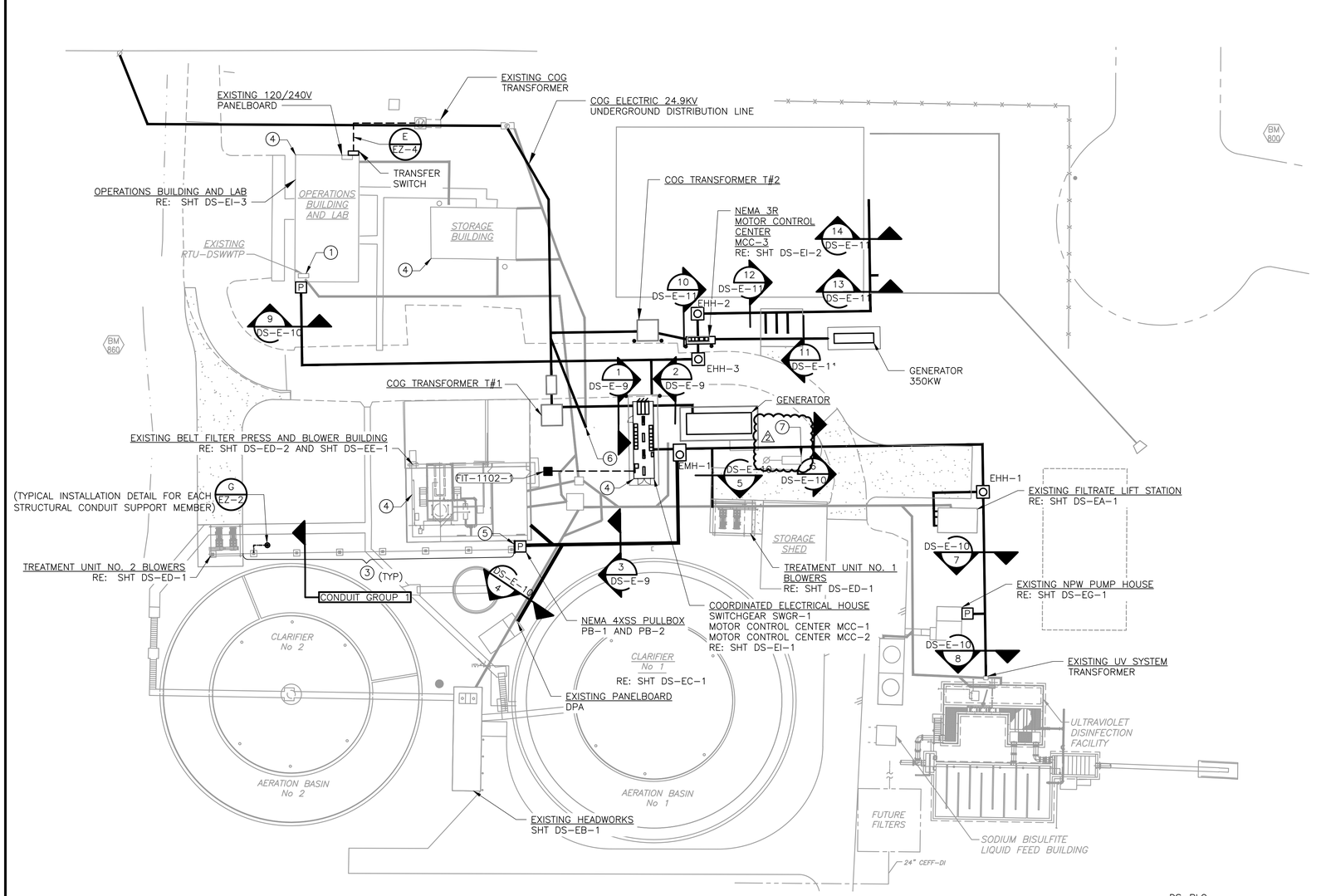
CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP REHABILITATION

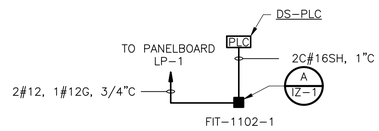
DOVE SPRINGS WWTP
OVERALL SITE
ELECTRICAL MODIFICATION PLAN

PROJECT NO. 2048-264953
FILE NAME: DSD100STPL.DWG

SHEET NO.
DS-D-100



DOVE SPRINGS ELECTRICAL SITE
PLAN
1" = 30'
15 0 30



FIT-1102-1 WIRING DIAGRAM 1 –

GENERAL ELECTRICAL NOTES:

1. ELECTRICAL DRAWINGS ARE INTENDED TO SHOW THE GENERAL LAYOUT OF WORK TO BE INSTALLED UNDER THIS CONTRACT WITHOUT ATTEMPTING TO SHOW ALL DETAILS. FURNISH LABOR, MATERIALS, EQUIPMENT AND INCIDENTALS REQUIRED FOR A COMPLETE AND OPERATIONAL ELECTRICAL SYSTEM AS SHOWN ON THE CONTRACT DOCUMENTS.
2. COORDINATE WORK WITH OTHER TRADES AND THE OWNER.
3. FIELD VERIFY EXISTING UNDERGROUND ELECTRICAL CONDUIT, CONCRETE DUCT BANKS, MANHOLES, PULL BOXES, ETC. AND MECHANICAL PIPING. CONTRACTOR SHALL INCLUDE IN BID COSTS ASSOCIATED WITH RELOCATION OR REMOVAL OF UNDERGROUND EQUIPMENT AS REQUIRED BY THIS CONTRACT. USE DUE CARE IN CONGESTED AREAS TO AVOID DAMAGE TO EXISTING UNDERGROUND UTILITIES.
4. REPAIR, IN ACCORDANCE WITH SPECIFICATIONS, SIDEWALKS, WALLS, ROADWAYS, ETC. DISTURBED BY CONSTRUCTION ACTIVITIES WHETHER OR NOT SHOWN FOR REPAIR/REPAVING ON CIVIL DRAWINGS.
5. CONCEAL CONDUITS TO GREATEST EXTENT PRACTICABLE. CONDUITS RUN AT EXISTING STRUCTURES SHALL BE RUN EXPOSED.

KEY NOTES:

(1) APPROXIMATE LOCATION OF EXISTING EQUIPMENT. FIELD VERIFY EXACT LOCATION.

(2) CONDUIT TRANSITION FROM UNDERGROUND DUCTBANK TO CONDUIT SUPPORT SYSTEM.

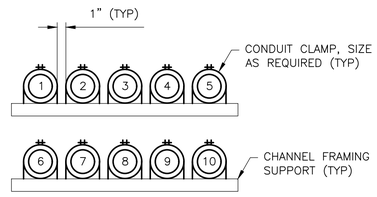
(3) CONDUIT SUPPORT SYSTEM REFERENCE STRUCTURAL DRAWINGS. FOR EACH CONDUIT SUPPORT STRUCTURE, PROVIDE #6 BARE COPPER GROUNDING CONDUCTOR FROM STRUCTURAL STEEL TO GROUND PLATE.

(4) PROVIDE A LIGHTNING PROTECTION SYSTEM FOR THE STRUCTURE IN ACCORDANCE WITH NFPA 780.

(5) PROVIDE NEMA 4XSS PULLBOXES SIZED PER NEC. SUPPORT PULLBOXES FROM CONDUIT SUPPORT STRUCTURES USING STAINLESS STEEL CHANNEL FRAMING.

(6) CONDUITS TO BE ABANDONED IN PLACE. CUT FLUSH WITH GRADE AND FILL.

(7) PLACE THE RELOCATED LIGHTS TO BEST SUIT FIELD CONDITIONS. INTERCEPT EXISTING LIGHTING CIRCUIT. REFER TO DETAIL F/EZ-4 FOR POLE BASE DETAILS.
△2



CONDUIT GROUP 1
SECTION 1 DS-E-1
NTS

TABLE FOR CONDUIT GROUP 1	
CONDUIT NO.	DESCRIPTION
1	EXPOSED CONDUIT FROM MCC-2 TO BLR-1310-3 MOTOR VIA DUCTBANK/PULLBOX PB-1
2	EXPOSED CONDUIT FROM MCC-2 TO BLR-1310-3 MOTOR ANCILLARY DEVICES VIA DUCTBANK/ PULLBOX PB-1
3	EXPOSED CONDUIT FROM MCC-2 TO LCP-1310-3 VIA DUCTBANK/ PULLBOX PB-2
4	EXPOSED CONDUIT FROM DS-RIO2 TO LCP-1310-3 VIA DUCTBANK/PULLBOX PB-2
5	EXPOSED CONDUIT FROM MCC-2 TO MPZ-2 VIA DUCTBANK/ PULLBOX PB-1
6	EXPOSED CONDUIT FROM MCC-2 TO BLR-1310-4 MOTOR VIA DUCTBANK/PULLBOX PB-1
7	EXPOSED CONDUIT FROM MCC-2 TO BLR-1310-4 MOTOR ANCILLARY DEVICES VIA DUCTBANK/PULLBOX PB-1
8	EXPOSED CONDUIT FROM MCC-2 TO LCP-1310-4 VIA DUCTBANK/ PULLBOX PB-2
9	EXPOSED CONDUIT FROM DS-RIO2 TO LCP-1310-4 VIA DUCTBANK/PULLBOX PB-2
10.	EXPOSED CONDUIT FROM DS-RIO2 TO PIT-1311-2 VIA DUCTBANK/ PULLBOX PB-2

Juan Carlos Saenz
STATE OF TEXAS
JUAN CARLOS SAENZ
138331
LICENSED PROFESSIONAL ENGINEER
12/21/2023

REV. NO.	DATE	DRWN	CHKD	REMARKS
2	12/19/23	LES	JCS	REVISED PER ADDENDUM NO. 2

DESIGNED BY: S. KAMAL
DRAWN BY: S. KAMAL
SHEET CHK'D BY: M. CZACH
CROSS CHK'D BY: G. PRABHU
APPROVED BY: J. SAENZ
DATE: NOVEMBER 2023

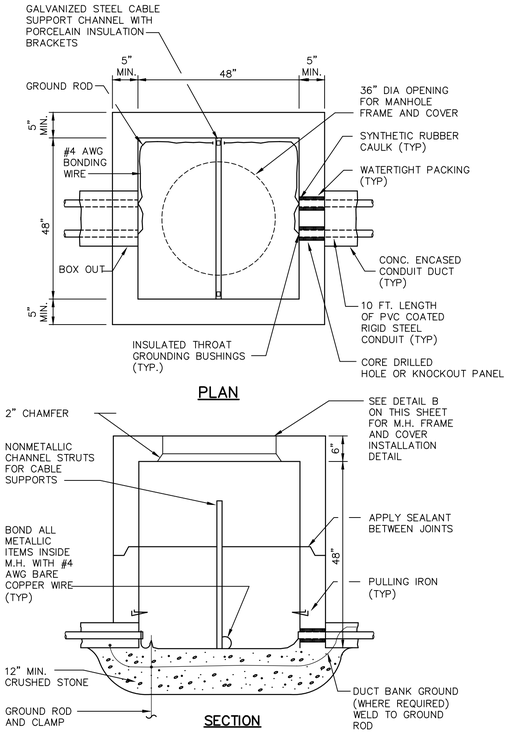
CDM Smith
8310-1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

DOVE SPRINGS WWTP
OVERALL SITE
ELECTRICAL NEW WORK PLAN

PROJECT NO. 2048-264953
FILE NAME: DSE01STPL.DWG
SHEET NO. DS-E-1



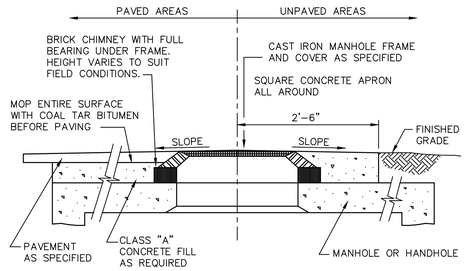
NOTES:

1. BOND ALL METALLIC ITEMS INSIDE EHH TO GROUND W/MIN. #4 AWG BARE COPPER CABLE UNO.
2. HANDHOLES SHALL BE REINFORCED FOR H20 WHEEL LOAD.
3. CABLES SHALL BE RACKED ON PORCELAIN INSULATION CLAMPS.

ELECTRICAL HANDHOLE (EHH)

DETAIL A

NTS



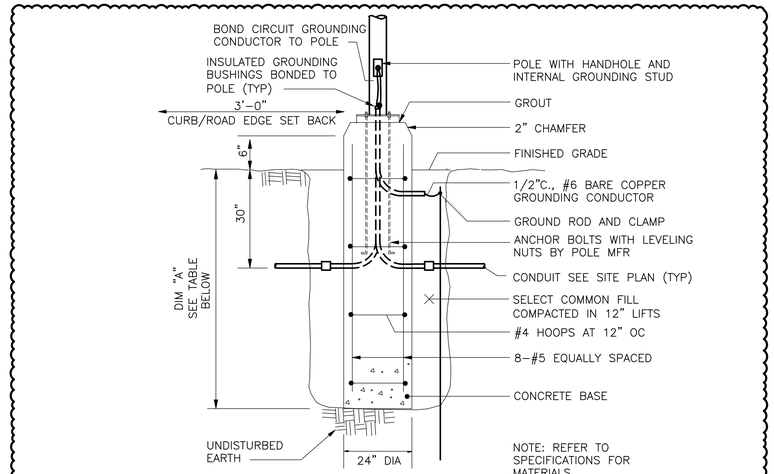
NOTE:

1. FINAL GRADING SHALL PROVIDE ADEQUATE DRAINAGE AWAY FROM MANHOLE COVER IN ALL DIRECTIONS.

MANHOLE OR HANDHOLE FRAME AND COVER

DETAIL B

NTS

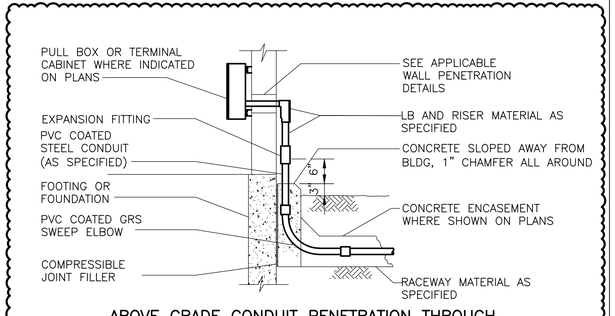


POLE HEIGHT	DIMENSION "A"
10'-0"	4'-6"
20'-0"	4'-6"
30'-0"	6'-6"
40'-0"	6'-6"

STANDARD LIGHTING BASE

DETAIL C

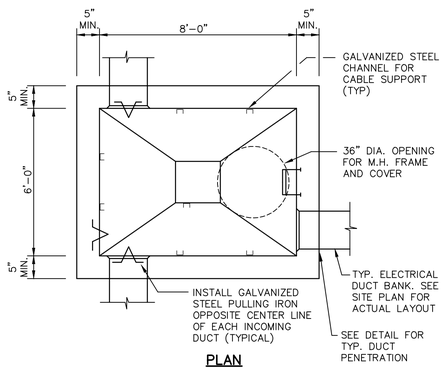
N.T.S.



ABOVE GRADE CONDUIT PENETRATION THROUGH EXISTING BUILDINGS OR STRUCTURES

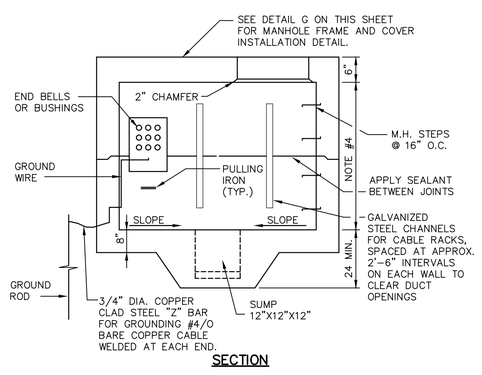
DETAIL D

NTS



NOTES:

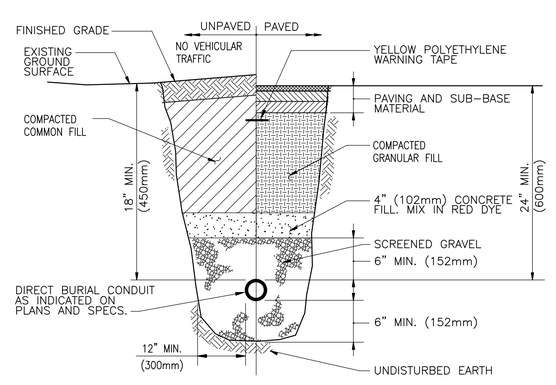
1. BOND ALL METALLIC ITEMS INSIDE MH TO GROUND BAR W/MIN. #4 AWG BARE COPPER CABLE. ADJUST SIZE IF REQUIRED BY NEC.
2. MANHOLES SHALL BE REINFORCED FOR H20 WHEEL LOAD.
3. CABLES SHALL BE RACKED ON PORCELAIN INSULATION CLAMPS.
4. MINIMUM DEPTH SHALL BE 8', CONTRACTOR SHALL PROVIDE STACKING RINGS AS REQUIRED TO MEET THE FIELD CONDITIONS.



ELECTRICAL MANHOLE (EMH)

DETAIL E

NTS



TYPICAL DIRECT BUIAL CONDUIT INSTALLATION

DETAIL F

NTS

Juan Carlos Saenz
STATE OF TEXAS
JUAN CARLOS SAENZ
138331
LICENSED PROFESSIONAL ENGINEER
12/21/2023

REV. NO.	DATE	DRWN	CHKD	REMARKS
2	12/19/23	LES	JCS	REVISED PER ADDENDUM NO. 2

DESIGNED BY: V. MANJU
DRAWN BY: V. MANJU
SHEET CHK'D BY: M. CZACH
CROSS CHK'D BY: G. PRABHU
APPROVED BY: J. SAENZ
DATE: NOVEMBER 2023

CDM Smith
8310-1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP REHABILITATION

ELECTRICAL STANDARD DETAILS IV

PROJECT NO. 2048-264953
FILE NAME: EZ04NFDT.DWG
SHEET NO. EZ-4

SECTION 400519 - DUCTILE IRON PROCESS PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ductile-iron pipe.
2. Ductile-iron, malleable-iron, and cast-iron fittings.
3. Accessories.

B. Related Requirements:

1. Section 099679 “Atmospheric Protection and Plant Service Areas Coatings” for product and execution requirements for non-buried ductile iron pipe specified by this Section.
2. Section 400506 “Couplings, Adapters, and Specials for Process Piping” for piping appurtenances.
3. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
4. Section 400551 “Common Requirements for Process Valves” for common product requirements for valves for placement by this Section.

1.3 COORDINATION

A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information regarding pipe and fittings.

B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe fittings, gaskets, linings, and exterior coating

for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified.

B. Prior to Pipe Shipment:

1. Certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, along with a sworn affidavit of compliance that the pipe complies with the referenced standards.
2. Copies of shop tests, including hydrostatic tests.

C. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and invert or centerline elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 WARRANTY

A. Provide Manufacture/Supplier warranty in accordance with CIP16, “Warranty”.

1.8 QUALITY ASSURANCE

A. Hydrostatically test each length of ductile iron pipe at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Furnish certified test results in duplicate to the Engineer prior to time of shipment.

B. Inspect and test by Manufacturer the ductile-iron pipe and fittings at the foundry as required by the AWWA C600, Hydrostatic Testing; ASTM A716, Standard Specification for Ductile Iron Culvert Pipe; and ASTM A746, Standard Specification for Ductile Iron Gravity Sewer Pipe as applicable. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.

C. Pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by Owner at their expense.

D. Owner will inspect the pipe and fittings after delivery. Products are subject to rejection at any time on account of failure to meet any of the specified requirements, even though accepted as

satisfactory at the place of manufacture. Immediately mark pipe rejected after delivery and remove from the job site.

E. Permanently mark pipe and fittings with the following information:

1. Manufacturer name and trademark.
2. Manufacturing date.
3. Size, type, class, or wall thickness.
4. Production standard (AWWA, ASTM, etc.).
5. Apply pipe labelling per ASME A13.1-2015 Label Color Coding for Background and Lettering.

F. Perform Work according to City of Georgetown, TCEQ, and manufacturer's standards.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Texas.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Photograph and provide written documentation of damaged materials.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Coverall openings to prevent entrance of dirt, water, and debris.
3. Protect piping and appurtenances by storing off ground.
4. Limit stacking height to manufacturers specified maximum.
5. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. Piping:

1. Comply with AWWA C115, C150 or C151 as applicable for service.
2. Ductile Iron pipe as manufactured by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; all divisions of the McWane Company or an approved equal who is a member of the Ductile Iron Pipe Research Association (DIPRA).
3. Pressure Ratings:

	Pipe Diameter	Minimum Pressure Rating (psi)
a.	4-inches through 12-inches	350
b.	14-inches and larger	250

B. Fittings:

1. Material: AWWA C110, ductile iron AWWA C153, ductile iron.

    a. Pressure Rating: 150 psi

2. Mechanical Joints: Comply with AWWA C110 and AWWA C111.
3. Push-on Joints: Comply with AWWA C111.
4. Restrained Joints: Comply with AWWA C111.
5. Flanged Fittings (for above grade piping): Comply with AWWA C110 and ASME B16.1 Class 125

    a. Assembly bolts: square headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Threads conform to ANSI B1.1. Bolt length: 1/8 inch to 5/8 inch protrusion from nut after torquing.
    b. Flange gaskets shall be full face type per AWWA C111 to provide positive sealing for the flanged ductile iron joints. Thickness shall be 1/8-inch unless otherwise indicated.
    c. Steel flanges in conformance with AWWA C207, Class D, may be mated to iron valves, fittings, or other parts having either integral Class 125 iron flanges or screwed Class 125 companion flanges. When such construction is used, the raised face on mating flanges shall be removed.

6. Grooved joints: Comply with AWWA C606.

    a. Rigid couplings: Style 31 couplings as manufactured by Victaulic, Anvil International, or equal.
    b. For direct connection of ductile pipe to steel pipe of IPS sizes: Victaulic Style 307 transition coupling with offsetting, angle-pattern, bolt pads.
    c. Grooved end fittings for AWWA ductile iron pipe: Conform to ANSI A21.10/AWWA C110 for center-to-end dimensions and ANSI A21.10/AWWA C110 or AWWA C153 for wall thickness, with AWWA C606 grooved ends.

7. Sleeve type couplings: Dresser Style 38 or 138 as manufactured by Dresser Industries, or equivalent products of Smith-Blair, Romac Industries, Ford Meter Box Company, or equal.
8. Flanged coupling adaptors: Smith-Blair Type 913, or equivalent products of Klamflex Pipe Couplings (PTY) LTD, Robar Industries LTD, or equal.

C. Interior Linings:

1. Ductile iron pipe and fittings shall have epoxy lining.
2. Epoxy Lining:

   a. Line ductile iron pipe and fittings with a ceramic-filled amine-cured epoxy, Protecto 401 by Induron.
   b. Lining thickness of 40 mils minimum. Applicator approved by the coating manufacturer and applied in accordance with manufacturer's instructions and under controlled conditions at the applicator's shop or the pipe manufacturer's plant.
   c. Submit a certified affidavit of compliance with manufacturer's instructions and requirements specified.

D. Exterior Coating:

1. Exposed Service: As specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coatings.”
2. If required, coatings "hold-backs" to be provided at pipe and fitting ends for satisfactory installation for joint connections in the field.
3. Provide all necessary coating materials to perform field coating applications at joints compatible with or equal to the shop applied material.
4. Field repair of pipe with damaged coating shall receive prior approval of Engineer. If, in the opinion of Engineer coating damage is beyond repair, replace pipe at expense of Contractor.
5. All flange bearing surfaces shall be uncoated.
6. Mechanically clean or brush blast all surfaces to have exterior coating applied to ductile iron surfaces. Chemical cleaning or wiping with solvent is not acceptable.

2.2 ACCESSORIES

A. Gaskets:

1. Full face type SBR per AWWA C111 to provide positive sealing for the flanged ductile iron joints.
2. Thickness 1/8-inch.

B. Pipe Hangers and Supports:

1. Pipe hangers and supports shall be specified in Section 400507 “Hangers and Supports for Process Piping”.
2. Pipe hangers and supports shall be provided at suitable distance along the pipeline regardless whether they are shown or not shown on the Drawings.

C. Base bends and base tees shall have machined and drilled bases.

D. Filler flanges and beveled filler flanges shall be furnished and installed as required. Filler flanges and beveled filler flanges shall be furnished faced and drilled complete with extra length bolts. Filler flanges shall be equal to Clow Figure F 1984 and beveled filler flanges shall be equal to Clow Figure F 1986.

2.3 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly. See Section 400551 “Common Requirements for Process Valves” for pipe testing requirements.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Thoroughly clean pipe and fittings before installation.

B. Surface Preparation:

1. Clean surfaces to remove loose rust, mill scale, and other foreign substances by power wire brushing.
2. Touch up shop-primed surfaces with primer as specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coatings.”
3. Solvent-clean surfaces that are not shop primed.

3.3 INSTALLATION

A. Buried Service Piping: As specified in Section W1 Ductile Iron Pipe and Fittings.

B. Exposed Service Piping:

1. According to ASME B31.3.
2. In compliance with manufacturer’s instructions.

3. Run piping straight along alignment as indicated on Drawings, with minimum number of joints.
4. Clean each length prior to installation.
5. Support per Section 400507 “Hangers and Supports for Process Piping”.
6. Do not use equipment flanges for support; support pipe separately.

C. Fittings:

1. According to manufacturer instructions.
2. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer instructions.
4. Flanged joints to be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts to conform to the same ANSI Standard as the flanges. Bolts shall be ASTM A307, grade B, heavy hex nut.
5. Provide required upstream and downstream clearances from devices as indicated on Drawings.

D. Make taps to ductile iron piping only with service saddle, tapping boss of a fitting or valve body, or equipment casting.

E. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.

F. Support exposed piping as specified in Section 400507 “Hangers and Supports for Process Piping.”

G. Provide expansion joints as specified in Section 400506 “Couplings, Adapters, and Specials for Process Piping”, and pipe guides as specified in Section 400507 “Hangers and Supports for Process Piping”, to compensate for pipe expansion due to temperature differences.

H. Dielectric Fittings: Provide between dissimilar metals.

I. Field Cuts: According to pipe manufacturer instructions. Cutting by abrasive saw only, leaving a smooth cut at right angles to the axis of the pipe. Damage to the lining repaired to the satisfaction of the Engineer. Seal Field cut ends approved epoxy coating in accordance with manufacturer's instructions.

J. Finish primed surfaces according to Section 099679 “Atmospheric Protection and Plant Service Areas Coatings.”

K. Installation Standards: Install Work according to City of Georgetown standards.

3.4 TOLERANCES

A. Deflection at joints not to exceed that recommended by the pipe manufacturer.

B. Supply and install fittings, in addition to those shown on Drawings, in areas where conflict exists with existing facilities.

3.5 FIELD QUALITY CONTROL

A. Inspection:

1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Engineer.
2. Repair damaged piping or provide new, undamaged pipe at no additional cost to the project.
3. After installation, inspect for proper supports and interferences.

B. Pressure Testing:

1. Test Pressure: 150 psi
2. Conduct hydrostatic test for minimum two hours.
3. Filling:

    a. Fill section to be tested with water slowly and expel air from piping at high points.
    b. Install corporation cocks at high points.
    c. Close air vents and corporation cocks after air is expelled.
    d. Raise pressure to specified test pressure.

4. Observe joints, fittings, and valves under test.
5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
6. Leakage:

    a. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
    b. Maintain pressure within plus or minus 5 psi of test pressure.
    c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
    d. Compute maximum allowable leakage by following formula:

        1) L = SD x sqrt(P)/C.
        2) L = testing allowance in gph.
        3) S = length of pipe tested in feet.
        4) D = nominal diameter of pipe in inches.
        5) P = average test pressure during hydrostatic test in psig.
        6) C = 148,000.
        7) If pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

    e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
    f. Correct visible leaks regardless of quantity of leakage.

3.6 CLEANING

A. Keep pipe interior clean as installation progresses.

B. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION 400519

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SECTION 464315 – PECAN BRANCH MAINTENANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Leveling Existing Weir Plates at Pecan Branch WWTP
   a. Adjust existing Aeration Basin 3-4 Influent Channel weirs to the elevations as shown in Attached Exhibit.

2. Pipe Cleanout of Existing 10” Return Activated Sludge Pipeline at Pecan Branch WWTP.

   a. Provide temporary piping as shown on the Exhibits to maintain Owner’s operation of at least four RAS pumps during pipeline cleaning.
   b. Flush and clean any settled solids, grit, and debris in the 10” RAS line, as detailed in the Attached Exhibit.

1.3 ACTION SUBMITTALS

A. Shop Drawings:
   1. Submit shutdown plan and anticipated schedule for removal and leveling of existing weirs at each aeration basin one at a time.
   2. Submit temporary piping plan, sequence of construction, and anticipated schedule for RAS pipe cleanout work.
   3. Submit for Owner’s information temporary water and or pumps required to pig or clean the piping.

1.4 DELEGATED DESIGN SUBMITTALS (NOT USED)

1.5 INFORMATIONAL SUBMITTALS

A. Field Quality Controls: Indicate results of Contractor-furnished inspections and survey results.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION
1.

B. Weir Plates:
1. Carefully align and level to the elevations shown on the attached exhibits. No variation greater than 1/8-inches.
a. Provide survey measurements at a minimum of 2 evenly spaced locations at each aeration basin weir for acceptance of work.

C. 10-inch RAS Cleanout:
1. Prior to pipeline pigging, Contractor shall CCTV the line and report results to Owner and Engineer.
2. Submit, for engineer review and approval, materials as well as means and methods for pipeline pigging.

3.2 FIELD QUALITY CONTROL

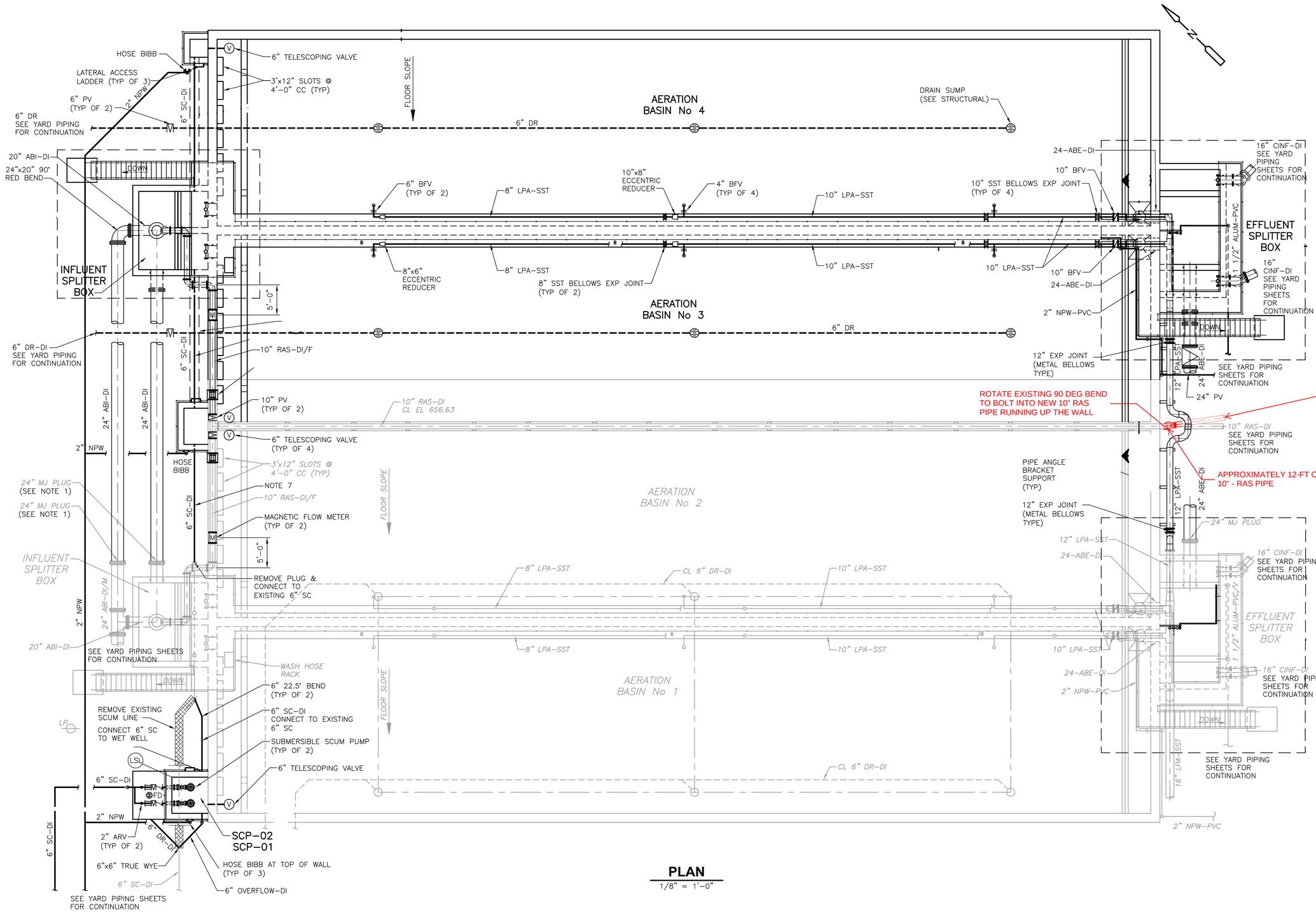
A. Submit inspection reports to Owner and Engineer.

3.3 ADJUSTING

A. Adjust and correct defects in fabrication and installation allowing proper operation of system and related components.

3.4 SEE ATTACHED FOR EXHIBITS

END OF SECTION 464315



PLAN
1/8" = 1'-0"

NOTES:

1. TEMPORARY RAS PIPING FOR CLEANING WORK SHOWN IN EXHIBIT PAGES 1-4 IS SHOWN IN RED.

2. 10" - RAS PIPE MATERIAL TO BE SUBMITTED FOR APPROVAL.

3. CONTRACTOR TO REFER TO THE FOLLOWING SPECIFICATIONS FOR INSTALLATION OF 10" - RAS PIPE:

   SECTION 400506 FOR PIPING APPURTENANCES.

   SECTION 400507 FOR PIPE SUPPORT REQUIREMENTS

   SECTION 400551 FOR PROCESS VALVES.

   SECTION 400519 FOR DUCTILE IRON PROCESS PIPE

4. PIPE SUPPORTS ARE DELEGATED DESIGN. REFER TO SECTION 400507 FOR REQUIREMENTS.

CDM Smith
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Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

PECAN BRANCH
WASTEWATER TREATMENT PLANT

AERATION BASINS
TEMPORARY RAS PIPING PLAN

EXHIBIT
464315-1

1" = 10'

0+45.62
DEF ANG 56.25° RT
16" 11.25° BEND
16" 45° BEND
N 10219423.30
E 3150642.87

0+17.52
DEF ANG 45° RT
16" 45° BEND
N 10219385.66
E 3150674.55

0+99.25
DEF ANG 45° RT
16" 45° BEND
N 10219384.10
E 3150679.47

0+81.59
DEF ANG 45° RT
16" 45° BEND
N 10219338.83
E 3150718.27

16" CINF-DI

16" CEFF-DI

0+94.73
DEF ANG 45° RT
16" 45° BEND
N 10219325.70
E 3150717.82

0+05.75
(2) 16" 90° BENDS
SEE SHEET MD-3

CLARIFIER No 3

CLARIFIER No 4

GOOSENECK LADDER
(TYP FOR EACH CLARIFIER)

F
MD-3

0+01.87
DEF ANG 56.25° LT
16" 90° BEND
16" 45° BEND
SEE SHEET CP-5

AERATION BASIN
No 4

0+10.02
16" 45° BEND

2" NPW-PVC

1/2" SHC-PVC

3-45° BENDS

MH No E-2

1+18.09
20"x16" REDUCER
20"x16" TEE
16" 90° BEND

1-45° BEND

1+36.01
20"x20" TEE

20" CEFF-DI

36" EFF DI

TIE INTO THE EXISTING
10" - RAS -DI PIPE.

AERATION BASIN
No 3

0+09.59
16" 45° BEND

0+01.87
DEF ANG 23.7374° LT
16" 90° BEND
16" 45° BEND
SEE SHEET CP-5

SEE SHEET MD-4

RAS PUMP STATION

INSTALL 4" MH
N 10219349.55
E 3150644.68
(SEE NOTE 1)

1 1/2" ALUM-PVC/V

24" PV

2" NPW-PVC/V

MATCH LINE SEE SHEET CP-3

16" CINF-DI/P

10" RAS-DI/P

1/2" SHC-PVC

TEMPORARY
10" - RAS PIPE

SEE SHEET EXHIBIT
PAGE 3 FOR
CONTINUATION

4"x4" TEE
(2) 4"x2" REDUCERS

24" ABE-DI

4" NPW-PVC/P

1 1/2" ALUM-PVC/V

RAS PUMP STATION

TERTIARY TREATMENT FACILITY

LP

20" CEFF-DI

16" CEFF-DI

4" NPW-PVC

MH

MH No 9

1/2" SHC-PVC/V

16" NPW-PVC/V

AERATION BASIN
No 2

CLARIFIER No 1

CLARIFIER No 2

4" NPW-PVC/V

2" NPW-PVC/V

EMH-2

16" CEFF-DI

MATCH LINE SEE SHEET CP-2

Exhibit
464315-1

16" CINF-DI/P

6" SC

8" DR-PVC

MH No 8

4" NPW-PVC/V

10" DR-PVC

1/2" SHC-PVC/V

2" PW-PVC/V

METER VAULT

EMH-3

EMH-1

4" DR-PVC

1/2" PW-PVC/V

MH No 4

16" CEFF-DI

10" DR-PVC

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Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

PECAN BRANCH
WASTEWATER TREATMENT PLANT

YARD PIPING
TEMPORARY RAS PIPING PLAN

EXHIBIT
464315-2

CLARIFIER No 1

CLARIFIER No 2

CLARIFIER No 3

10" SL-DI/P

6" DR-DI/P

6" WAS-DI/P

WAS MAGNETIC FLOW METER

SEE YARD PIPING SHEETS FOR CONTINUATION

4' DIA MH

RESTRAINED FLANGE COUPLING ADAPTER (TYP OF 2)

2 1/2" NPW-GS/T

6" DR-PVC/P

2" NPW-PVC/N

6" SC-DI/P

6" DR-DI/P

10" SL-DI/P

3 MD-5

SEE YARD PIPING SHEETS FOR CONTINUATION

TEMPORARY 10" - RAS FORCEMAIN ROUTE ON GRADE

(2) 90 DEG BENDS

10" - RAS - DI CL EL 652.52

6" X 10" X 10" DI TEE (TYP OF 5)

16" CINF-DI/P

14'-0"

RASP-01

RASP-02

RASP-03

RASP-04

RASP-05

RASP-06

6" RAS-DI/F

4" DR-PVC/P

8" RAS-DI

PI

PSH

FD

2" SEWAGE TYPE ARV (TYP OF 3)

6" DR (TYP)

BURIED VALVE (TYP)

RAS PUMP STATION

RESTRAINED PLUG

1 MD-5

6" DR-DI/P AT 1.00% SLOPE

28'-0"

4 MD-5

6" PV (TYP)

6" CV (TYP)

8" PV (TYP)

SEE NOTE 2

1/2" DR-PVC ROUTE TO DRAIN

10" SL-DI

SEE YARD PIPING SHEETS FOR CONTINUATION

16'-10"

6" DR-DI

6" SC-DI

4' DIA MH
IE (OUT) 632.86
IE (6" DR IN) 632.86
IE (6" SC IN) 641.00

2" NPW-PVC

1" SHC-PVC

2-45° BENDS

6" PV (TYP OF 2)

BURIED VALVE (TYP)

N

NOTES:

1. RASP-06 WILL BE OUT OF SERVICE AS THE PIPE CLEANING EFFORT IS TAKING PLACE. USE CONNECTION POINT AT RASP-06 AS THE ACCESS POINT FOR PIPELINE CLEANING.

2. PRIOR TO COMMENCEMENT OF WORK, DRAIN 10" FORCEMAIN HEADER TO NEARBY 4'-DIA MH. CLOSE RASP-06 8" SUCTION PLUG VALVE AND 6" DISCHARGE PLUG VALVE TO ISOLATE THE LINE FROM BOTH THE CLARIFIER AND THE 10" FORCEMAIN. REMOVE 6" DISCHARGE CHECK VALVE AND CONNECT A 6" FLEX HOSE AND ROUTE TO MANHOLE FOR DRAINING OF LINE. WHEN READY TO DRAIN, OPEN 6" PLUG VALVE.

3. MINIMIZE DOWNTIME OF RAS PUMPS TO CONNECT TO TEMPORARY FORCEMAIN PRIOR TO CLEANING WORK AND TO RETURN PIPING TO ORIGINAL ORIENTATION AFTER CLEANING WORK IS ACCEPTED BY OWNER. PERFORM BOTH SHUTDOWNS DURING LOW FLOW PERIOD. SUBMIT PLAN OF CONSTRUCTION TO ENGINEER FOR REVIEW.

PLAN

3/8" = 1'-0"

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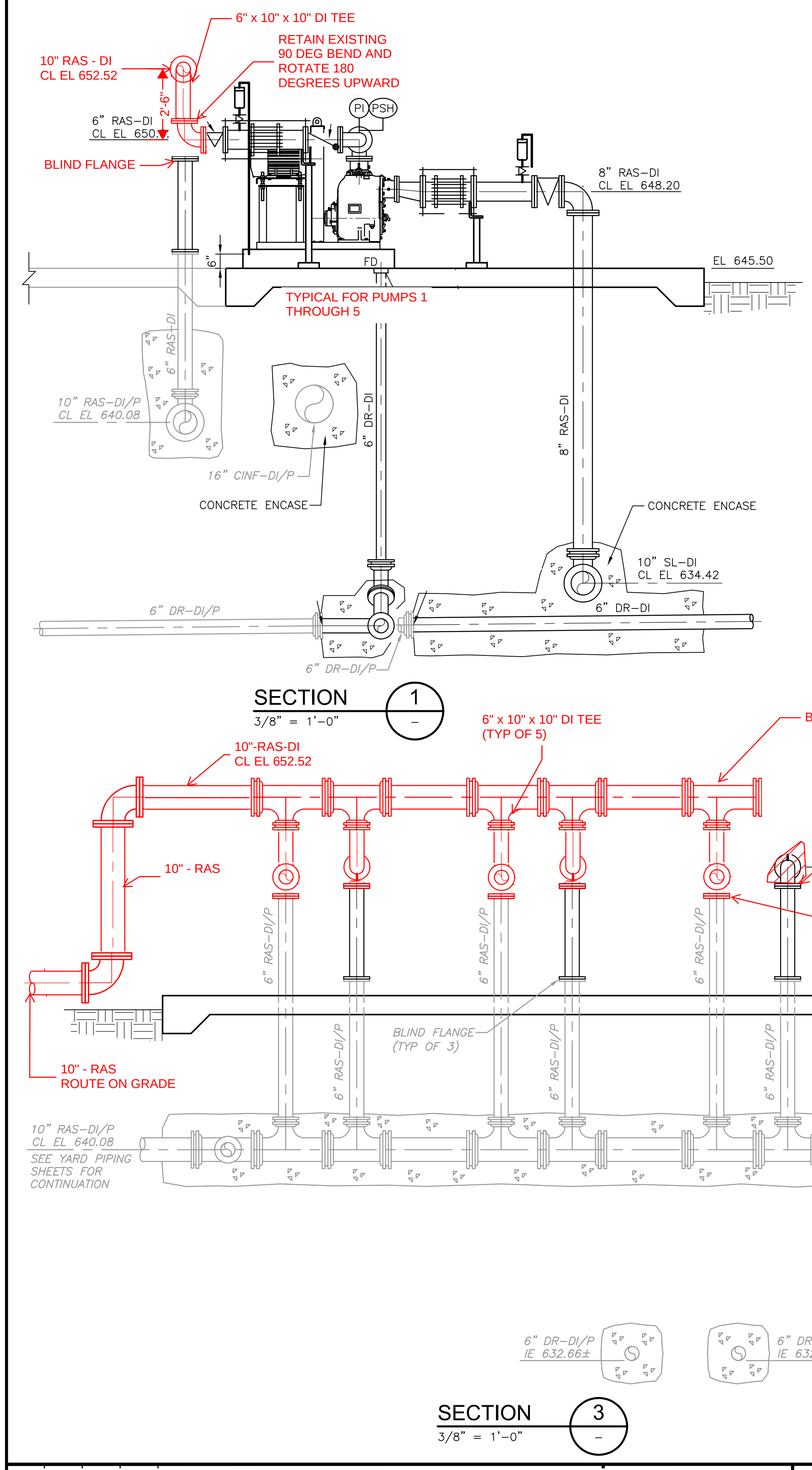
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

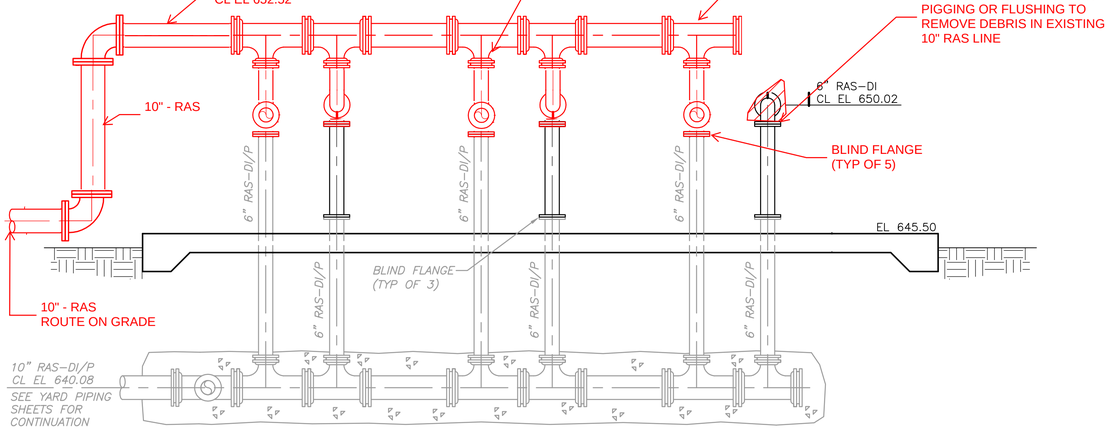
PECAN BRANCH
WASTEWATER TREATMENT PLANT

RAS PUMP STATION
TEMPORARY RAS PIPING PLAN

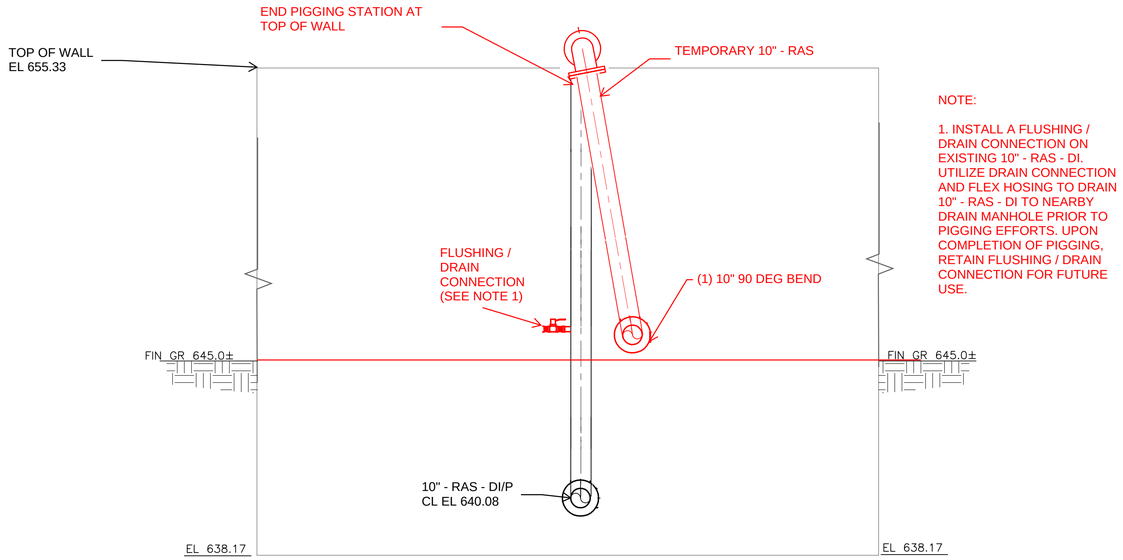
EXHIBIT
464315-3



SECTION 1
3/8" = 1'-0"



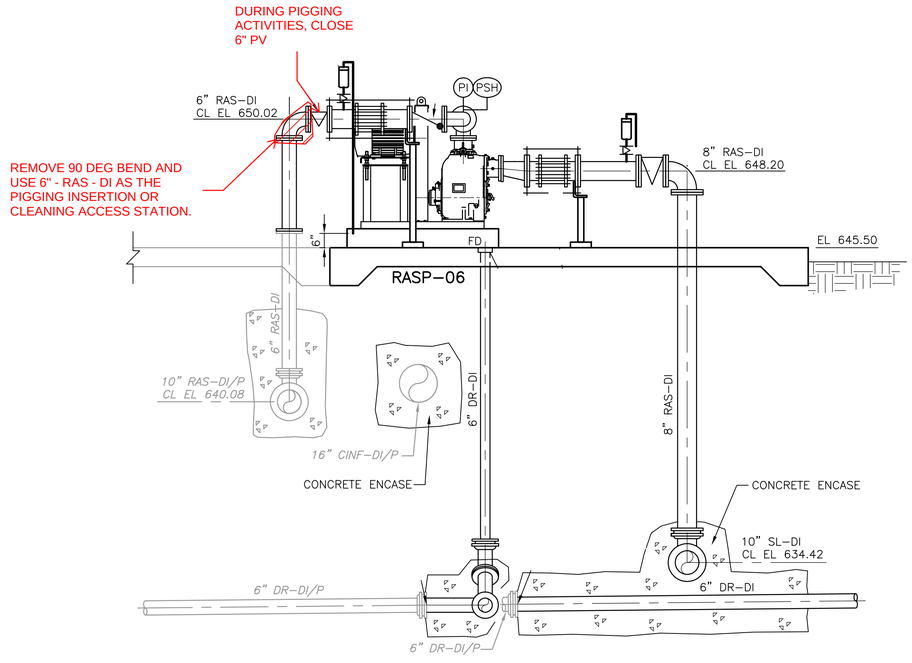
SECTION 3
3/8" = 1'-0"



NOTE:

1. INSTALL A FLUSHING / DRAIN CONNECTION ON EXISTING 10" - RAS - DI. UTILIZE DRAIN CONNECTION AND FLEX HOSING TO DRAIN 10" - RAS - DI TO NEARBY DRAIN MANHOLE PRIOR TO PIGGING EFFORTS. UPON COMPLETION OF PIGGING, RETAIN FLUSHING / DRAIN CONNECTION FOR FUTURE USE.

PIPE ROUTING UP AERATION BASIN WALL



SECTION 4
3/8" = 1'-0"

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CITY OF GEORGETOWN, TEXAS

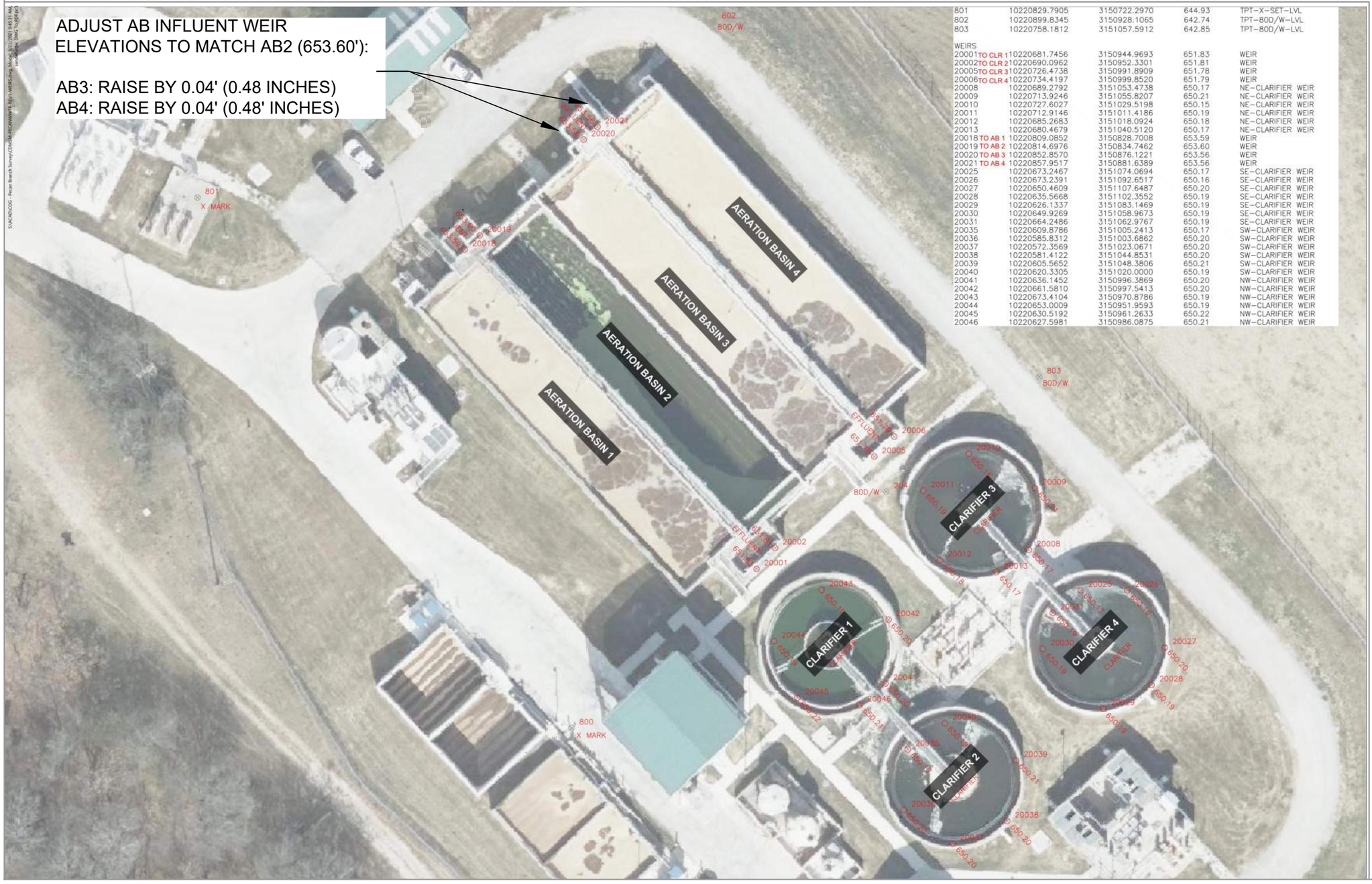
PECAN BRANCH
WASTEWATER TREATMENT PLANT

RAS PUMP STATION
TEMPORARY RAS PIPING PLAN

EXHIBIT
464315-4

ADJUST AB INFLUENT WEIR ELEVATIONS TO MATCH AB2 (653.60'):

AB3: RAISE BY 0.04' (0.48 INCHES)
AB4: RAISE BY 0.04' (0.48' INCHES)



801	10220829.7905	3150722.2970	644.93	TPT-X-SET-LVL
802	10220899.8345	3150928.1065	642.74	TPT-80D/W-LVL
803	10220758.1812	3151057.5912	642.85	TPT-80D/W-LVL
WEIRS				
20001 TO CLR 1	10220681.7456	3150944.9693	651.83	WEIR
20002 TO CLR 2	10220690.0962	3150952.3301	651.81	WEIR
20005 TO CLR 3	10220726.4738	3150991.8909	651.78	WEIR
20006 TO CLR 4	10220734.4197	3150999.8520	651.79	WEIR
20008	10220689.2792	3151053.4738	650.17	NE-CLARIFIER WEIR
20009	10220713.9246	3151055.8207	650.21	NE-CLARIFIER WEIR
20010	10220727.6027	3151029.5198	650.15	NE-CLARIFIER WEIR
20011	10220712.9146	3151011.4186	650.19	NE-CLARIFIER WEIR
20012	10220685.2683	3151018.0924	650.18	NE-CLARIFIER WEIR
20013	10220680.4679	3151040.5120	650.17	NE-CLARIFIER WEIR
20018 TO AB 1	10220809.0852	3150828.7008	653.59	WEIR
20019 TO AB 2	10220814.6976	3150834.7462	653.60	WEIR
20020 TO AB 3	10220852.8570	3150876.1221	653.56	WEIR
20021 TO AB 4	10220857.9517	3150881.6389	653.56	WEIR
20025	10220673.2467	3151074.0694	650.17	SE-CLARIFIER WEIR
20026	10220673.2391	3151092.6517	650.16	SE-CLARIFIER WEIR
20027	10220650.4609	3151107.6487	650.20	SE-CLARIFIER WEIR
20028	10220635.5668	3151102.3552	650.19	SE-CLARIFIER WEIR
20029	10220626.1337	3151083.1469	650.19	SE-CLARIFIER WEIR
20030	10220649.9269	3151058.9673	650.19	SE-CLARIFIER WEIR
20031	10220664.2486	3151062.9767	650.19	SE-CLARIFIER WEIR
20035	10220609.8786	3151005.2413	650.17	SW-CLARIFIER WEIR
20036	10220585.8312	3151003.6862	650.20	SW-CLARIFIER WEIR
20037	10220572.3569	3151023.0671	650.20	SW-CLARIFIER WEIR
20038	10220581.4122	3151044.8531	650.20	SW-CLARIFIER WEIR
20039	10220605.5652	3151048.3806	650.21	SW-CLARIFIER WEIR
20040	10220620.3305	3151020.0000	650.19	SW-CLARIFIER WEIR
20041	10220636.1452	3150996.3869	650.20	NW-CLARIFIER WEIR
20042	10220661.5810	3150997.5413	650.20	NW-CLARIFIER WEIR
20043	10220673.4104	3150970.8786	650.19	NW-CLARIFIER WEIR
20044	10220653.0009	3150951.9593	650.19	NW-CLARIFIER WEIR
20045	10220630.5192	3150961.2633	650.22	NW-CLARIFIER WEIR
20046	10220627.5981	3150986.0875	650.21	NW-CLARIFIER WEIR

NOTES:

1. PROVIDE BULKHEAD IN FRONT OF EACH WEIR SO THAT ONLY ONE AERATION BASIN IS TAKEN OUT OF SERVICE AT A TIME TO PERFORM LEVELING WORK.

PHOTOGRAPH OF AERATION BASIN INFLUENT WEIRS TYPICAL FOR AERATION BASINS 1/2 AND 3/4

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CITY OF GEORGETOWN
PECAN BRANCH
WASTEWATER TREATMENT PLANT

EXHIBIT 434315-5

INFLUENT SPLITTER BOX WEIR ELEVATION ADJUSTMENTS

DECEMBER 2023

DWG: C:\pw_pl1\fletcherjb\d2742323\EXHIBIT 1.dwg USER: FletcherJB
DATE: Sep 28, 2021 2:08pm XREFS:

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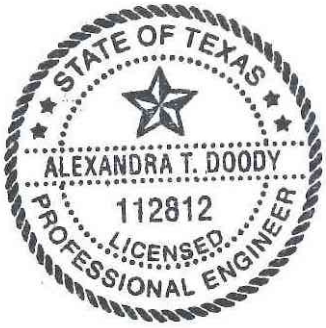
CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

CITY OF GEORGETOWN

DOVE SPRINGS WWTP REHABILITATION PROJECT

ADDENDUM NO. 3

Date Issued: January 5, 2024



Prepared by Alexandra T. Doody, PE 112812
CDM Smith Inc Texas Registration No. F-3043

Proposers on this project are hereby notified that this addendum shall be attached to and made a part of the above-named Contract Documents and Technical Specifications, dated November 2023.

The following items are issued to add to, modify, and clarify the Contract Documents and Technical Specifications and Drawings. These items shall have full force and effect as the Contract Documents and Technical Specifications, and cost involved shall be included in proposal prices. Proposals to be submitted on the specific proposal date shall conform to the additions and revisions listed herein.

Acknowledge receipt of this addendum by designating receipt of the addendum on the first page of the Proposal. Failure to do so may subject proposer to disqualification.

ADDITIONAL INFORMATION

1. Addendum No. 2 indicated that two revisions to the Proposal Form will be provided. A new Proposal Form is included herein, albeit with only one revision to incorporate an Additive Alternate Lump Sum line item for the Pecan Branch Maintenance.

2. This Addendum includes revised drawings to clarify piping to be procured and installed by the Contractor for the package plant by AUC Group. This work shall be priced under Proposal Item No. 2.

QUESTIONS AND ANSWERS:

Below are questions received and their associated responses:

1. **Question:** I do not see any Galvanized pipe specs such as the Sch 40, Sch 20 etc. All galvanized notes references back to supports and such. Please provide some guidance here.

Answer: *Refer to Section 400524 "Steel Process Pipe" for requirements of the galvanized pipe.*

2. **Question:** The change of the low [pressure] air pipe from stainless to galvanized effects the fabrication companies approved to be used, such as Felker. We have reached out to our normal galvanized pipe fabricator after the addendum 2 posted and this gives them very little time to review. I did not see anything noting approved fabricators, please clarify only experience of 3-5 years of fabricating is required. Please consider pushing the bid date a week or so to allow the fabricators time to put a package together for this project.

   Answer: *The galvanized pipe requirement, as clarified in Addendum No. 1, does not list approved fabricators. The only requirement of the fabricator must be that the company has a minimum five years' experience in a specialization of manufacturing products per Section 400524, Paragraph 1.7.A.*

3. **Question:** Section 431117, paragraph 1.3.E.1 the spec lists "pre-refurbishment compressor performance tests per PTC-13." Please confirm if this was meant to be "post-refurbishment" as the pre-refurbishment blower motors will not be sized accordingly for the higher flow requirement.

   Answer: *Yes, post-refurbishment testing is correct. Refer to REVISIONS TO TECHNICAL DOCUMENTS below.*

4. **Question:** Can Golden Harvest be added to the list of acceptable slide gate manufacturers in Section 400561?

   Answer: *No, Golden Harvest will not be added to the list of acceptable manufacturers as it is not confirmed they are an equal product to the named manufacturers, including for the requirement for a single piece guide frame per Section 400559.23 Paragraph 2.2.D.1.*

5. **Question:** Can Crispin be added to the list of acceptable gate valve manufacturers in Section 400559.23?

   Answer: *No, Crispin Valves will not be added to the list of acceptable manufacturers at this time. In the future, it is recommended to coordinate during design phase to ensure valves meet or exceed the specifications.*

6. **Question:** Section 431118 Paragraph 2.8 and notes on the Drawings indicate the discharge butterfly valves and check valves associated with the permanent blowers system are to be supplied by the blower manufacturer/supplier. Is the intent for the valves at the temporary blower system to be supplied by the Temporary Blower Package System supplier or the Contractor?

   Answer: *The 8" inlet butterfly valve and the 12" discharge valves associated with the temporary blowers at the Package Plant are to be provided by the General Contractor, as detailed in Section 400551-A Process Mechanical Valve Schedule. The Inlet Filter/Silencer will be provided by the blower supplier during refurbishment per Section 431117. See REVISIONS TO TECHNICAL DOCUMENTS below for clarification on the valve size.*

REVISIONS TO TECHNICAL DOCUMENTS

SECTION 00300 – PROPOSAL FORM

a) DELETE Specification 00300 "Proposal Form" in its entirety and REPLACE with the revised attached proposal form.

SECTION 400551A – TABLE VALVE SCHEDULE

a) Page 40055A-1, REVISE the Valve Size (Inches) for the following valves from 8" to 12"
   - BV-1325-1
   - BV-1325-2
   - BV-1325-3
   - CV-1330-1
   - CV-1330-2
   - CV-1330-3
   - BFV-1330-1
   - BFV-1330-2
   - BFV-1330-3

SECTION 431117 – MULTISTAGE CENTRIFUGAL BLOWER REFURBISHMENT

a) Page 431117-4, Paragraph 1.3.E.1, REVISE the sentence to read as "Post-refurbishment compressor performance tests per ASME testing method PTC-13."

REVISIONS TO DRAWINGS

G-2 – DRAWING INDEX

a) ADD Drawing Sheet DS-MB-4 to the Drawing Index.

DS-C-6 – YARD PIPING PLAN

a) Refer to REVISED Sheet DS-C-6 attached to this addendum for changes.

DS-MB-1 – RENTAL PACKAGE PLANT AERATION BLOWER PLAN

a) Refer to REVISED Sheet DS-MB-1 attached to this addendum for changes.

DS-MB-2 – RENTAL PACKAGE PLANT AERATION BLOWER SECTIONS

a) Refer to REVISED Sheet DS-MB-2 attached to this addendum for changes.

DS-MB-4 – RENTAL PACKAGE PLANT PLAN

a) Refer to NEW Sheet DS-MB-4 attached to this addendum for clarification and details on the Temporary Package Plant Pipe Layout including delineation of Package Plant Supplier-provided pipe versus Contractor-provided pipe.

END OF ADDENDUM NO. 3

EXHIBIT 00300 – PROPOSAL FORM

The Proposal Form is attached to this Exhibit 00300.

Proposers shall provide the estimated quantities for trench safety implementation based on their proposed construction means and methods.

A . ALLOWANCES

Owner's Contingency Allowance

Allowance to be used for additional facility improvements, landscaping, and/or miscellaneous modifications.

Electric Utility Allowance

Allowance to be used for paying fees and charges for permanent electrical service from Georgetown Utility Systems. Refer to Drawing E-3 (Electrical General Notes), Service and Metering notes.

Fence Relocation Allowance

Allowance for the fence relocation at Dove Springs WWTP, as needed.

B . ALTERNATES

Deductive Alternate D-1

Base bid shall be based on payment of 95 percent of the invoiced equipment value for equipment upon delivery as specified in the General Conditions of the Contract.

For this Deductive Alternate, Proposer shall indicate the credited price to the Owner for the following alternate payment terms for equipment (multistage blowers, ceramic diffusers, submersible pumps, and motor control centers) will be allowed based on the following terms:

- 5% of invoiced equipment value upon approval of shop drawings.
- 90% of invoiced equipment value upon delivery.

Additive Alternate A-1

For this Additive Alternate, Proposer shall indicate the additional price to the Owner to provide maintenance assistance at the Pecan Branch WWTP including provision of temporary piping, cleaning of a RAS forcemain, and leveling of weirs as specified in Section 464313 – PECAN BRANCH MAINTENANCE.

C. ALTERNATE PROPOSAL DEVIATIONS

Proposer must submit a Proposal that is in strict conformance with the Contract Documents as modified by Addenda. Provided this fully compliant Proposal is submitted, Proposer may submit up to three (3) Alternate Proposal Deviations that offer Work that is not in strict compliance with the Contract Documents. Describe the intent and substance of the changes in the Alternate Proposal Deviations in adequate detail so that the changes are clearly understood. Acceptance of Alternate Proposal Deviations is at the sole discretion of the Owner and will not be considered if the intent of the change is not clearly

understood or is deemed to be in the Owner's best interest.

Alternate Proposal Deviations are to be clearly marked as 00300-B Alternate Proposal Deviations and are to be submitted with the fully compliant base Proposal. Do not provide a duplicate of the base Proposal. Identify components that are different in the proposed Alternate Proposal Deviation.

Describe the intent and substance of the changes in the Alternate Proposal Deviation in adequate detail so the changes are clearly understood using Section 00300-B Alternate Proposal Deviations form. Details in the base Proposal will remain in effect unless specifically listed in the Alternate Proposal Deviation using Section 00300-B Alternate Proposal Deviations. All provisions not specifically modified by the Alternate Proposal Deviation are to remain in effect in the Alternate Proposal Deviation.

Each and every deviation from the terms, conditions, specifications, or performance requirements of these Contract Documents shall be listed using Section 00300-B Alternate Proposal Deviations upon submission of your Proposal. Proposer may submit up to three (3) deviations listed in Section 00300-B Alternate Proposal Deviation. The Alternate Proposal Deviation will consist of those deviations accepted by Owner. Owner reserves the right to reject proposed deviations.

Alternate Proposal Deviations must clearly show the difference in cost of the Alternate Proposal Deviation. Clearly note the cost impact of each submitted deviation.

SECTION 00300 PROPOSAL FORM

PROPOSER'S NAME_____

PROJECT IDENTIFICATION:

City of Georgetown
Project Name: Dove Springs WWTP Rehabilitation
Project Address: Rock Dove Ln. Georgetown, TX 78626

RFP NUMBER: 202407

THIS PROPOSAL IS SUBMITTED TO:

The City of Georgetown, Texas
Georgetown Municipal Court
Purchasing Department
510 W. 9th Street
Georgetown, Texas 78626

1.01 The undersigned Proposer proposes and agrees, if this Proposal is accepted, to enter into an Agreement with Owner in the form included in the Proposal Documents to perform all Work as specified or indicated in the Proposal Documents for the prices and within the times indicated in this Proposal and in accordance with the other terms and conditions of the Proposal Documents.

1.02 Proposer understands and agrees that the Owner has the right to reject any or all Proposals and to waive any minor technicalities.

2.01 Proposer accepts all of the terms and conditions of the Advertisement or Request for Proposal and Instructions to Proposers, including without limitation those dealing with the disposition of Proposal security. The Proposal will remain subject to acceptance for 90 days after the Proposal opening, or for such longer period of time that Proposer may agree to in writing upon request of Owner.

3.01 In submitting this Proposal, Proposer represents, as set forth in the Agreement, that:

A. Proposer has examined and carefully studied the Proposal Documents, the other related data identified in the Proposal Documents, and the following Addenda, receipt of all which is hereby acknowledged.

Addendum No.	Addendum Date
_____	_____
_____	_____
_____	_____
_____	_____

B. Proposer has visited the Site and become familiar with and is satisfied as to the general, local and Site conditions that may affect cost, progress, and performance of the Work.

C. Proposer is familiar with and is satisfied as to all federal, state and local laws and regulations that may affect cost, progress and performance of the Work.

D. Proposer has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in paragraph 4.02 of the General Conditions, and (2) reports and drawings of a Hazardous Environmental Condition, if any, which has been identified in the Supplementary Conditions as provided in paragraph 4.06 of the General Conditions.

E. Proposer has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Proposer, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Proposal Documents to be employed by Proposer, and safety precautions and programs incident thereto.

F. Proposer does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Proposal for performance of the Work at the price(s) proposed and within the times and in accordance with the other terms and conditions of the Proposal Documents.

G. Proposer is aware of the general nature of work to be performed by OWNER and others at the Site that relates to the Work as indicated in the Proposal Documents.

H. Proposer has correlated the information known to Proposer, information and observations obtained from visits to the Site, reports and drawings identified in the Proposal Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Proposal Documents.

I. Proposer has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that Proposer has discovered in the Proposal Documents, and the written resolution thereof by ENGINEER is acceptable to Proposer.

J. The Proposal Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Proposal is submitted.

4.01 Proposer further represents that this Proposal is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Proposer has not directly or indirectly induced or solicited any other Proposer to submit a false or sham Proposal; Proposer has not solicited or induced any individual or entity to refrain from proposing; and Proposer has not sought by collusion to obtain for itself any advantage over any other Proposer or over OWNER.

5.01 Proposer will complete the Work in accordance with the Contract Documents for the following price(s):

UNIT PRICE SCHEDULE FOR DOVE SPRINGS WWTP REHABILITATION					
ITEM NO.	**ESTIMATED QUANTITY**	**UNIT**	**ITEM DESCRIPTION & PRICE IN WORDS**	**UNIT PRICE IN FIGURES**	**TOTAL ESTIMATED PRICE**
1	1	LUMP SUM	Insurance, Bonds and Mobilization/Demobilization Related Expenses not to exceed 5% of Total Proposal.	$_____	$_____
2	1	LUMP SUM	Furnish all necessary labor, materials, equipment and incidentals necessary to construct the **Dove Springs WWTP Rehabilitation** improvements to the 2.5 million gallons per day Dove Springs Wastewater Treatment Plant including pipe connections to the Temporary Wastewater Treatment Package Plant, as more fully described in the Drawings and the Summary of Work contained in Section CIP3 and the delineation of Package Plant scope provided in Section 015353. This item shall include all work as specified and shown on the Drawings including all ancillary equipment, complete in place including incidental work obviously needed for the complete project, except those costs specifically included in the other items in this Schedule of Prices. Procurement of the Package Plant equipment has been provided by the City under a separate solicitation.	$_____	$_____
3	1	LUMP SUM	Furnish all necessary labor, materials, equipment, and incidentals necessary to **Refurbish and Relocate the existing three Multistage Blowers** for use at the Package Plant as more fully described in the Drawings, the Summary of Work in Section CIP3, and in Section 431117.	$_____	$_____
4	400	WET TONS	Furnish all necessary labor, materials, equipment and incidentals necessary to perform **Removal, Loading, Transport, and Disposal** of wastewater solids, grit, rags, and debris from the Aeration Basins Tanks and all other related work complete in place as detailed on the Drawings and as specified in Section 460200 “Tank and Structure Cleaning” except those costs specifically included in other items in this Schedule of Prices.	$_____	$_____

ALLOWANCES FOR BASE PROPOSAL:

UNIT PRICE SCHEDULE FOR DOVE SPRINGS WWTP REHABILITATION					
ITEM NO.	**ESTIMATED QUANTITY**	**UNIT**	**ITEM DESCRIPTION & PRICE IN WORDS**	**UNIT PRICE IN FIGURES**	**TOTAL ESTIMATED PRICE**
1	1	LUMP SUM	Owner's Contingency Allowance are considered provisional amounts to be used only if directed and are exclusive of work indicated in the Contract Documents for which payment is included in other items in the Schedule of Prices. Contractor's cost for bonds, insurance, overhead, profits, etc. associated with this allowance shall be included in the lump sum Proposal items above; no mark-up shall be allowed for these funds, the sum of one million dollars and no cents.	$ 1,000,000.00	$ 1,000,000.00
2	1	LUMP SUM	Allowance to be used for paying fees and charges for permanent electrical service from Georgetown Utility Systems. Refer to Drawing E-3 (Electrical General Notes), Service and Metering notes. The cost for the work to be performed shall be negotiated and Contractor shall be paid for the work out of this allowance, the sum of one hundred and seventy thousand dollars and no cents.	$ 170,000.00	$ 170,000.00
3	1	LUMP SUM	Allowance for additional relocation of fence around Dove Springs WWTP beyond the scope of work shown on the Contract Drawings, as needed for the sum of ten thousand dollars and no cents.	$ 10,000.00	$ 10,000.00

TOTAL OF ALL ESTIMATED PRICES - BASE PROPOSAL

*$*_____ (in Figures)

_____ (in Words)

ALTERNATE PROPOSAL:

UNIT PRICE SCHEDULE FOR DOVE SPRINGS WWTP REHABILITATION					
ITEM NO.	**ESTIMATED QUANTITY**	**UNIT**	**ITEM DESCRIPTION & PRICE IN WORDS**	**UNIT PRICE IN FIGURES**	**TOTAL ESTIMATED PRICE**
D-1	1	LUMP SUM	Deductive cost if Owner accepts alternative payment terms as detailed in this Proposal Form.	$ _____	$ _____
A-1	1	LUMP SUM	Additive cost if Owner accepts the price provided for assistance with maintenance items at the Pecan Branch WWTP as specified in Section 464313 – PECAN BRANCH MAINTENANCE.	$ _____	$ _____

Unit Prices have been computed in accordance with paragraph 11.03.B of the General Conditions.

Proposer acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Proposals, and final payment for all Unit Price Proposal items will be based on actual quantities provided, determined as provided in the Contract Documents.

6.01 Proposer agrees that the Work will be substantially complete within 640 calendar days after the day of the written Notice to Proceed and that the Work including all Package Plant lease will be fully complete and ready for final payment within 700 days after the date of the written Notice to Proceed.

6.02 Proposer accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the times specified above, which shall be stated in the Agreement.

7.01 The following documents are attached to and made a condition of this Proposal:

A. Required Proposal security in the form of _____;

B. Section 00400, Statement of Proposer's Experience, including Attachments A – I.

8.01 The terms used in this Proposal with initial capital letters have the meanings indicated in the Instructions to Proposers, the General Conditions, and the Supplementary Conditions.

SUBMITTED on _____, 20____.

PROPOSAL EQUIPMENT

Equipment Item or Material	Spec Section	Manufacturer/Supplier
Lift Station Submersible Pumps	432513	a. Wilo b. Hydromatic c. Myers
New Multistage Centrifugal Blowers (for Treatment Units)	431118	a. Lone Star Blower b. Continental c. Hoffman Lamson Gardner Denver
Multistage Centrifugal Blower Refurbishment and Relocation (for Package Plant)	431117	a. Lone Star Blower b. Continental c. Hoffman Lamson Gardner Denver
Ceramic Disc Fine Bubble Diffusers	465136	a. ITT-Sanitaire Xylem b. Aquarius Technologies c. EDI
Programmable Logic Controllers	406343	a. Allen-Bradley

ALTERNATE MANUFACTURERS/SUPPLIERS

Proposer proposes the following alternate manufacturers and suppliers for the equipment or material categories identified:

Equipment Item or Material	Drawing No.	Spec. Section	Alternative Manufacturer/Supplier (List One Only)	Deductible Amount (Indicate whether lump sum or unit price)
1.				
2.				
3.				
4.				
5.				

SCHEDULE OF SUBCONTRACTORS

Proposer proposes the following subcontractors to be used for the Project. All subcontractor specialties indicated below and any subcontractors that, due to the nature of the construction work, comprise a critical or essential element of the construction such that the amount of the subcontract is equal to or greater than 10% of the construction budget or $50,000, whichever is greater must be listed and submitted with the Proposal. Proposers shall provide the address and phone number for each subcontractor listed and three (3) references for similar size and type of project (Attachment D of Section 00400) with the Proposal in accordance with Section 00100. The references shall include name of project, and contact information, including name, phone number and address, for the Owner, Engineer and General Contractor for each project. Failure to provide this information by the specified date and time will disqualify the Proposal from consideration.

Proposer may change subcontractors after Proposal submittal only as approved in writing by the Engineer. The information provided will be used in the evaluation of the Proposer.

SUBCONTRACTOR	SPECIALTY
1.	Electrical
2.	Instrumentation
3.	
4.	
5.	

IF PROPOSER IS:

An Individual

Name (typed or printed): _____

By: _____(SEAL)

(Individual's signature)

Doing business as: _____

Business address: _____

Phone No.: _____ FAX No.: _____

A Partnership

Partnership Name: _____(SEAL)

By: _____

(Signature of general partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Business address: _____

Phone No.: _____ FAX No.: _____

A Corporation

Corporation Name: _____(SEAL)

State of Incorporation: _____

Type (General Business, Professional, Service, Limited Liability):_____

By: _____

(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(CORPORATE SEAL)

Attest _____

(Signature of Corporate Secretary)

Business address: _____

Phone No.: _____ FAX No.: _____

Date of Qualification to do business is _____.

A Joint Venture

Joint Venturer Name: _____(SEAL)

By: _____

(Signature of joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ FAX No.: _____

Joint Venturer Name: _____(SEAL)

By: _____

(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

Phone No.: _____ FAX No.: _____

Phone and FAX Number, and Address for receipt of official communications:

_____

_____

Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.

ALTERNATE PROPOSAL DEVIATIONS

Proposer:

_____

Proposer's Certification: *The Proposer is offering to complete the Work described in the Contract Documents with the deviations described in this request as an Alternate Proposal Deviation. The Proposer certifies that, with the exception of the deviations specifically described in this list of Alternate Proposal Deviations, the Proposal is based on completing Work in strict compliance with the Contract Documents and Owner can rely on this certification in consideration of awarding a contract for this Alternate Proposal Deviation.*

Certified by: _____ Date: _____

Deviation Number: _____Description: _____

Specification Section: _____ Page Number: _____Paragraph: _____

Drawing Number: _____Detail Description: _____

Describe Deviation and Benefits to Owner: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Proposed Change in Contract Price: ☐ Add ☐ Deduct $_____

Change in Contract Time: ☐ Add ☐ Deduct _____ Days

Deviation Number: _____ Description: _____

Specification Section: _____ Page Number: _____ Paragraph: _____

Drawing Number: _____ Detail Description: _____

Describe Deviation and Benefits to Owner: _____

_____

_____

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Proposed Change in Contract Price: ☐ Add ☐ Deduct $_____

Change in Contract Time: ☐ Add ☐ Deduct _____ Days

Deviation Number: _____ Description: _____

Specification Section: _____ Page Number: _____ Paragraph: _____

Drawing Number: _____ Detail Description: _____

Describe Deviation and Benefits to Owner: _____

_____

_____

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_____

_____

Proposed Change in Contract Price: ☐ Add ☐ Deduct $_____

Change in Contract Time: ☐ Add ☐ Deduct _____ Days

NOTES (CONTINUED)

9. MAGNETIC FLOW METER AND GATE VALVE TO BE SUPPORTED ON A CONCRETE PAD. BOTH SUPPORT AND CONCRETE PAD TO BE DELEGATED DESIGN. CONTRACTOR TO SUBMIT PLANS AND DESIGN FOR ENGINEER APPROVAL.PROVIDE 5'–0" OF STRAIGHT PIPE LENGTH UPSTREAM OF FLOW METER AND 3'–0" OF STRAIGHT PIPE LENGTH DOWNSTREAM OF FLOW METER.
10. PRIOR TO POURING CONCRETE FOR TREATMENT UNIT NO. 1 BLOWER SLAB,INSTALL 16" STEEL SPLIT CASING TO THE EXTENT SHOWN AROUND THE 8" DR.
11. EASEMENT OF 7.5–FT ON EITHER SIDE OF THE CITY OF GEORGETOWN ELECTRICAL 24.9 KV UNDERGROUND DISTRIBUTION LINE IS REQUIRED.CONTRACTOR TO ENSURE PROPER CLEARANCE OF ALL NEW PIPING.
12. 12" PACKAGE PLANT INFLUENT AND 4" SLUDGE TRANSFER TO EXIT GROUND AT THIS LOCATION. ROUTE VERTICAL PIPING SUCH THAT THE CENTERLINE ELEVATION OF THE 12" PACKAGE PLANT LINE IS AT 741.25 TO CONNECT DIRECTLY INTO THE PACKAGE PLANT SUPPLIER PROVIDED FLANGE. CONTRACTOR TO DESIGN THE PIPE SUPPORTS REQUIRED WHEN PIPES ARE AT CL EL 741.25 AND NOT ROUTED ON FINISHED GRADE. REFER TO SECTION 400507 FOR DELEGATED PIPE SUPPORT DESIGN REQUIREMENTS.

3. CONTRACTOR TO PROVIDE 18" – LPA – GS PIPING UP TO THE PACKAGE PLANT SUPPLIER PROVIDED FLANGE AS SHOWN ON SHEET DS–MB–4.

B / CZ–3 CONCRETE ENCASE 12"–INF–DI UNDER NEW ROAD

2 (1) 4" 90 DEG BEND IN VERTICAL 20–FT VERTICAL 4" SLUDGE TRANSFER PIPING UP TO ASHT NO.2 (2) 4" 90 DEG BEND IN HORIZONTAL

CITY OF GEORGETOWN ELECTRICAL 24.9 KV UNDERGROUND DISTRIBUTION LINE (SEE NOTE 11)

N

1" = 20'
10 0 20

(1) 12" 90 DEG BEND CL EL 741.25

(2) 12" 90 DEG BENDS IN VERTICAL SEE NOTE 12

(2) 4" 90 DEG BENDS IN VERTICAL SEE NOTE 12

4" – TEMPORARY PACKAGE PLANT SLUDGE EFFLUENT – YELO–MINE

(2) 12" 90 DEG BENDS IN VERTICAL SEE NOTE 3

(2) 4" 90 DEG BENDS IN VERTICAL SEE NOTE 3

GV–1101–1
FE–1102–1
SEE NOTE 9

12" 22.5 DEG BEND

SEE NOTE 1

TREATMENT UNIT NO. 2 BLOWER PAD

NEW 14" LPA–SS OVERHEAD PIPING TO TREATMENT UNIT NO. 2

EXISTING LPA– GS HEADER ON TOP OF TANK TO REMAIN. REFER TO DS–MC DRAWINGS FOR MECHANICAL MODIFICATIONS

MODIFIED HEADWORKS

OPERATIONS BUILDING AND LAB

STORAGE BUILDING

AERATED SLUDGE HOLDING TANK No 2

CLARIFIER No 2

AERATION BASIN No 2

BAR SCREEN

HEADWORKS

POSITIVE DISPLACEMENT BLOWERS

CLARIFIER No 1

AERATION BASIN No 1

CONC. SLAB

FH

P

FL ELEV=736.0

FL ELEV=735.40

CLARIFIER

AERATION BASINS

SLUDGE HOLDING TANK

4" PVC SDR26 PERFORATED PIPE WRAPPED IN GEOTEXTILE SOCK. 1/2" HOLES @ 2' ON CENTER. ALTERNATE SIDES.

14" – TEMPORARY PACKAGE PLANT EFLUENT – YELOMINE ON GRADE

FL ELEV=734.65

6" PVC SDR26 PIPE

FL ELEV=736.0

18" –LPA–GS BY CONTRACTOR SEE NOTE 13

VAULT

BLOWER PAD

GENERATOR PAD

CONCRETE ENCASE 4" – NPW UNDERNEATH ELECTRICAL HOUSE

GENERATOR

CONCRETE ENCASE 6" DI UNDERNEATH NEW PAVEMENT B / CZ–3 TYP

4" NPW LINE STUBOUT FOR FUTURE IRRIGATION USE

0.7%

FL ELEV=734.0

F / CZ–5 6" OUTFALL HEADWALL

14" – TEMPORARY PACKAGE PLANT EFFLUENT – YELO–MINE (SEE NOTE 6)

FILTRATE LIFT STATION

SEE NOTE 10

6" FM–DI

4'–6"

TREATMENT UNIT NO. 1 BLOWER PAD NEW 14" LPA–SS OVERHEAD PIPING TO TREATMENT UNIT NO. 1

PIPE SUPPORT (SEE NOTE 7) (TYP OF 3) B / MZ–3

8'–0"

10'–7"

15'–4"

2–INCH LPA BURIED PIPE TO UV DISINFECTION FACILITY TO BE ABANDONED IN PLACE. CAP 2–INCH PIPE.

INSTALL 14" TEE IN EXISTING 14" LPA PIPE

12" – TEMPORARY PACKAGE PLANT INFLUENT – YELO–MINE (AT GRADE)

(1) 12" 45 DEG BEND

(3)12" 22.5 DEG BEND

NPW PUMP HOUSE

2 (2) 14" 90 DEG BENDS 10–FT VERTICAL 14" EFFLUENT PIPING UP THE UV WALL

UV SYSTEM

ULTRAVIOLET DISINFECTION FACILITY AND CASCADE

SODIUM BISULFITE LIQUID FEED BUILDING (ABANDONED)

CHLORINATION BASIN

FUTURE FILTERS

2 (1) 90 DEG BEND DOWN INTO UV DISINFECTION CHANNEL

OUTFALL 001

NOTES

1. EXISTING 14" LPA LINE TO TREATMENT UNIT 1 AND TREATMENT UNIT 2 ARE TO BE ABANDONED IN PLACE. CAP 14–INCH PIPE AFTER BLOWERS ARE INSTALLED AND COMMISSIONED. SEE DS–DD–1 FOR DETAILS.
2. ALL NEW PIPING IS ABOVE GROUND PIPING UNLESS STATED OTHERWISE. PIPE SUPPORTS SHALL NOT BE LOCATED OVER BURIED PIPE.
3. CONTRACTOR TO ROUTE 12" – TEMPORARY PACKAGE PLANT INFLUENT AND 4" SLUDGE TRANSFER ABOVE GRADE UNTIL THIS LOCATION, AT WHICH THE LINES WILL BE BURIED WITH AT LEAST 3.5–FT OF COVER TO CROSS UNDER THE ROAD. CONTRACTOR TO POT HOLE EXISTING AREA TO VERIFY LOCATIONS OF ALL ELECTRICAL UTILITIES, 12" – SD – PVC, AND 4" – NPW–PVC PRIOR TO CONSTRUCTION OF THE TEMPORARY PACKAGE PLANT LINES BEING INSTALLED UNDER THE ROAD. ENSURE CLEARANCE FROM ALL PROCESS AND ELECTRICAL LINES.
4. CONTRACTOR TO SUPPLY (2) SOLIDS HANDLING SUBMERSIBLE PUMPS (ONE DUTY, ONE SHELF SPARE) FOR SLUDGE TRANSFER FROM THE TEMPORARY SLUDGE HOLDING TANK TO AERATED SLUDGE HOLDING TANK NO. 2. CONTRACTOR TO ROUTE PIPING TO TOP OF TANK TO ALLOW FOR FREE DISCHARGE INTO ASHT NO. 2. PUMPS TO BE MANUFACTURED BY LIBERTY PUMPS, MODEL XLE100 OR EQUAL WITH HARD PIPING IN BASIN AND SUPPORTED PER MANUFACTURER RECOMMENDATIONS. CONTRACTOR TO PROVIDE 3" X 4" INCREASER FOR CONNECTION FROM PUMP TO DISCHARGE PIPING. CONTRACTOR TO CONFIRM TOTAL DYNAMIC HEAD WHEN ROUTING IS VERIFIED. SEE DS–G–2 FOR PUMP DESIGN CRITERIA.
5. PIPE ROUTING TO AND FROM THE TEMPORARY PACKAGE PLANT IS SHOWN FOR BIDDING PURPOSES. CONTRACTOR MAY SUBMIT ALTERNATIVE MEANS OF ROUTING TEMPORARY PACKAGE PLANT PIPING. ALL PIPING SHALL BE ROUTED ON GRADE UNLESS FOR ROAD ACCESS. PIPE UNDER ROAD SHALL FOLLOW DETAIL E ON CZ–1. PIPE SUPPORTS FOR ALL PIPING TO AND FROM THE TEMPORARY PACKAGE PLANT SHALL BE OF DELEGATED DESIGN BY CONTRACTOR AND SUBMITTED TO ENGINEER FOR APPROVAL.
6. TREATMENT PACKAGE PLANT 14" – EFFLUENT TO BE ROUTED ON GRADE TO UPSTREAM OF EXISTING UV DISINFECTION BASIN. EFFLUENT PIPING TO BE ROUTED UP THE UV DISINFECTION STRUCTURE AND SUPPORTED ON TOP OF THE WALL TO DISCHARGE FREELY INTO CHANNEL. CONTRACTOR IS RESPONSIBLE FOR DELEGATED DESIGN OF THE TEMPORARY EFFLUENT PIPE SUPPORT DESIGN.
7. IN FIELD PIPE SUPPORTS TO BE LOCATED AT THE DISTANCES AS SHOWN HEREIN. REFER TO SHEET DS–SD–1 FOR DETAILS ON CONCRETE PADS FOR PIPE SUPPORTS.
8. TEMPORARY PACKAGE PLANT PIPING TO BE CERTA–LOK YELOMINE RESTRAINED JOINT PVC PRESSURE PIPING SUPPLIED BY WEST LAKE PIPE OR ENGINEER APPROVED EQUAL. ALTERNATIVE PIPE MATERIAL MUST BE APPROVED BY ENGINEER TO ENSURE APPROPRIATE INNER PIPE DIAMETER AND UV RESISTANCE. TEMPORARY PACKAGE PLANT 14" EFFLUENT PIPING IS A NON–STANDARD DIAMETER, HOWEVER IT IS REQUIRED FOR THE HYDRAULIC PROFILE. CONTRACTOR TO COORDINATE WITH MANUFACTURER ON PURCHASING AND SUPPLY.

PLAN
1" = 20'

REV. NO.	DATE	DRWN	CHKD	REMARKS
3	1/2/24	JAM	ATD	REVISED FOR ADDENDUM NO.3
2	12/19/23	JAM	ATD	REVISED FOR ADDENDUM NO.2
1	12/18/23	JAM	ATD	REVISED FOR ADDENDUM NO.1

DESIGNED BY: J. MAYER
DRAWN BY: S. MALPASS
SHEET CHK'D BY: A. DOODY
CROSS CHK'D BY: A. WOELKE
APPROVED BY: A. DOODY
DATE: DECEMBER 2023

CDM Smith
8310–1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
Tel: (512) 346–1100
TBPE Firm Registration No. F–3043

CITY OF GEORGETOWN, TEXAS

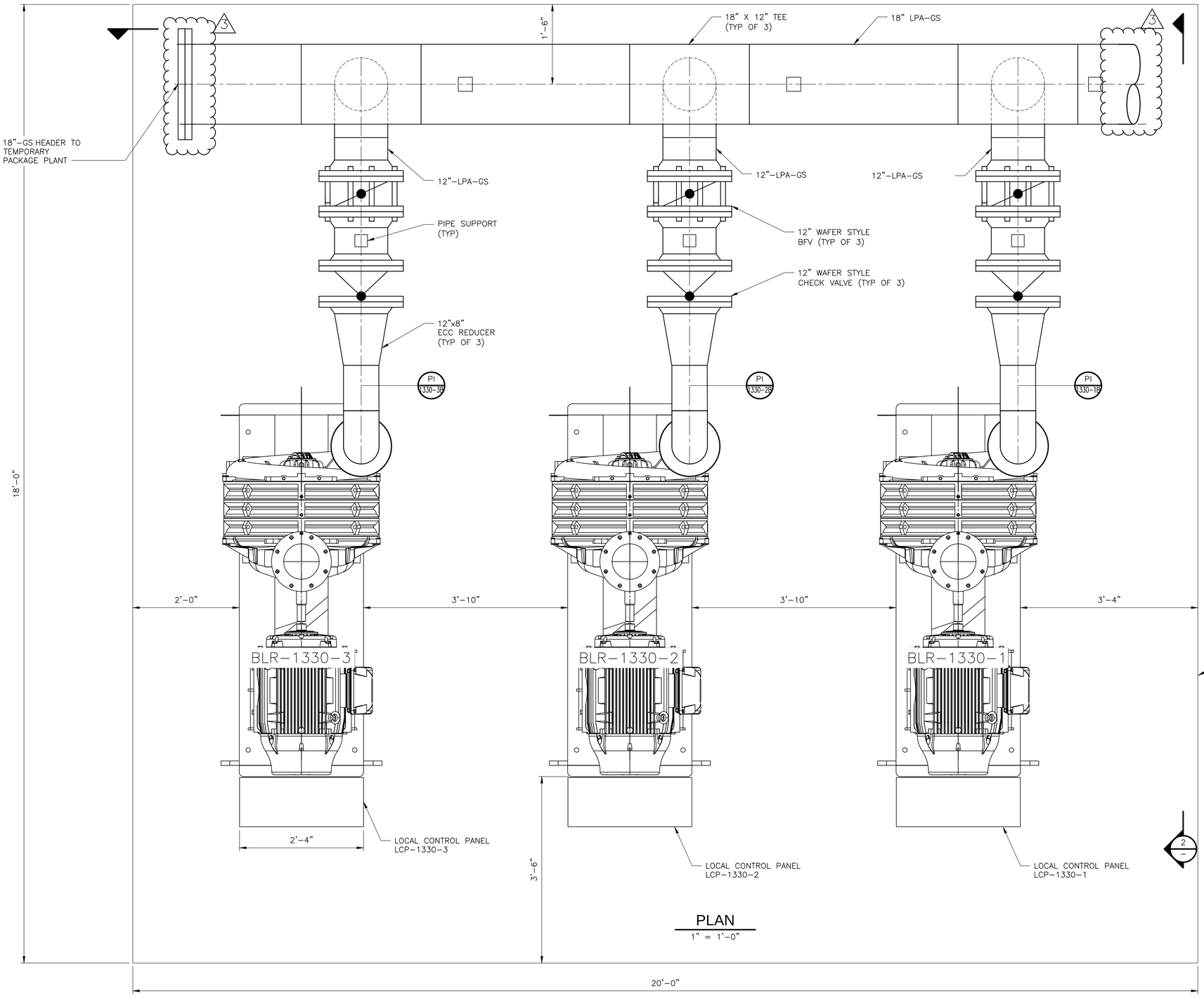
DOVE SPRINGS WWTP REHABILITATION

DOVE SPRINGS WWTP YARD PIPING PLAN

PROJECT NO. 2048–264953
FILE NAME: C106YPPL.DWG

SHEET NO.
DS–C–6

Alexandra T. Doody
STATE OF TEXAS
ALEXANDRA T. DOODY
112812
LICENSED
PROFESSIONAL ENGINEER
1/4/2023



PLAN

1" = 1'-0"

NOTES:

1. RENTAL BLOWERS AND SKID SUPPORTED LOCAL CONTROL PANEL WILL BE FURNISHED AND SUPPLIED BY OTHERS UNDER A SEPARATE CITY SOLICIATION. GENERAL CONTRACTOR IS RESPONSBILE FOR PROCURING THE MISCELLANEOUS EQUIPMENT, BLOWER CONCRETE PAD, AND THE DELEGATED DESIGN OF PIPE SUPPORTS FOR THE BLOWER DISCHARGE AND BLOWER HEADER PIPING. PIPE SUPPORTS SHOWN ON THE DRAWINGS ARE NOT DESIGNED SPECIFIC TO THE APPLICATION. REFER TO SECTION 400507 FOR REQUIREMENTS.
2. COORDINATE WITH OWNER AND ENGINEER ON THE RELOCATION OF THE EXISTING BLOWERS FROM THE DOVE SPRINGS BLOWER ROOM TO THE TEMPORARY PACKAGE PLANT BLOWER PAD, PER DETAILS IN SECTION 431117.

Alexandra T. Doody

STATE OF TEXAS
ALEXANDRA T. DOODY
112812
LICENSED
PROFESSIONAL ENGINEER

1/4/2023

REV. NO.	DATE	DRWN	CHKD	REMARKS
3	1/4/24	JAM	ATD	REVISED FOR ADDENDUM NO.3
1	12/8/23	JAM	ATD	REVISED FOR ADDENDUM NO.1

DESIGNED BY: J. MAYER
DRAWN BY: V. CHERANJEEVI
SHEET CHK'D BY: A. DOODY
CROSS CHK'D BY: R. GUJJA
APPROVED BY: A. DOODY
DATE: NOVEMBER 2023

CDM Smith
8310-1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

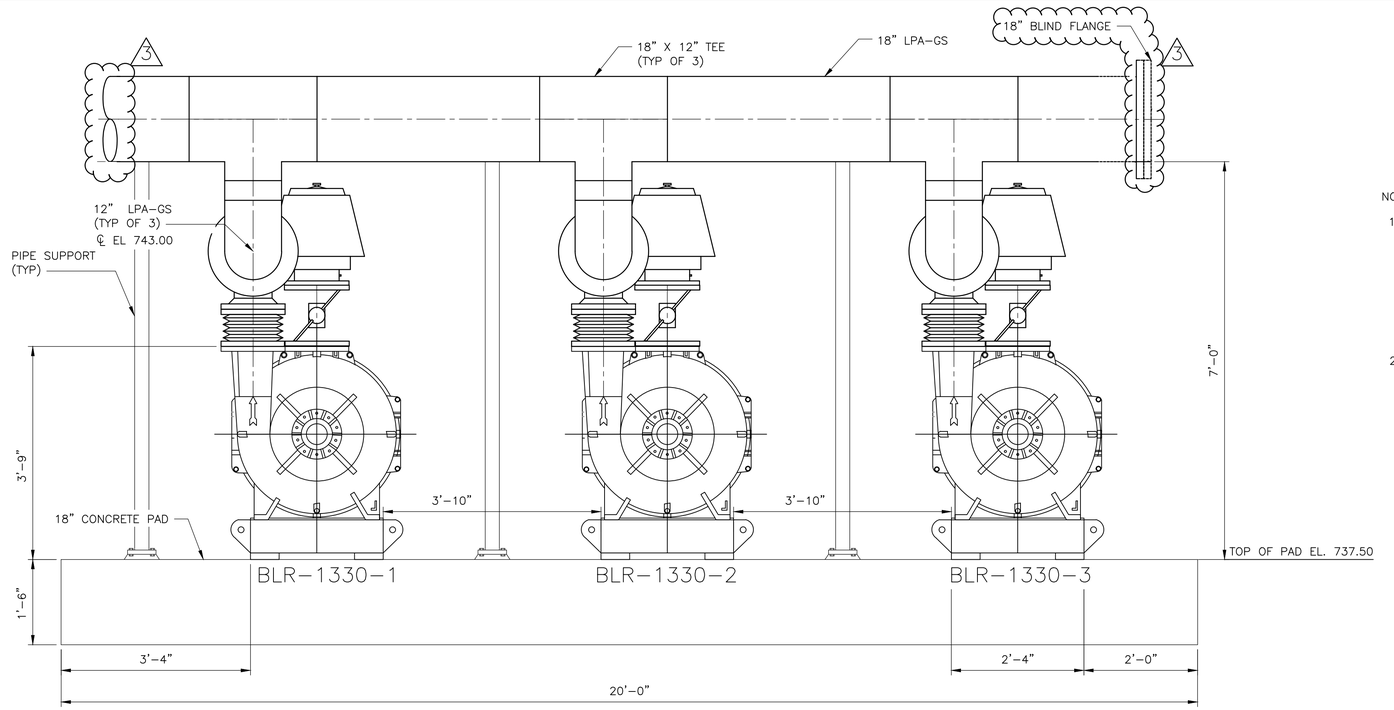
CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

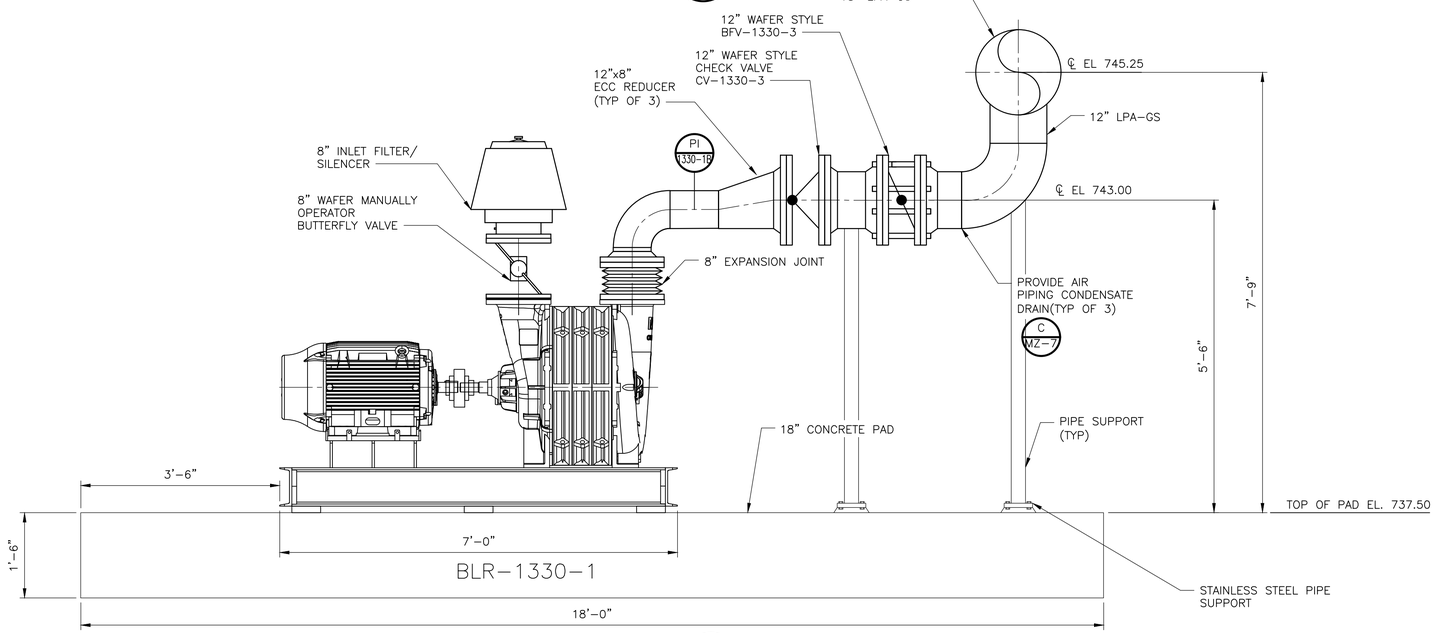
DOVE SPRINGS WWTP
RENTAL PACKAGE PLANT
AERATION BLOWER PLAN

PROJECT NO. 2048-264953
FILE NAME: DSMB4.DWG

SHEET NO.
DS-MB-1



SECTION 1
3/4" = 1'-0"



SECTION 2
3/4" = 1'-0"

NOTES:

1. RENTAL BLOWERS AND SKID SUPPORTED LOCAL CONTROL PANEL WILL BE FURNISHED AND SUPPLIED BY OTHERS UNDER A SEPARATE CITY SOLICIATION. GENERAL CONTRACTOR IS RESPONSBILE FOR PROCURING THE MISCELLANEOUS EQUIPMENT, BLOWER CONCRETE PAD, AND THE DELEGATED DESIGN OF PIPE SUPPORTS FOR THE BLOWER DISCHARGE AND BLOWER HEADER PIPING. PIPE SUPPORTS SHOWN ON THE DRAWINGS ARE NOT DESIGNED SPECIFIC TO THE APPLICATION. REFER TO SECTION 400507 FOR REQUIREMENTS.
2. COORDINATE WITH OWNER AND ENGINEER ON THE RELOCATION OF THE EXISING BLOWERS FROM THE DOVE SPRINGS BLOWER ROOM TO THE TEMPORARY PACKAGE PLANT BLOWER PAD, PER DETAILS IN SECTION 431117.

Alexandra T. Doody
STATE OF TEXAS
ALEXANDRA T. DOODY
112812
LICENSED
PROFESSIONAL ENGINEER
1/4/2023

REV. NO.	DATE	DRWN	CHKD	REMARKS
3	1/4/24	JAM	ATD	REVISED FOR ADDENDUM NO.3
1	12/8/23	JAM	ATD	REVISED FOR ADDENDUM NO.1

DESIGNED BY: J. MAYER
DRAWN BY: V. CHERANJEEVI
SHEET CHK'D BY: A. DOODY
CROSS CHK'D BY: R. GUJJA
APPROVED BY: A. DOODY
DATE: NOVEMBER 2023

CDM Smith
8310-1 N. Capital of Texas Hwy, Suite 250
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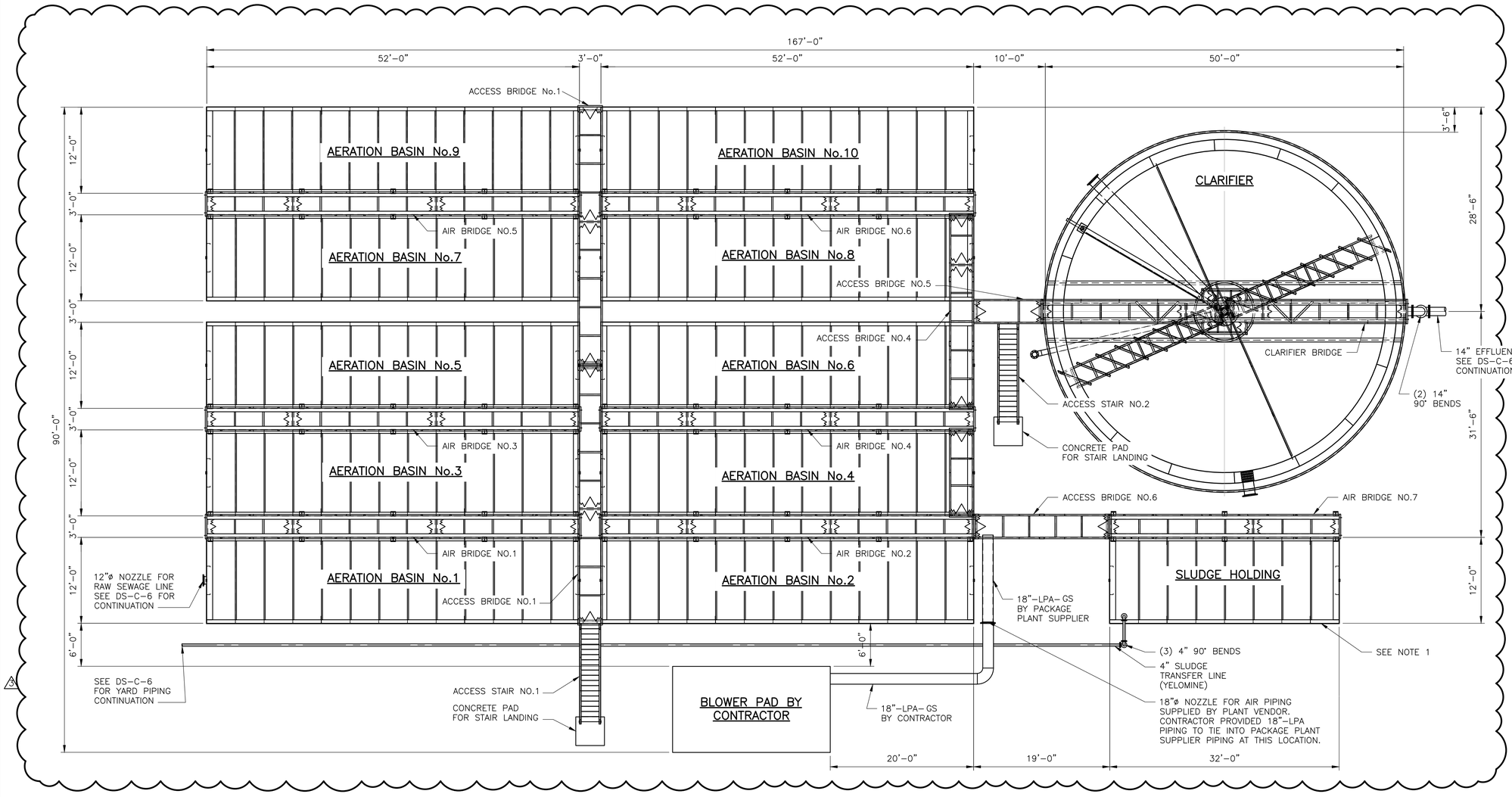
CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

DOVE SPRINGS WWTP
RENTAL PACKAGE PLANT
AERATION BLOWER SECTIONS

PROJECT NO. 2048-264953
FILE NAME: DSMB5.DWG

SHEET NO.
DS-MB-2



NOTES:

1. SLUDGE TRANSFER PUMPS AND SLUDGE HOLDING TANK FLOAT SWITCH LEVELS TO BE PROVIDED BY GENERAL CONTRACTOR. FLOAT SWITCH LEVELS ARE AS FOLLOWS:
   LSHH = 747.67
   LSH = 746.00
   LSL = 741.00
   LSLL = 740.00
2. UNLESS NOTED OTHERWISE HEREIN, ALL WORK SHOWN IS BY THE PACKAGE PLANT SUPPLIER UNDER SEPARATE CITY CONTRACT. REFER TO SECTION 015353 FOR SCOPE OF WORK DELINEATION TABLE.
3. PIPE SUPPORTS FOR THE TEMPORARY PACKAGE PLANT PROCESS PIPING BY THE GENERAL CONTRACTOR ARE REQUIRED TO BE DELEGATED DESIGN, SUBMITTED TO THE ENGINEER FOR APPROVAL. PIPE SUPPORTS SHOWN ON THE DRAWINGS ARE NOT DESIGNED SPECIFIC TO THE APPLICATION.

PLAN
1/8" = 1'-0"

Alexandra T. Doody
STATE OF TEXAS
ALEXANDRA T. DOODY
112812
LICENSED PROFESSIONAL ENGINEER
1/4/2023

REV. NO.	DATE	DRWN	CHKD	REMARKS
3	1/4/24	KBR	ATD	REVISED PER ADDENDUM NO.3

DESIGNED BY: J. MAYER
DRAWN BY: G. GANESH
SHEET CHK'D BY: A. DOODY
CROSS CHK'D BY: R. GUJJA
APPROVED BY: A. DOODY
DATE: DECEMBER 2023

CDM Smith
8310-1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

DOVE SPRINGS WWTP
RENTAL PACKAGE PLANT PLAN

PROJECT NO. 2048-264953
FILE NAME: DSMB4-NEW.DWG
SHEET NO.
DS-MB-4

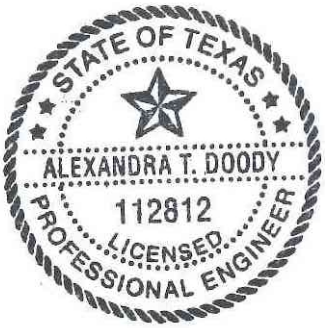
CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

CITY OF GEORGETOWN

DOVE SPRINGS WWTP REHABILITATION PROJECT

ADDENDUM NO. 4

Date Issued: January 10, 2024



Prepared by Alexandra T. Doody, PE 112812
CDM Smith Inc Texas Registration No. F-3043

Proposers on this project are hereby notified that this addendum shall be attached to and made a part of the above-named Contract Documents and Technical Specifications, dated November 2023.

The following items are issued to add to, modify, and clarify the Contract Documents and Technical Specifications and Drawings. These items shall have full force and effect as the Contract Documents and Technical Specifications, and cost involved shall be included in proposal prices. Proposals to be submitted on the specific proposal date shall conform to the additions and revisions listed herein.

Acknowledge receipt of this addendum by designating receipt of the addendum on the first page of the Proposal. Failure to do so may subject proposer to disqualification.

ADDITIONAL INFORMATION

1. All Proposals are now due on or before 2:00 PM CDT on Tuesday January 16, 2024. The public opening will be held virtually through Microsoft Teams. This is accessible using the link and call in information provided below:

   Click here to join the meeting
   Meeting ID: 236 225 608 299
   Passcode: Uzjvdd
   Download Teams | Join on the web
   Or call in (audio only)
   +1 512-672-8405,,208549091# United States, Austin
   Phone Conference ID: 208 549 091#
   Find a local number | Reset PIN

2. This Addendum includes revised electrical drawings to clarify power requirements by the Contractor for the package plant provided by AUC Group. This work shall be priced under Proposal Item No. 2.

QUESTIONS AND ANSWERS

a. Question: Can the Liberty Pump, Model Number 3XLM07-Series 7.5 hp Monovane pump by approved for application at the Filtrate Lift Station?

Answer: Yes. The Liberty 3XLM07 Series 7.5 HP pump is an engineer approved equal that may be considered for use at the Filtrate Lift Station.

REVISIONS TO TECHNICAL DOCUMENTS

SECTION 00100 – REQUEST FOR PROPOSAL SERVICES

a) Cover Page, UPDATE to read as "Due: January 16, 2024, 2:00 PM CT"

b) Page 4, Notice to Proposers, Paragraph A "Notice", REVISE the due date for the RFP Receipt in the first sentence to read as "All Proposals are due on or before 2:00 PM CST on January 16, 2024.".

c) Page 4, Notice to Proposers, Paragraph D "Anticipated Schedule of Important Dates", REVISE the due date for the Proposals Closing Date and Time to read as January 16, 2024.

SECTION 00410 – PROPOSAL BOND

a) Page 00410-1, REVISE the RFP DUE DATE to "2:00 PM CST, January 16, 2024".

SECTION 407000 – INSTRUMENTATION FOR PROCESS SYSTEMS

a) Section 407000 Appendix A, Page 1, REVISE the Set Point for Tag Name LSL-1001 from 729.93 to read as 730.50.

b) Section 407000 Appendix A, Page 1, REVISE the Set Point for Tag Name LSLL-1001 from 729.43 to read as 730.20.

REVISIONS TO DRAWINGS

G-2 – DRAWING INDEX

a) ADD Drawings DS-EB-2, DS-EB-2A, DS-EB-3, and DS-EB-4 to the Drawing Index.
b) DELETE Drawing DS-EY-5 from the Drawing Index.

DS-G-3 – AREA CLASSIFCATION

a) ADD hatching on the Wastewater Treatment Package Plant Plan to depict Class 1 Division 2, per the area classification legend and the table.

DS-MA-1 – FILTRATE LIFT STATION PLAN AND SECTION

a) Section View, REVISE the PUMP OFF LEVEL to read as EL 730.50 and the LOW LEVEL ALARM to read as EL 730.20.

E-4 – ELECTRICAL LIGHTING FIXTURE SCHEDULE

a) Replace with the attached re-issued drawing.

DS-E-1 – DOVE SPRINGS WWTP OVERALL SITE ELECTRICAL NEW WORK PLAN

a) Replace with the attached re-issued drawing.

DS-E-6 – MOTOR CONTROL CENTER MCC-3 ONE-LINE DIAGRAM

a) Replace with the attached re-issued drawing.

DS-E-6A – MOTOR CONTROL CENTER MCC-3 ONE-LINE DIAGRAM (BLOWER RELOCATION)

a) Replace with the attached re-issued drawing.

DS-E-7 – PANELBOARD SCHEDULES

a) Replace with the attached re-issued drawing.

DS-E-8 – PANELBOARD SCHEDULES

a) Replace with the attached re-issued drawing.

DS-E-11 – ELECTRICAL DUCTBANK SCHEDULE III

a) Replace with the attached re-issued drawing.

DS-EB-X DRAWINGS

a) Add new Drawing DS-EB-2 DOVE SPRINGS WWTP RENTAL PACKAGE PLANT BLOWERS – POWER AND CONTROL PLANS. This drawing is for the rental blowers.

b) Add new Drawing DS-EB-2A DOVE SPRINGS WWTP RENTAL PACKAGE PLANT BLOWERS – MODIFIED POWER AND CONTROL PLANS. This drawing is for the refurbished and relocated blowers.

c) Add new Drawing DS-EB-3 DOVE SPRINGS WWTP RENTAL PACKAGE PLANT CLARIFIER – POWER AND CONTROL PLANS

d) Add new Drawing DS-EB-4 DOVE SPRINGS WWTP RENTAL PACKAGE PLANT SLUDGE PUMP – POWER AND CONTROL PLANS

e) Add new Drawing DS-EB-5 – DOVE SPRINGS WWTP PACKAGE PLANT LIGHTING PLAN

DS – EY-5 – ELECTRICAL CONTROL SCHEMATICS V

a) DELETE sheet details in its entirety.

DS-IB-1 – PACKAGE PLANT P&ID

a) ADD the following as Note 4 “SOLENOID VALVE AND ASSOCIATED PANEL FOR THE TEMPORARY PACKAGE PLANT WAS AIRLIFT TO BE PROVIDED BY THE PACKAGE PLANT SUPPLIER. CONTRACTOR TO PROVIDE ASSOCIATED WIRING AND INSTALLATION OF PANEL AND VALVE.”

END OF ADDENDUM NO. 4

LIGHTING FIXTURE SCHEDULE

TYPE	LAMPS	MOUNTING	DESCRIPTION	VOLTAGE	MINIMUM LUMEN OUTPUT	MAXIMUM WATTAGE	MANUFACTURER
AL1	LED	PENDANT	4 FOOT LINEAR LED STRIP FIXTURE WITH UL LISTED FOR DAMP LOCATION, 4000K, 80 CRI	120V	6996	46	EATON METALUX 4ILED-LD5-7-W-UNV-L840-CD1 OR EQUAL
AL1E	LED	PENDANT	4 FOOT LINEAR LED STRIP FIXTURE WITH UL LISTED FOR DAMP LOCATION, 4000K, 80 CRI AND EMERGENCY BATTERY PACK	120V	6996	46	EATON METALUX 4ILED-LD5-7-W-UNV-L840-EL7W-CD1 OR EQUAL
AL2	LED	PENDANT	4 FOOT LONG ENCLOSED AND GASKETED LINEAR LED WIDE DISTRIBUTION ACRYLC, DEEP FROSTED LENS UL LISTED FOR WET LOCATION, 4000K, 80CRI	120V	6000	37.8	LITHONIA FEM-L48-6000LM-AMAFD-WD-MVOLT-GZ10-40K-80CRI1-STSL OR EQUAL
CL1	LED	PENDANT	INDUSTRIAL HIGH BAY LIGHTING, SEALED DIE CAST HOUSING, 80 CRI, 4000K, L80 HOURS = 170,000 @ 25 DEGREES CELSIUS, WET LOCATION LISTED, RATED FOR CORROSIVE ENVIRONMENT, AND INTEGRATED OCCUPANCY AND DAYLIGHT SENSOR.	120V	16326	74	EATON METALUX BMK-15-MCL-UNV-L840-CD1-SVPD3-U OR EQUAL
CL2	LED	STANCHION	STANCHION MOUNTED NEMA 4X SUITABLE FOR WET LOCATIONS AND HOSE DOWN ENVIRONMENTS, TYPE I OPTIC DISTRIBUTION, 5000K, DIFFUSED LENS WITH PHOTOCELL OPTION	120V	3250	28	EATON PWML-3-P-R1-UNV1 OR EQUAL
-		STANCHION MOUNT POLE	TELESCOPIC ADJUSTABLE RAISED HEIGHT LIGHT POLE FOR TYPE CL2 FIXTURE SUITABLE FOR HAND RAIL MOUNTING WITH STAINLESS STEEL TUBULAR RAIL HANDRAIL MOUNTING KIT, NEMA 4 RATED, HARDWARE: 316 STAINLESS STEEL, XYLAN 1400 COATED FOR CORROSION PROTECTION				CROUSE HINDS V65H(MHK-RTS)-A OR EQUAL
WLE1	LED	WALL	LED ARCHITECTURAL WALL SCONCE, DIE CAST ALUMINUM BACK PLATE, TYPE 3 DISTRIBUTION, BRONZE FINISH WITH INTEGRAL PHOTOCELL AND OCCUPANCY SENORS, WET LOCATION UL LISTED, WITH BATTERY BACK UP. (PROVIDE ONE SCP REMOTE CONTROL)	120V	1556	15	HUBELL LIGHTING LNC2-9L-4K-3-U-DBT-PCU-E OR EQUAL
E1	LED	UNIVERSAL	EXIT SIGN SINGLE FACE SELF POWERED WITH RED LETTERS, WHITE FINISH, MAINTENANCE FREE SEALED NICKEL-CADMIUM BATTERY WITH 90 MINUTES OF EMERGENCY POWER, SELF DIAGNOSTICS	120V		1.3	LITHONIA LE S 1 R EL N SD OR EQUAL

LIGHTING FIXTURE
SCHEDULE
NTS

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	01/09/24	SS	JCS	REVISED PER ADDENDUM NO. 4

DESIGNED BY: V. MANJU
DRAWN BY: V. MANJU
SHEET CHK'D BY: M. CZACH
CROSS CHK'D BY: G. PRABHU
APPROVED BY: J. SAENZ
DATE: DECEMBER 2023

CDM Smith
8310-1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

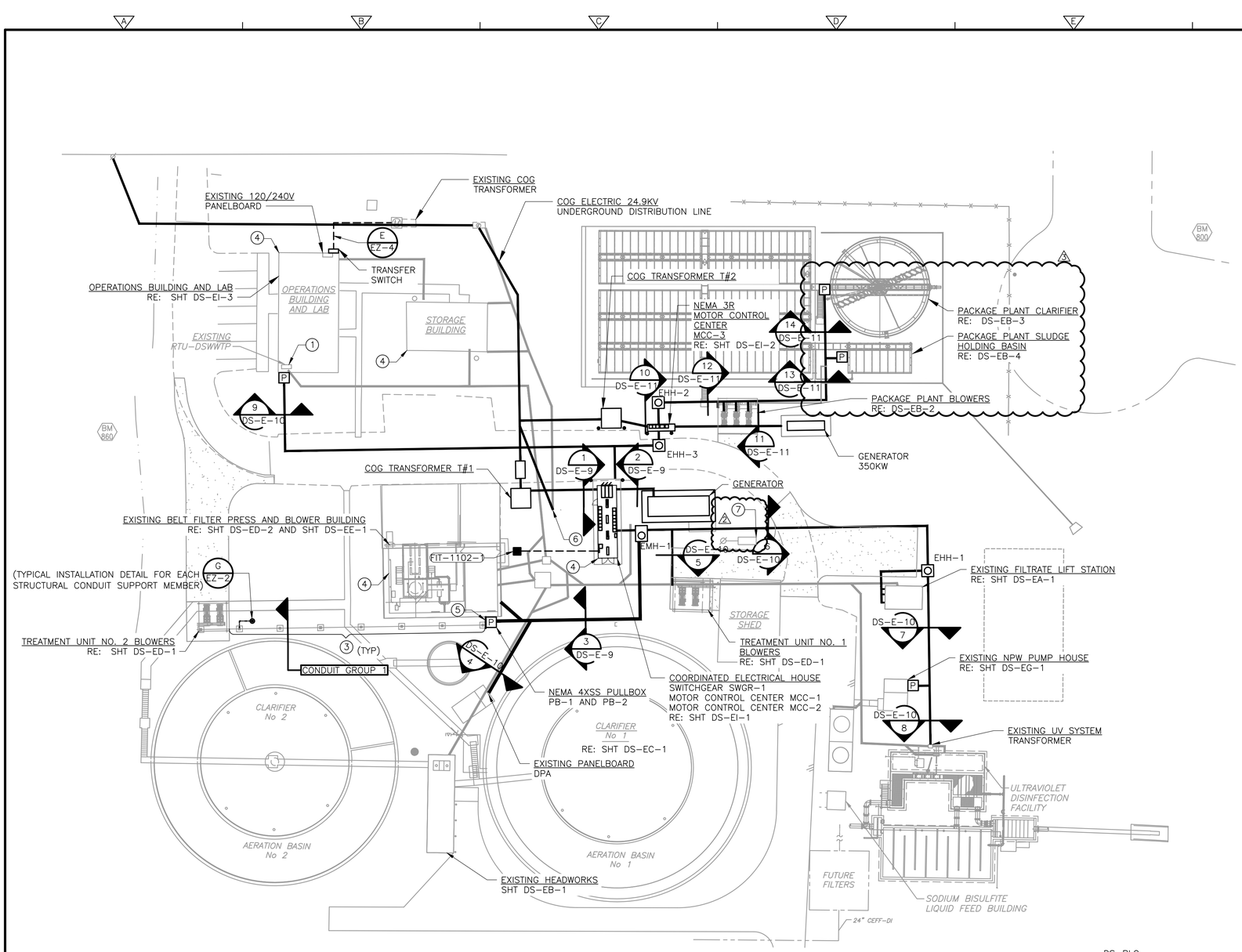
DOVE SPRINGS WWTP
REHABILITATION

ELECTRICAL
LIGHTING FIXTURE SCHEDULE

Juan Carlos Saenz
STATE OF TEXAS
JUAN CARLOS SAENZ
138331
LICENSED
PROFESSIONAL ENGINEER
01/09/2024

PROJECT NO. 2048-264953
FILE NAME: E004LFSC.DWG

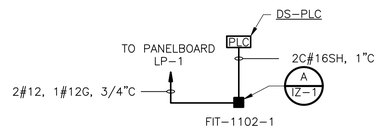
SHEET NO.
E-4



DOVE SPRINGS ELECTRICAL SITE PLAN

1" = 30'

15 0 30



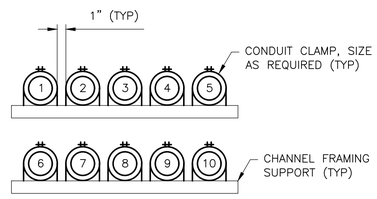
FIT-1102-1 WIRING DIAGRAM 1 –

GENERAL ELECTRICAL NOTES:

1. ELECTRICAL DRAWINGS ARE INTENDED TO SHOW THE GENERAL LAYOUT OF WORK TO BE INSTALLED UNDER THIS CONTRACT WITHOUT ATTEMPTING TO SHOW ALL DETAILS. FURNISH LABOR, MATERIALS, EQUIPMENT AND INCIDENTALS REQUIRED FOR A COMPLETE AND OPERATIONAL ELECTRICAL SYSTEM AS SHOWN ON THE CONTRACT DOCUMENTS.
2. COORDINATE WORK WITH OTHER TRADES AND THE OWNER.
3. FIELD VERIFY EXISTING UNDERGROUND ELECTRICAL CONDUIT, CONCRETE DUCT BANKS, MANHOLES, PULL BOXES, ETC. AND MECHANICAL PIPING. CONTRACTOR SHALL INCLUDE IN BID COSTS ASSOCIATED WITH RELOCATION OR REMOVAL OF UNDERGROUND EQUIPMENT AS REQUIRED BY THIS CONTRACT. USE DUE CARE IN CONGESTED AREAS TO AVOID DAMAGE TO EXISTING UNDERGROUND UTILITIES.
4. REPAIR, IN ACCORDANCE WITH SPECIFICATIONS, SIDEWALKS, WALLS, ROADWAYS, ETC. DISTURBED BY CONSTRUCTION ACTIVITIES WHETHER OR NOT SHOWN FOR REPAIR/REPAVING ON CIVIL DRAWINGS.
5. CONCEAL CONDUITS TO GREATEST EXTENT PRACTICABLE. CONDUITS RUN AT EXISTING STRUCTURES SHALL BE RUN EXPOSED.

KEY NOTES:

1. APPROXIMATE LOCATION OF EXISTING EQUIPMENT. FIELD VERIFY EXACT LOCATION.
2. CONDUIT TRANSITION FROM UNDERGROUND DUCTBANK TO CONDUIT SUPPORT SYSTEM.
3. CONDUIT SUPPORT SYSTEM REFERENCE STRUCTURAL DRAWINGS. FOR EACH CONDUIT SUPPORT STRUCTURE, PROVIDE #6 BARE COPPER GROUNDING CONDUCTOR FROM STRUCTURAL STEEL TO GROUND PLATE.
4. PROVIDE A LIGHTNING PROTECTION SYSTEM FOR THE STRUCTURE IN ACCORDANCE WITH NFPA 780.
5. PROVIDE NEMA 4XSS PULLBOXES SIZED PER NEC. SUPPORT PULLBOXES FROM CONDUIT SUPPORT STRUCTURES USING STAINLESS STEEL CHANNEL FRAMING.
6. CONDUITS TO BE ABANDONED IN PLACE. CUT FLUSH WITH GRADE AND FILL.
7. PLACE THE RELOCATED LIGHTS TO BEST SUIT FIELD CONDITIONS. INTERCEPT EXISTING LIGHTING CIRCUIT. REFER TO DETAIL F/EZ-4 FOR POLE BASE DETAILS. (2)



CONDUIT GROUP 1 SECTION 1 DS-E-1

NTS

TABLE FOR CONDUIT GROUP 1	
CONDUIT NO.	DESCRIPTION
1	EXPOSED CONDUIT FROM MCC-2 TO BLR-1310-3 MOTOR VIA DUCTBANK/PULLBOX PB-1
2	EXPOSED CONDUIT FROM MCC-2 TO BLR-1310-3 MOTOR ANCILLARY DEVICES VIA DUCTBANK/ PULLBOX PB-1
3	EXPOSED CONDUIT FROM MCC-2 TO LCP-1310-3 VIA DUCTBANK/ PULLBOX PB-2
4	EXPOSED CONDUIT FROM DS-RIO2 TO LCP-1310-3 VIA DUCTBANK/PULLBOX PB-2
5	EXPOSED CONDUIT FROM MCC-2 TO MPZ-2 VIA DUCTBANK/ PULLBOX PB-1
6	EXPOSED CONDUIT FROM MCC-2 TO BLR-1310-4 MOTOR VIA DUCTBANK/PULLBOX PB-1
7	EXPOSED CONDUIT FROM MCC-2 TO BLR-1310-4 MOTOR ANCILLARY DEVICES VIA DUCTBANK/PULLBOX PB-1
8	EXPOSED CONDUIT FROM MCC-2 TO LCP-1310-4 VIA DUCTBANK/ PULLBOX PB-2
9	EXPOSED CONDUIT FROM DS-RIO2 TO LCP-1310-4 VIA DUCTBANK/PULLBOX PB-2
10.	EXPOSED CONDUIT FROM DS-RIO2 TO PIT-1311-2 VIA DUCTBANK/ PULLBOX PB-2

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JUAN CARLOS SAENZ
138331
LICENSED PROFESSIONAL ENGINEER
01/09/2024

REV. NO.	DATE	DRWN	CHKD	REMARKS
3	01/09/24	SS	JCS	REVISED PER ADDENDUM NO. 4
2	12/19/23	LES	JCS	REVISED PER ADDENDUM NO. 2

DESIGNED BY: S. KAMAL
DRAWN BY: S. KAMAL
SHEET CHK'D BY: M. CZACH
CROSS CHK'D BY: G. PRABHU
APPROVED BY: J. SAENZ
DATE: DECEMBER 2023

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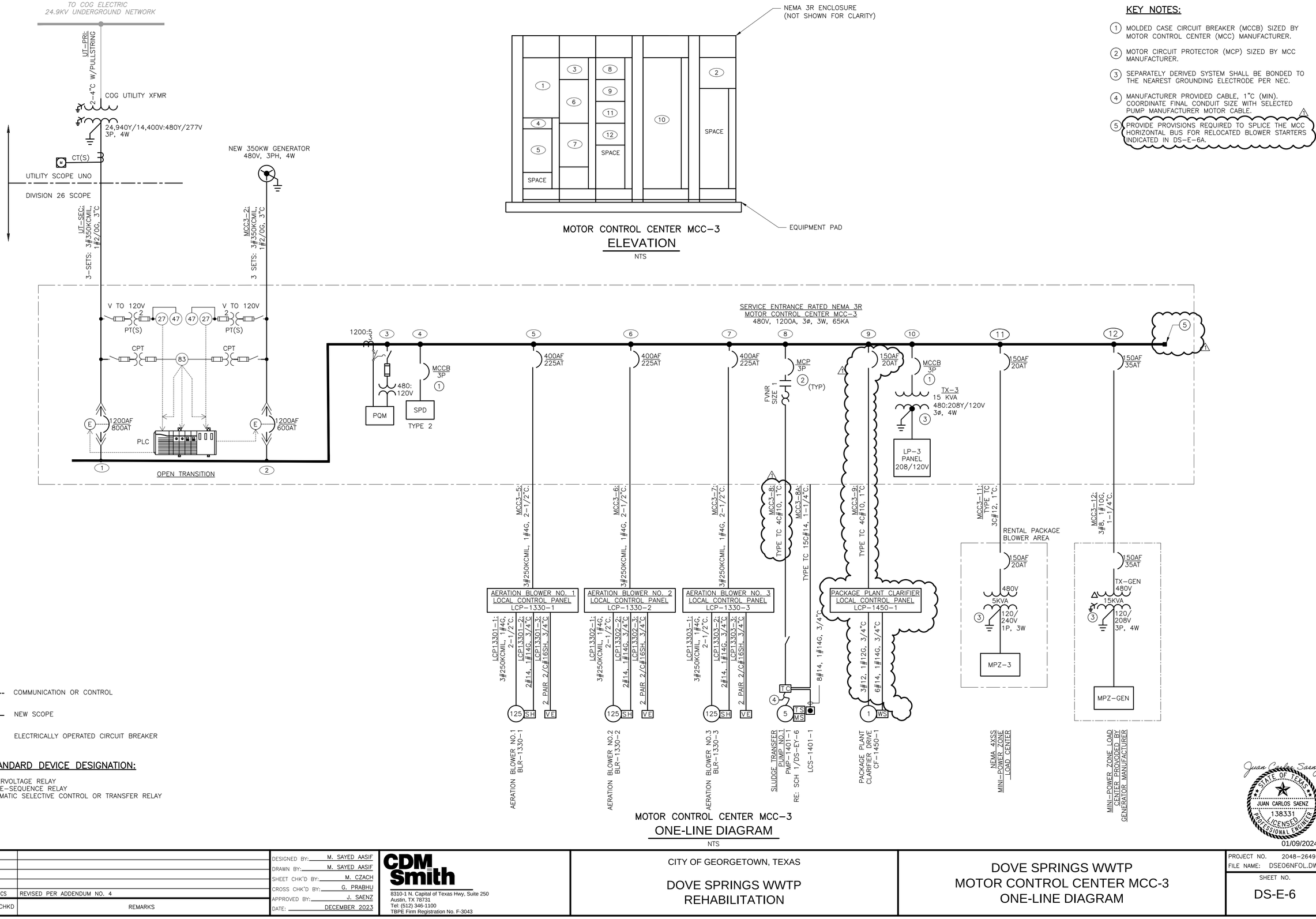
CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP REHABILITATION

DOVE SPRINGS WWTP OVERALL SITE ELECTRICAL NEW WORK PLAN

PROJECT NO. 2048-264953
FILE NAME: DSE01STPL.DWG

SHEET NO.
DS-E-1



MOTOR CONTROL CENTER MCC-3
ONE-LINE DIAGRAM
NTS

MOTOR CONTROL CENTER MCC-3
ELEVATION
NTS

KEY NOTES:

1. MOLDED CASE CIRCUIT BREAKER (MCCB) SIZED BY MOTOR CONTROL CENTER (MCC) MANUFACTURER.
2. MOTOR CIRCUIT PROTECTOR (MCP) SIZED BY MCC MANUFACTURER.
3. SEPARATELY DERIVED SYSTEM SHALL BE BONDED TO THE NEAREST GROUNDING ELECTRODE PER NEC.
4. MANUFACTURER PROVIDED CABLE, 1"C (MIN). COORDINATE FINAL CONDUIT SIZE WITH SELECTED PUMP MANUFACTURER MOTOR CABLE.
5. PROVIDE PROVISIONS REQUIRED TO SPLICE THE MCC HORIZONTAL BUS FOR RELOCATED BLOWER STARTERS INDICATED IN DS-E-6A.

LEGEND:

---------- COMMUNICATION OR CONTROL

———— NEW SCOPE

(E) ELECTRICALLY OPERATED CIRCUIT BREAKER

ANSI STANDARD DEVICE DESIGNATION:

27 – UNDERVOLTAGE RELAY
47 – PHASE-SEQUENCE RELAY
83 – AUTOMATIC SELECTIVE CONTROL OR TRANSFER RELAY

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01/09/2024

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	01/09/24	SS	JCS	REVISED PER ADDENDUM NO. 4

DESIGNED BY: M. SAYED AASIF
DRAWN BY: M. SAYED AASIF
SHEET CHK'D BY: M. CZACH
CROSS CHK'D BY: G. PRABHU
APPROVED BY: J. SAENZ
DATE: DECEMBER 2023

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CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

DOVE SPRINGS WWTP
MOTOR CONTROL CENTER MCC-3
ONE-LINE DIAGRAM

PROJECT NO. 2048-264953
FILE NAME: DSE06NFOL.DWG

SHEET NO.
DS-E-6

XREFs: [CDMS_2224_DS] Images: []
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TO COG ELECTRIC
24.9KV UNDERGROUND NETWORK

UT–PRI:
2–4"C W/PULLSTRING

COG UTILITY XFMR

24,940Y/14,400V:480Y/277V
3P, 4W

CT(S)

UTILITY SCOPE UNO

DIVISION 26 SCOPE

UT–SEC:
3–SETS: 3#350KCMIL, 1#2/0G, 3"C

350KW GENERATOR
480V, 3PH, 4W

MCC3–2:
3 SETS: 3#350KCMIL, 1#2/0G, 3"C

V TO 120V
PT(S)
CPT
83
PLC
1200AF
800AF
1200AF
600AT
OPEN TRANSITION

SERVICE ENTRANCE RATED NEMA 3R
MOTOR CONTROL CENTER MCC–3
480V, 1200A, 3ø, 3W, 65KA

1200:5
480:
120V
PQM
SPD
TYPE 2
MCCB
3P
400AF
225AT
MCP
3P
FVNR
SIZE 1
150AF
20AT
TX–3
15 KVA
480:208Y/120V
3ø, 4W
LP–3
PANEL
208/120V
150AF
35AT
MCP
3P
1
(TYP)
BC
SSRVS–1
SSRVS–2
SSRVS–3

NEMA 3R ENCLOSURE
(NOT SHOWN FOR CLARITY)

SPACE

EQUIPMENT PAD

MOTOR CONTROL CENTER MCC–3
ELEVATION
NTS

GENERAL ELECTRICAL NOTES:

1. EQUIPMENT CONNECTIONS AT THE PLANT REQUIRE TEMPORARY OR PARTIAL SHUTDOWNS. THE CONTRACTOR SHALL MAKE EVERY EFFORT NECESSARY TO MINIMIZE THE SHUTDOWN TIME AND COORDINATE WITH THE OWNER PRIOR TO ATTEMPTING ANY SUCH POWER INTERRUPTIONS. FULL OR PARTIAL SHUTDOWNS SHALL BE LIMITED TO THE CONSTRAINTS SPECIFIED UNDER SECTION CIP NO. 01. WHEN REQUIRED BY THE OWNER, THE CONTRACTOR SHALL RESTORE POWER AND OPERATIONS DURING ANY SHUTDOWN.

KEY NOTES:

1. MOTOR CIRCUIT PROTECTOR (MCP) SIZED BY MCC MANUFACTURER.
2. PROVIDE LABOR, MATERIAL, AND ALL INCIDENTALS REQUIRED TO SPLICE THE MOTOR CONTROL CENTER HORIZONTAL BUS FOR THE NEW STARTERS. ALL NEW COMPONENTS SHALL MEET OR EXCEED SHORT CIRCUIT RATING OF THE INSTALLED MCC. THE OVERALL SHORT CIRCUIT RATING OF THE INSTALLED MCC SHALL BE MAINTAINED.

MCC3–8:
TYPE TC 4C#10, 1"C

MCC3–8A:
TYPE TC 15C#14, 1–1/4"C

8#14, 1#14G, 3/4"C

MCC3–9:
TYPE TC 4C#10, 1"C

MCC3–11:
TYPE TC
3C#12, 1"C

MCC3–12:
3#6, 1#10G,
1–1/4"C.

MCC3–13:
3#4/0, 1#3G, 2"C.

MCC3–13A:
TYPE TC 5C#14, 3/4"C.

MCC3–14:
3#4/0, 1#3G, 2"C.

MCC3–14A:
TYPE TC 5C#14, 3/4"C.

MCC3–15:
3#4/0, 1#3G, 2"C.

MCC3–15A:
TYPE TC 5C#14, 3/4"C.

MCC3–1:
3#250KCMIL, 1#4G,
2–1/2"C.

MCC3–2:
3#250KCMIL, 1#4G,
2–1/2"C.

MCC3–3:
3#250KCMIL, 1#4G,
2–1/2"C.

LCP1330–1:
2#14, 1#14G, 3/4"C

LCP1330–2:
2#14, 1#14G, 3/4"C

LCP1330–3:
2#14, 1#14G, 3/4"C

LCP1330–5:
2 PAIR 2/C#16SH, 3/4"C

LCP1330–6:
2 PAIR 2/C#16SH, 3/4"C

LCP1330–7:
2 PAIR 2/C#16SH, 3/4"C

AERATION BLOWER NO. 1
LOCAL CONTROL PANEL
LCP–1330–1

AERATION BLOWER NO. 2
LOCAL CONTROL PANEL
LCP–1330–2

AERATION BLOWER NO. 3
LOCAL CONTROL PANEL
LCP–1330–3

PACKAGE PLANT CLARIFIER
LOCAL CONTROL PANEL
LCP–1450–1

3#12, 1#12G, 3/4"C
6#14, 1#14G, 3/4"C

125 SH VH
5 TS MS
1 WS

AERATION BLOWER NO.1
BLR–1330–1

AERATION BLOWER NO.2
BLR–1330–2

AERATION BLOWER NO.3
BLR–1330–3

SLUDGE TRANSFER
PUMP NO.1
PMP–1401–1
RE: SCH 1/DS–EY–6

LCS–1401–1

PACKAGE PLANT
CLARIFIER DRIVE
CF–1450–1

RENTAL PACKAGE
BLOWER AREA

150AF
20AT
480V
5KVA
120/
240V
1P, 3W
MPZ–3

NEMA 4XSS
MINI–POWER ZONE
LOAD CENTER

150AF
35AT
TX–GEN
480V
15KVA
120/
208V
3P, 4W
MPZ–GEN

MINI–POWER ZONE LOAD
CENTER PROVIDED BY
GENERATOR MANUFACTURER

150 TS SH

PLANT PACKAGE
AERATION BLOWER NO.1
BLR–1330–1

PLANT PACKAGE AERATION
BLOWER NO. 2
BLR–1330–2

PLANT PACKAGE AERATION
BLOWER NO. 3
BLR–1330–3

LEGEND:

⚠1 CONTRACTOR TO REMOVE ELECTRICAL EQUIPMENT, CONDUIT, WIRE, AND SUPPORT MATERIAL UNDER THIS CONTRACT

MOTOR CONTROL CENTER MCC–3
ONE-LINE DIAGRAM
NTS

Juan Carlos Saenz
STATE OF TEXAS
JUAN CARLOS SAENZ
138331
LICENSED
PROFESSIONAL ENGINEER
01/09/2024

REV. NO.	DATE	DRWN	CHKD	REMARKS
⚠1	01/09/24	SS	JCS	REVISED PER ADDENDUM NO. 4

DESIGNED BY: M. SAYED AASIF
DRAWN BY: M. SAYED AASIF
SHEET CHK'D BY: M. CZACH
CROSS CHK'D BY: G. PRABHU
APPROVED BY: J. SAENZ
DATE: DECEMBER 2023

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CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

DOVE SPRINGS WWTP
MOTOR CONTROL CENTER MCC-3
ONE-LINE DIAGRAM (BLOWER RELOCATION)

PROJECT NO. 2048–264953
FILE NAME: DSE06ANFOL.DWG

SHEET NO.
DS-E-6A

225 AMP MAIN BREAKEI — **EXISTING PANELBOARD DPA** — LOCATION: **HEADWORKS**
400 AMP BUS RATING **18** POLES **65** KA SHORT CIRCUIT RATING ENCLOSURE RATING: **NEMA 4X ,**
480 VOLTS **3** PHASE **3** WIRE **60 Hz.** ELECTRONIC GRADE: **NO** MOUNTING: **SURFACE**

CIRCUIT NO	DESCRIPTION	LOAD KVA PHASE A	LOAD KVA PHASE B	LOAD KVA PHASE C	BREAKER AMPS/ POLES	NOTES	CIRCUIT NO	DESCRIPTION	LOAD KVA PHASE A	LOAD KVA PHASE B	LOAD KVA PHASE C	BREAKER AMPS/ POLES	NOTES
1		2.00					2	POSITIVE DISPLACEMENT	18.00				
3	HCP-1		2.00		20 /3		4	BLOWER CONTROL PANEL		18.00		200 /3	
5				2.00			6	PDBCP			18.00		
7		2.00					8		5.00				
9	CLARIFIER CONTROL PANEL CLRCP-2		2.00		20 /3		10	MINI-LOAD CENTER MPA		5.00		40 /3	
11				2.00			12				5.00		
13		0.33					14					/2	
(1) 15	**MOTORIZED VALVE SG-1101-1**		0.33		20 /3		16						
17				0.33			18					/1	
	TOTAL PHASE KVA THIS SIDE	4.33	4.33	4.33				TOTAL PHASE KVA THIS SIDE	23.00	23.00	23.00		
								TOTAL KVA PER PHASE	27.33	27.33	27.33		
								TOTAL THREE PHASE KVA		81.99			

NOTES:		NOTES CONT.:	
1.	PROVIDE LOCKING HARDWARE	2.	5 ma GROUND FAULT INTERRUPTER (GFI) CIRCUIT BREAKER
3.	30 ma GFI CIRCUIT BREAKER FOR EQUIPMENT PROTECTION ONLY (HEAT TRACE)	4.	PROVIDE LOCKING HARDWARE & PAINT BREAKER HANDLE RED (FACP)
5.	BRANCH CIRCUIT WIRING: 3/4"C, 3#12 & 1#12G	6.	BRANCH CIRCUIT WIRING: 3/4'C, 3#10 & 1#10G
7.	BRANCH CIRCUIT WIRING: 3/4"C, 2#12 & 1#12G	8.	BRANCH CIRCUIT WIRING: 3/4'C, 3#12 & 1#12G
9.	BRANCH CIRCUIT WIRING: 3'C, 3#350KCMIL & 1#3G	10.	BRANCH CIRCUIT WIRING: 1'C, 3#8 & 1#10G
11.	BRANCH CIRCUIT WIRING: 1-1/2'C, 3#2 & 1#6G	12.	

EXISTING PANELBOARD DPA
SCHEDULE
NTS

60 AMP MAIN BREAKER — **PANELBOARD LP-1** — LOCATION: **EHOUSE**
100 AMP BUS RATING **42** POLES **10** KA SHORT CIRCUIT RATING ENCLOSURE RATING: **NEMA 1 ,**
208/120 VOLTS **3** PHASE **4** WIRE **60 Hz.** INTERNAL SPD: YES MOUNTING: **SURFACE**

CIRCUIT NO.	DESCRIPTION	LOAD KVA PHASE A	LOAD KVA PHASE B	LOAD KVA PHASE C	BREAKER AMPS/ POLES	NOTES	CIRCUIT NO.	DESCRIPTION	LOAD KVA PHASE A	LOAD KVA PHASE B	LOAD KVA PHASE C	BREAKER AMPS/ POLES	NOTES
1	EHOUSE LIGHTS	0.22			20 /1	7	2	EHOUSE RECEPTACLES	0.90			20 /1	7
3	LEVEL RELAY PANEL,LRP-1001-1		0.10		20 /1	7	4	BFP FACP		0.50		20 /1	4
5	FIT-1102-1			0.25	20 /1	7	6	SPARE				20 /1	
7	SPARE				20 /1		8	SPARE				20 /1	
9	SPARE				20 /1		10	LI-1005-1		0.50		20 /1	7
11	SPARE				20 /1		12	SPARE				20 /1	
13	SPARE				20 /1		14	SPARE				20 /1	
15	SPARE				20 /1		16	NETWORK SWITCH DS-RIO2		0.25		20 /1	7
17	SPACE				/1		18	SPACE				/1	
19	SPACE				/1		20	SPACE				/1	
21	SPACE				/1		22	SPACE				/1	
23	SPACE				/1		24	SPACE				/1	
25	SPACE				/1		26	SPACE				/1	
27	SPACE				/1		28	SPACE				/1	
29	SPACE				/1		30	SPACE				/1	
31	SPACE				/1		32	SPACE				/1	
33	SPACE				/1		34	SPACE				/1	
35	SPACE				/1		36	SPACE				/1	
37	SPACE				/1		38	SPACE				/1	
39	SPACE				/1		40	SPACE				/1	
41	SPACE				/1		42	SPACE				/1	
	TOTAL PHASE KVA THIS SIDE	0.22	0.1	0.25				TOTAL PHASE KVA THIS SIDE	0.90	1.25	0.00		
								TOTAL KVA PER PHASE	1.12	1.35	0.25		
								TOTAL THREE PHASE KVA		2.72			

NOTES:		NOTES CONT.:	
1.	PROVIDE LOCKING HARDWARE	2.	5 ma GROUND FAULT INTERRUPTER (GFI) CIRCUIT BREAKER
3.	30 ma GFI CIRCUIT BREAKER FOR EQUIPMENT PROTECTION ONLY (HEAT TRACE)	4.	PROVIDE LOCKING HARDWARE & PAINT BREAKER HANDLE RED (FACP)
5.	BRANCH CIRCUIT WIRING: 3/4"C, 3#12 & 1#12G	6.	BRANCH CIRCUIT WIRING: 3/4'C, 3#10 & 1#10G
7.	BRANCH CIRCUIT WIRING: 3/4"C, 2#12 & 1#12G	8.	BRANCH CIRCUIT WIRING: 3/4'C, 3#12 & 1#12G
9.	BRANCH CIRCUIT WIRING: 3'C, 3#350KCMIL & 1#3G	10.	BRANCH CIRCUIT WIRING: 1'C, 3#8 & 1#10G
11.	BRANCH CIRCUIT WIRING: 1-1/2'C, 3#2 & 1#6G	12.	

PANELBOARD LP–1
SCHEDULE
NTS

GENERAL ELECTRICAL NOTES:

1. THIS DRAWINGS REPRESENTS THE LATEST DOCUMENTED INFORMATION AVAILABLE ON THE EXISTING SYSTEM. HOWEVER, UNDOCUMENTED CHANGES MAY EXIST THAT MAY REQUIRE FIELD INVESTIGATION.
2. PROVIDE A NEW TYPED PANELBOARD DIRECTORY BY UPDATING THE MODIFICATION.

KEY NOTES:

(1) UTILIZE EXISTING SPACE TO HOUSE NEW CIRCUIT BRAEKER TO FEED NEW LOAD. ALL NEW COMPONENTS SHOULD MEET OR EXCEED SHORT CIRCUIT RATING OF THE EXISTING PANELBOARD.

60 AMP MAIN BREAKER — **PANELBOARD LP-3** — LOCATION: **MCC-3**
100 AMP BUS RATING **24** POLES **10** KA SHORT CIRCUIT RATING ENCLOSURE RATING: **NEMA 1 ,**
208/120 VOLTS **3** PHASE **4** WIRE **60 Hz.** ELECTRONIC GRADE: **NO** MOUNTING: **SURFACE**

CIRCUIT NO.	DESCRIPTION	LOAD KVA PHASE A	LOAD KVA PHASE B	LOAD KVA PHASE C	BREAKER AMPS/ POLES	NOTES	CIRCUIT NO.	DESCRIPTION	LOAD KVA PHASE A	LOAD KVA PHASE B	LOAD KVA PHASE C	BREAKER AMPS/ POLES	NOTES
1	SPARE				20 /1		2	NETWORK SWITCH DS-RIO1	0.50			20 /1	
3	SPARE				20 /1		4	PACKAGE AERATION BASIN LIGHTS		0.99		20 /1	7
5	SPARE				20 /1		6	SPARE				20 /1	
7	SPARE				20 /1		8	SPARE				20 /1	
9	SPACE				/1		10	SPACE				/1	
11	SPACE				/1		12	SPACE				/1	
13	SPACE				/1		14	SPACE				/1	
15	SPACE				/1		16	SPACE				/1	
17	SPACE				/1		18	SPACE				/1	
19	SPACE				/1		20	SPACE				/1	
21	SPACE				/1		22	SPACE				/1	
23	SPACE				/1		24	SPACE				/1	
	TOTAL PHASE KVA THIS SIDE	0	0	0				TOTAL PHASE KVA THIS SIDE	0.50	0.99	0.00		
								TOTAL KVA PER PHASE	0.50	0.99	0.00		
								TOTAL THREE PHASE KVA		1.49			

NOTES:		NOTES CONT.:	
1.	PROVIDE LOCKING HARDWARE	2.	5 ma GROUND FAULT INTERRUPTER (GFI) CIRCUIT BREAKER
3.	30 ma GFI CIRCUIT BREAKER FOR EQUIPMENT PROTECTION ONLY (HEAT TRACE)	4.	PROVIDE LOCKING HARDWARE & PAINT BREAKER HANDLE RED (FACP)
5.	BRANCH CIRCUIT WIRING: 3/4"C, 3#12 & 1#12G	6.	BRANCH CIRCUIT WIRING: 3/4'C, 3#10 & 1#10G
7.	BRANCH CIRCUIT WIRING: 3/4"C, 2#12 & 1#12G	8.	BRANCH CIRCUIT WIRING: 3/4'C, 3#12 & 1#12G
9.	BRANCH CIRCUIT WIRING: 3'C, 3#350KCMIL & 1#3G	10.	BRANCH CIRCUIT WIRING: 1'C, 3#8 & 1#10G
11.	BRANCH CIRCUIT WIRING: 1-1/2'C, 3#2 & 1#6G	12.	

PANELBOARD LP–3
SCHEDULE
NTS

Juan Carlos Saenz
STATE OF TEXAS
JUAN CARLOS SAENZ
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PROFESSIONAL ENGINEER
01/09/2024

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	01/09/24	SS	JCS	REVISED PER ADDENDUM NO. 4

DESIGNED BY: S. KAMAL
DRAWN BY: S. KAMAL
SHEET CHK'D BY: M. CZACH
CROSS CHK'D BY: G. PRABHU
APPROVED BY: J. SAENZ
DATE: DECEMBER 2023

CDM Smith
8310-1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
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TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

DOVE SPRINGS WWTP
PANELBOARD SCHEDULES

PROJECT NO. 2048–264953
FILE NAME: DSE07PBSC.DWG
SHEET NO.
DS-E-7

MINI POWER ZONE MPZ-1

5 KVA 1-PHASE TRANSFORMER — **480** VOLT PRIMARY — 20 **AMP 2 POLE PRIMARY MAIN BREAKER** — 65 KA

30 AMP 2 POLE SECONDARY MAIN BREAKER — LOCATION: **TREATMENT UNIT NO. 1**

30 AMP BUS RATING — 12 POLES — 10 KA SHORT CIRCUIT RATING — ENCLOSURE RATING: **NEMA 4X ,**

120/240 VOLTS SECONDARY — 1 PHASE — 3 WIRE — **60 Hz.** — ELECTRONIC GRADE: **NO** — MOUNTING: **SURFACE**

CIRCUIT NO.	DESCRIPTION	LOAD KVA LINE 1	LOAD KVA LINE 2	BREAKER AMPS/ POLES	NOTES	CIRCUIT NO.	DESCRIPTION	LOAD KVA LINE 1	LOAD KVA LINE 2	BREAKER AMPS/ POLES	NOTES
1	TREATMENT 1 BLOWER LIGHTS	0.12		20 /1	5	2	TREATMENT 1 BLOWER RECEPTACLE	0.18		20 /1	5
3	LCP-1310-1		0.5	20 /1	5	4	LCP-1310-2		0.5	20 /1	5
5	NETWORK SWITCH DS-TU1	0.5		20 /1	5	6	PIT-1311-1	0.1		20 /1	5
7	VIT-1310-1A/-1B		0.2	20 /1	5	8	VIT-1310-2A/-2B		0.2	20 /1	5
9	SPARE			20 /1		10	SPARE			20 /1	
11	SPARE			20 /1		12	SPARE			20 /1	
	TOTAL LINE KVA THIS SIDE	0.62	0.7				TOTAL LINE KVA THIS SIDE	0.28	0.7		
							TOTAL KVA PER LINE	0.9	1.4		
							TOTAL KVA	2.3			

NOTES:		NOTES CONT.:	
1.	PROVIDE LOCKING HARDWARE	2.	5 ma GROUND FAULT INTERRUPTER (GFI) CIRCUIT BREAKER
3.	30 ma GFI CIRCUIT BREAKER FOR EQUIPMENT PROTECTION ONLY (HEAT TRACE)	4.	PROVIDE LOCKING HARDWARE & PAINT BREAKER HANDLE RED (FACP)
5.	BRANCH CIRCUIT WIRING: 3/4"C, 2#12 & 1#12G	6.	
7.		8.	

PANELBOARD MPZ–1
SCHEDULE
NTS

MINI POWER ZONE MPZ-2

5 KVA 1-PHASE TRANSFORMER — **480** VOLT PRIMARY — 20 **AMP 2 POLE PRIMARY MAIN BREAKER** — 65 KA

30 AMP 2 POLE SECONDARY MAIN BREAKER — LOCATION: **TREATMENT UNIT NO. 2**

30 AMP BUS RATING — 12 POLES — 10 KA SHORT CIRCUIT RATING — ENCLOSURE RATING: **NEMA 4X ,**

120/240 VOLTS SECONDARY — 1 PHASE — 3 WIRE — **60 Hz.** — ELECTRONIC GRADE: **NO** — MOUNTING: **SURFACE**

CIRCUIT NO.	DESCRIPTION	LOAD KVA LINE 1	LOAD KVA LINE 2	BREAKER AMPS/ POLES	NOTES	CIRCUIT NO.	DESCRIPTION	LOAD KVA LINE 1	LOAD KVA LINE 2	BREAKER AMPS/ POLES	NOTES
1	TREATMENT 2 BLOWER LIGHTS	0.12		20 /1	5	2	TREATMENT 2 BLOWER RECEPTACLE	0.18		20 /1	5
3	LCP-1310-3		0.5	20 /1	5	4	LCP-1310-4		0.5	20 /1	5
5	VIT-1310-3A/-3B	0.2		20 /1	5	6	PIT-1311-2	0.1		20 /1	5
7	SPARE			20 /1		8	VIT-1310-4A/-4B		0.2	20 /1	5
9	SPARE			20 /1		10	SPARE			20 /1	
11	SPARE			20 /1		12	SPARE			20 /1	
	TOTAL LINE KVA THIS SIDE	0.32	0.5				TOTAL LINE KVA THIS SIDE	0.28	0.7		
							TOTAL KVA PER LINE	0.6	1.2		
							TOTAL KVA	1.8			

NOTES:		NOTES CONT.:	
1.	PROVIDE LOCKING HARDWARE	2.	5 ma GROUND FAULT INTERRUPTER (GFI) CIRCUIT BREAKER
3.	30 ma GFI CIRCUIT BREAKER FOR EQUIPMENT PROTECTION ONLY (HEAT TRACE)	4.	PROVIDE LOCKING HARDWARE & PAINT BREAKER HANDLE RED (FACP)
5.	BRANCH CIRCUIT WIRING: 3/4"C, 2#12 & 1#12G	6.	
7.		8.	

PANELBOARD MPZ–2
SCHEDULE
NTS

MINI POWER ZONE MPZ-3

5 KVA 1-PHASE TRANSFORMER — **480** VOLT PRIMARY — 20 **AMP 2 POLE PRIMARY MAIN BREAKER** — 65 KA

30 AMP 2 POLE SECONDARY MAIN BREAKER — LOCATION: **RENTAL PACKAGE BLOWER**

30 AMP BUS RATING — 12 POLES — 10 KA SHORT CIRCUIT RATING — ENCLOSURE RATING: **NEMA 4X ,**

120/240 VOLTS SECONDARY — 1 PHASE — 3 WIRE — **60 Hz.** — ELECTRONIC GRADE: **NO** — MOUNTING: **SURFACE**

CIRCUIT NO.	DESCRIPTION	LOAD KVA LINE 1	LOAD KVA LINE 2	BREAKER AMPS/ POLES	NOTES	CIRCUIT NO.	DESCRIPTION	LOAD KVA LINE 1	LOAD KVA LINE 2	BREAKER AMPS/ POLES	NOTES
1	PACKAGE BLOWER LIGHTS	0.12		20 /1	5	2	PACKAGE BLOWER RECEPTACLE	0.18		20 /1	5
3	LEVEL RELAY PANEL LRP-1401-1		0.25	20 /1	5	4	PACKAGE CLARIFIER LIGHTS		0.19	20 /1	5
5	SOLENOID VALVE PANEL	0.25		20 /1	5	6	PACKAGE SLUDGE PUMP LIGHTS	0.19		20 /1	5
7	SPARE			20 /1		8	SPARE			20 /1	
9	SPARE			20 /1		10	SPARE			/1	
11	SPACE			/1		12	SPACE				
	TOTAL LINE KVA THIS SIDE	0.37	0.25				TOTAL LINE KVA THIS SIDE	0.37	0.19		
							TOTAL KVA PER LINE	0.74	0.44		
							TOTAL KVA	1.18			

NOTES:		NOTES CONT.:	
1.	PROVIDE LOCKING HARDWARE	2.	5 ma GROUND FAULT INTERRUPTER (GFI) CIRCUIT BREAKER
3.	30 ma GFI CIRCUIT BREAKER FOR EQUIPMENT PROTECTION ONLY (HEAT TRACE)	4.	PROVIDE LOCKING HARDWARE & PAINT BREAKER HANDLE RED (FACP)
5.	BRANCH CIRCUIT WIRING: 3/4"C, 2#12 & 1#12G	6.	
7.		8.	

PANELBOARD MPZ–3
SCHEDULE
NTS

Juan Carlos Saenz
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01/09/2024

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	01/09/24	SS	JCS	REVISED PER ADDENDUM NO. 4

DESIGNED BY: S. KAMAL
DRAWN BY: S. KAMAL
SHEET CHK'D BY: M. CZACH
CROSS CHK'D BY: G. PRABHU
APPROVED BY: J. SAENZ
DATE: DECEMBER 2023

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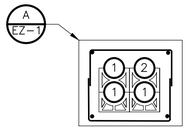
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

DOVE SPRINGS WWTP
PANELBOARD SCHEDULES

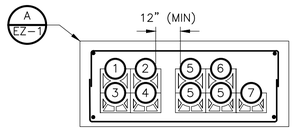
PROJECT NO. 2048–264953
FILE NAME: DSE08PBSC.DWG
SHEET NO.
DS-E-8



DUCTBANK SECTION 10 (DS-E-1)
NTS

TABLE FOR SECTION 10		
CONDUIT NO.	CONDUIT TAG/ SIZE	DESCRIPTION
1	UT-SEC/ 3"C.	FROM UTILITY TRANSFORMER T#2 TO MOTOR CONTROL CENTER MCC-3
2	SPARE 3"C. W/PULLSTRING	FROM UTILITY TRANSFORMER T#2 TO MOTOR CONTROL CENTER MCC-3

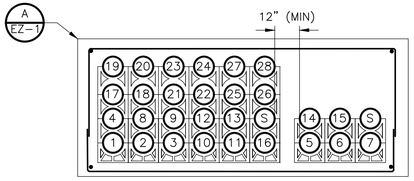
CONCRETE ENCASED DUCTBANK
SCHEDULE
NTS



DUCTBANK SECTION 11 (DS-E-1)
NTS

TABLE FOR SECTION 11		
CONDUIT NO.	CONDUIT TAG/ SIZE	DESCRIPTION
1	GENC-1/ 1"C.	FROM GENERATOR CONTROL PANEL TO MOTOR CONTROL CENTER MCC-3
2	GENC-2/ 1"C.	FROM GENERATOR CONTROL PANEL TO DS-RIO1
3	GENC-3/ 1"C.	FROM GENERATOR CONTROL PANEL TO DS-RIO1
4	SPARE 1"C. W/PULLSTRING	FROM GENERATOR CONTROL PANEL TO DS-RIO1
5	MCC3-2/ 3"C.	FROM GENERATOR TO MOTOR CONTROL CENTER MCC-3
6	SPARE 3"C. W/PULLSTRING	FROM GENERATOR TO MOTOR CONTROL CENTER MCC-3
7	MCC3-12/ 1-1/4"C.	FROM MOTOR CONTROL CENTER MCC-3 TO GENERATOR MINI-POWER ZONE LOAD CENTER MPZ-GEN

CONCRETE ENCASED DUCTBANK
SCHEDULE
NTS



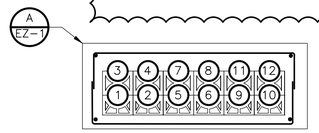
DUCTBANK SECTION 12 (DS-E-1)
NTS

TABLE FOR SECTION 12		
CONDUIT NO.	CONDUIT TAG/ SIZE	DESCRIPTION
1	MCC3-5/ 2-1/2"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT AERATION BLOWER BLR-1330-1
2	MCC3-6/ 2-1/2"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT AERATION BLOWER BLR-1330-2
3	MCC3-7/ 2-1/2"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT AERATION BLOWER BLR-1330-3
4	MCC3-11/ 1"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT AERATION BLOWER AREA MINI-POWER ZONE MPZ-3
5	LCP1330-1/ 1"C.	FROM DS-RIO1 TO PACKAGE PLANT AERATION BLOWER LCP-1330-1
6	LCP1330-1/ 1"C.	FROM DS-RIO1 TO PACKAGE PLANT AERATION BLOWER LCP-1330-1
7	LCP1330-1/ 1"C.	FROM DS-RIO1 TO PACKAGE PLANT AERATION BLOWER LCP-1330-1
8	MCC3-13/ 2"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT AERATION BLOWER BLR-1330-1
9	MCC3-13A/ 3/4"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT AERATION BLOWER BLR-1330-1
10	MCC3-14/ 2"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT AERATION BLOWER BLR-1330-2
11	MCC3-14A/ 3/4"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT AERATION BLOWER BLR-1330-2
12	MCC3-15/ 2"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT AERATION BLOWER BLR-1330-3
13	MCC3-15A/ 3/4"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT AERATION BLOWER BLR-1330-3
14	DSRIO1-1/ 2"C.	FROM DS-RIO1 TO PACKAGE PLANT AERATION BLOWER LOCAL CONTROL STATION LCS-1330-1, LCS-1330-2, LCS-1330-3
15	MCC3-A/ 2"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT AERATION BLOWER LCS-1330-1, LCS-1330-2, LCS-1330-3
16	LP3-4/ 1"C.	FROM PANELBOARD LP-3 TO PACKAGE PLANT AERATION BASIN AREA LIGHTS
17	MCC3-9/ 1"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT CLARIFIER LCP-1450-1
18	LCP1450-1/ 1"C.	FROM DS-RIO1 TO PACKAGE PLANT CLARIFIER LCP-1450-1
19	MPZ3-4/ 1"C.	FROM MINI-POWER ZONE MPZ-3 TO PACKAGE PLANT CLARIFIER LIGHTS
20	SPARE 1"C W/PULLSTRING.	FROM HANDHOLE EHH-2 TO PACKAGE PLANT CLARIFIER PULLBOX
21	MCC3-8/ 1"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT SLUDGE TRANSFER PUMP PMP-1401-1
22	MCC3-8A/ 1-1/4"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT SLUDGE TRANSFER PUMP PMP-1401-1
23	LRP1401-1/ 1"C.	FROM DS-RIO1 TO PACKAGE PLANT LEVEL RELAY LRP-1401-1
24	MPZ3-3/ 1"C.	FROM MINI-POWER ZONE MPZ-3 TO PACKAGE PLANT LEVEL RELAY LRP-1401-1
25	SOL1/ 1"C.	FROM DS-RIO1 TO PACKAGE PLANT SOLENOID VALVE PANEL
26	MPZ3-5/ 1"C.	FROM MINI-POWER ZONE MPZ-3 TO PACKAGE PLANT SOLENOID VALVE PANEL
27	MPZ3-6/ 1"C.	FROM MINI-POWER ZONE MPZ-3 TO PACKAGE PLANT SLUDGE TRANSFER PUMP LIGHTS
28	SPARE 1"C W/PULLSTRING.	FROM HANDHOLE EHH-2 TO PACKAGE PLANT SLUDGE TRANSFER PUMP PULLBOX

CONCRETE ENCASED DUCTBANK
SCHEDULE
NTS

GENERAL ELECTRICAL NOTES:

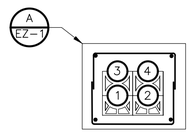
1. CONCRETE REINFORCED DUCTBANKS SHALL BE EXTENDED UNDERNEATH STRUCTURES OR ELECTRICAL EQUIPMENT AND ARE NOT SHOWN FOR CLARITY BUT THE RESPONSIBILITY OF ELECTRICAL CONTRACTOR.
2. PROVIDE PULLSTRING FOR SPARE CONDUITS.
3. DETAILS SHOWN ON THIS SHEET ARE FOR DIAGRAMMATICAL PURPOSES AND SHOW INTENT. DUCTBANK SECTIONS DO NOT NECESSARILY REFLECT ACTUAL CONDUIT PLACEMENT.



DUCTBANK SECTION 13 (DS-E-1)
NTS

TABLE FOR SECTION 13		
CONDUIT NO.	CONDUIT TAG/ SIZE	DESCRIPTION
1	MCC3-9/ 1"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT CLARIFIER LCP-1450-1
2	LCP1450-1/ 1"C.	FROM DS-RIO1 TO PACKAGE PLANT CLARIFIER LCP-1450-1
3	MPZ3-4/ 1"C.	FROM MINI-POWER ZONE MPZ-3 TO PACKAGE PLANT CLARIFIER LIGHTS
4	SPARE 1"C W/PULLSTRING.	FROM HANDHOLE EHH-2 TO PACKAGE PLANT CLARIFIER PULLBOX
5	MCC3-8/ 1"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT SLUDGE TRANSFER PUMP PMP-1401-1
6	MCC3-8A/ 1-1/4"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT SLUDGE TRANSFER PUMP PMP-1401-1
7	LRP1401-1/ 1"C.	FROM DS-RIO1 TO PACKAGE PLANT LEVEL RELAY LRP-1401-1
8	MPZ3-3/ 1"C.	FROM MINI-POWER ZONE MPZ-3 TO PACKAGE PLANT LEVEL RELAY LRP-1401-1
9	SOL1/ 1"C.	FROM DS-RIO1 TO PACKAGE PLANT SOLENOID VALVE PANEL
10	MPZ3-5/ 1"C.	FROM MINI-POWER ZONE MPZ-3 TO PACKAGE PLANT SOLENOID VALVE PANEL
11	MPZ3-6/ 1"C.	FROM MINI-POWER ZONE MPZ-3 TO PACKAGE PLANT SLUDGE TRANSFER PUMP LIGHTS
12	SPARE 1"C W/PULLSTRING.	FROM HANDHOLE EHH-2 TO PACKAGE PLANT SLUDGE TRANSFER PUMP PULLBOX

CONCRETE ENCASED DUCTBANK
SCHEDULE
NTS



DUCTBANK SECTION 14 (DS-E-1)
NTS

TABLE FOR SECTION 14		
CONDUIT NO.	CONDUIT TAG/ SIZE	DESCRIPTION
1	MCC3-9/ 1"C.	FROM MOTOR CONTROL CENTER MCC-3 TO PACKAGE PLANT CLARIFIER LCP-1450-1
2	LCP1450-1/ 1"C.	FROM DS-RIO1 TO PACKAGE PLANT CLARIFIER LCP-1450-1
3	MPZ3-4/ 1"C.	FROM MINI-POWER ZONE MPZ-3 TO PACKAGE PLANT CLARIFIER LIGHTS
4	SPARE 1"C W/PULLSTRING.	FROM HANDHOLE EHH-2 TO PACKAGE PLANT CLARIFIER PULLBOX

CONCRETE ENCASED DUCTBANK
SCHEDULE
NTS

Juan Carlos Saenz
STATE OF TEXAS
JUAN CARLOS SAENZ
138331
LICENSED PROFESSIONAL ENGINEER
01/09/2024

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	01/09/24	SS	JCS	REVISED PER ADDENDUM NO. 4

DESIGNED BY: S. KAMAL
DRAWN BY: S. KAMAL
SHEET CHK'D BY: M. CZACH
CROSS CHK'D BY: G. PRABHU
APPROVED BY: J. SAENZ
DATE: DECEMBER 2023

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8310-1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP REHABILITATION

ELECTRICAL DUCTBANK SCHEDULE III

PROJECT NO. 2048-264953
FILE NAME: DSE11DTSC.DWG
SHEET NO.
DS-E-11

GENERAL ELECTRICAL NOTES:

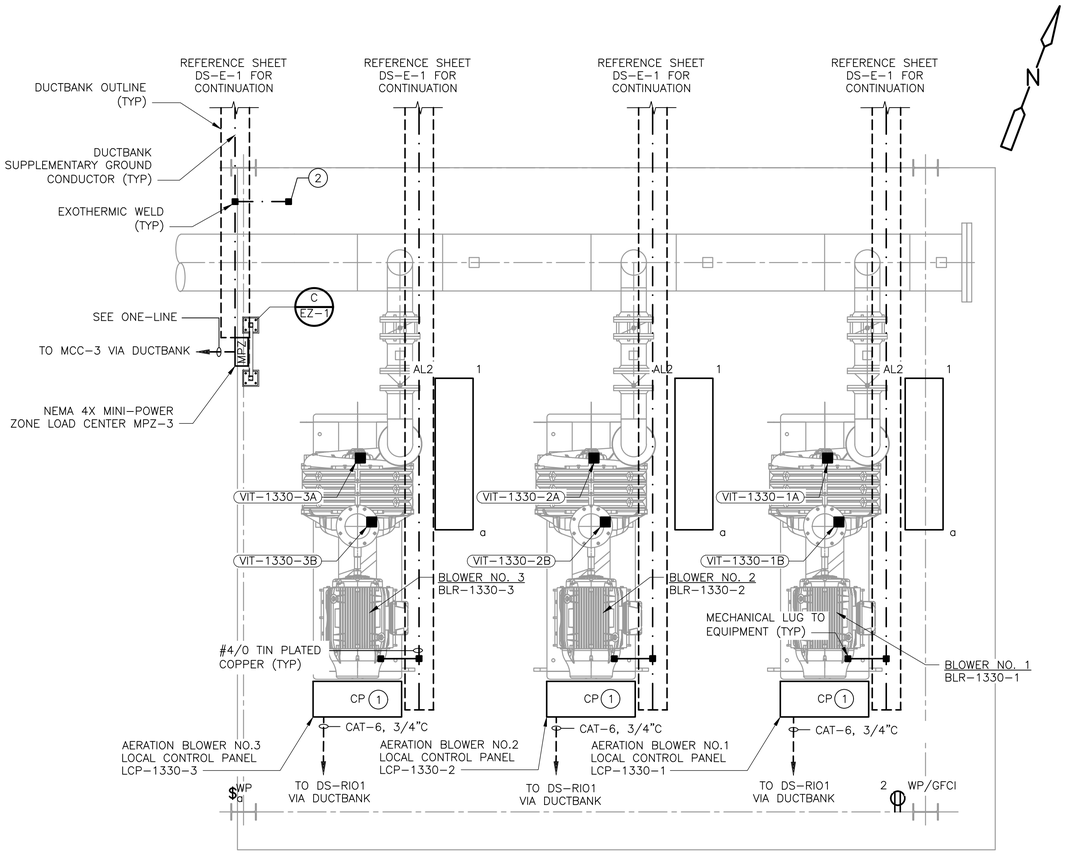
1. PROVIDE ALL LABOR, MATERIAL, AND INCIDENTALS REQUIRED TO INSTALL THE NEW CIRCUITS AS SCHEDULED IN THIS CONTRACT. DETAILS SHOWN ON THIS SHEET ARE FOR DIAGRAMMATICAL PURPOSES AND SHOW INTENT. FITTINGS SUCH AS CONDULETS, PULL BOXES, JUNCTION BOXES, OR CONDUIT PENETRATIONS ARE TYPICALLY NOT SHOWN FOR CLARITY. ALL DIMENSIONS GIVEN ARE APPROXIMATE. FIELD VERIFY AND ADJUST AS REQUIRED FOR FULLY FUNCTIONAL SYSTEM.
2. REFER TO SHEET DS-E-6 FOR ONE-LINE DIAGRAM.
3. REFER TO SHEET DS-E-8 FOR PANELBOARD SCHEDULE.

KEY NOTES:

(1) PROVIDED BY DIVISION 43.

(2) BOND #4/0 TIN PLATED COPPER TO STRUCTURAL STEEL.

(3) EQUIPMENT LOCATIONS ARE APPROXIMATE. COORDINATE FINAL LOCATIONS WITH PACKAGE PLANT SUPPLIER.



RENTAL PACKAGE BLOWER POWER AND CONTROL

PLAN (3)

1/2" = 1'- 0"

1 0 1 2

STATE OF TEXAS
JUAN CARLOS SAENZ
138331
LICENSED PROFESSIONAL ENGINEER
Juan Carlos Saenz
01/09/2024

REV. NO.	DATE	DRWN	CHKD	REMARKS
1	01/09/24	SS	JCS	REVISED PER ADDENDUM NO. 4

DESIGNED BY: J. SEANZ
DRAWN BY: V. MANJU
SHEET CHK'D BY: M. CZACH
CROSS CHK'D BY: G. PRABHU
APPROVED BY: J. SAENZ
DATE: DECEMBER 2023

CDM Smith
8310-1 N. Capital of Texas Hwy, Suite 250
Austin, TX 78731
Tel: (512) 346-1100
TBPE Firm Registration No. F-3043

CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

DOVE SPRINGS WWTP
RENTAL PACKAGE PLANT BLOWERS
POWER AND CONTROL PLANS

PROJECT NO. 2048-264953
FILE NAME: DSEB2BBPL.DWG

SHEET NO.
DS-EB-2

GENERAL ELECTRICAL NOTES:

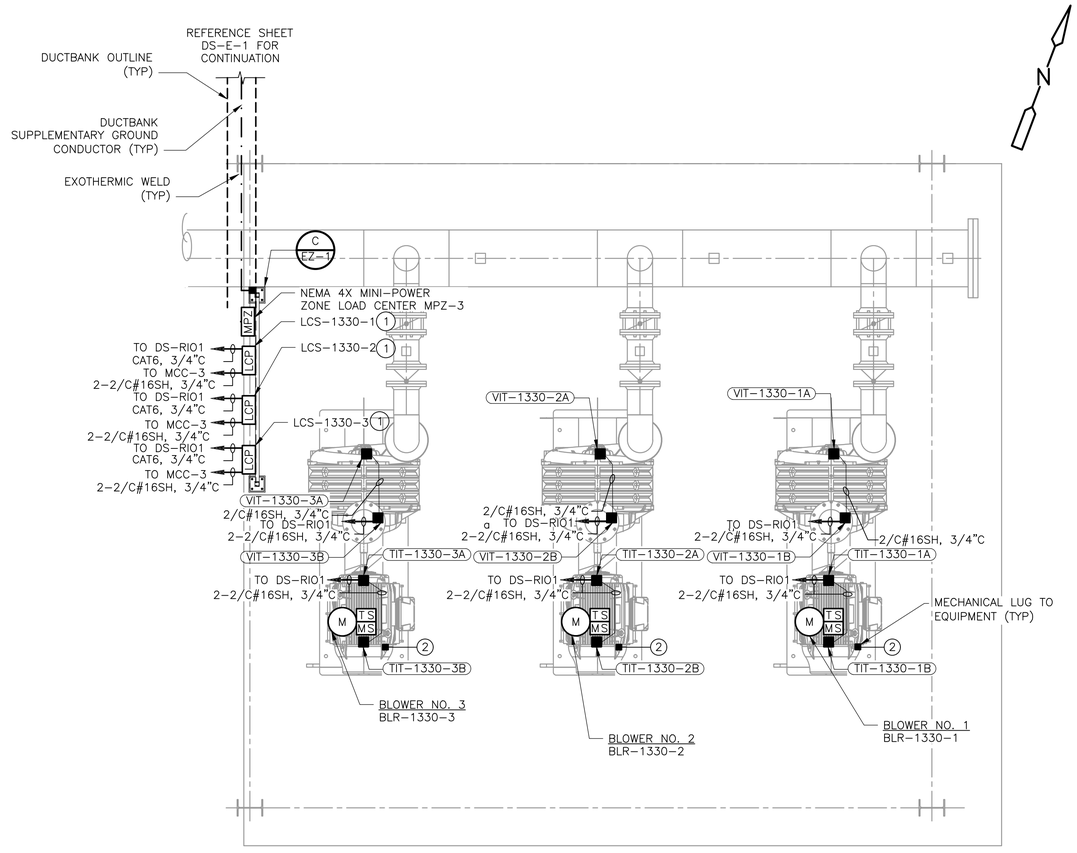
1. PROVIDE ALL LABOR, MATERIAL, AND INCIDENTALS REQUIRED TO REPLACE RENTAL BLOWERS WITH PERMANENT REFURBISHED BLOWERS. INSTALL THE NEW CIRCUITS AS SCHEDULED IN THIS CONTRACT. DETAILS SHOWN ON THIS SHEET ARE FOR DIAGRAMMATICAL PURPOSES AND SHOW INTENT. FITTINGS SUCH AS CONDULETS, PULL BOXES, JUNCTION BOXES, OR CONDUIT PENETRATIONS ARE TYPICALLY NOT SHOWN FOR CLARITY. ALL DIMENSIONS GIVEN ARE APPROXIMATE. FIELD VERIFY AND ADJUST AS REQUIRED FOR FULLY FUNCTIONAL SYSTEM.
2. CONTRACTOR SHALL DISCONNECT ELECTRICAL CIRCUITS IDENTIFIED FOR REMOVAL TO ALLOW FOR SAFE AND COMPLETE REMOVAL OF DESIGNATED EQUIPMENT. REFER TO SECTION CIP3 FOR PROPOSED CONSTRUCTION SEQUENCE.
3. REFER TO SHEET DS-E-6A FOR ONE-LINE DIAGRAM.
4. REFER TO SHEET DS-E-8 FOR PANELBOARD SCHEDULE.

KEY NOTES:

(1) PROVIDED BY DIVISION 43.

(2) BOND #4/0 TIN PLATED COPPER TO EXISTING GROUND GRID.

(3) EQUIPMENT LOCATIONS ARE APPROXIMATE. COORDINATE FINAL LOCATIONS WITH OWNER.



RENTAL PACKAGE PLANT MODIFIED BLOWER POWER AND CONTROL PLAN

1/2" = 1'- 0" (3)

1 0 1 2

Juan Carlos Saenz
STATE OF TEXAS
JUAN CARLOS SAENZ
138331
LICENSED PROFESSIONAL ENGINEER
01/09/2024

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1	01/09/24	SS	JCS	REVISED PER ADDENDUM NO. 4

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DOVE SPRINGS WWTP
REHABILITATION

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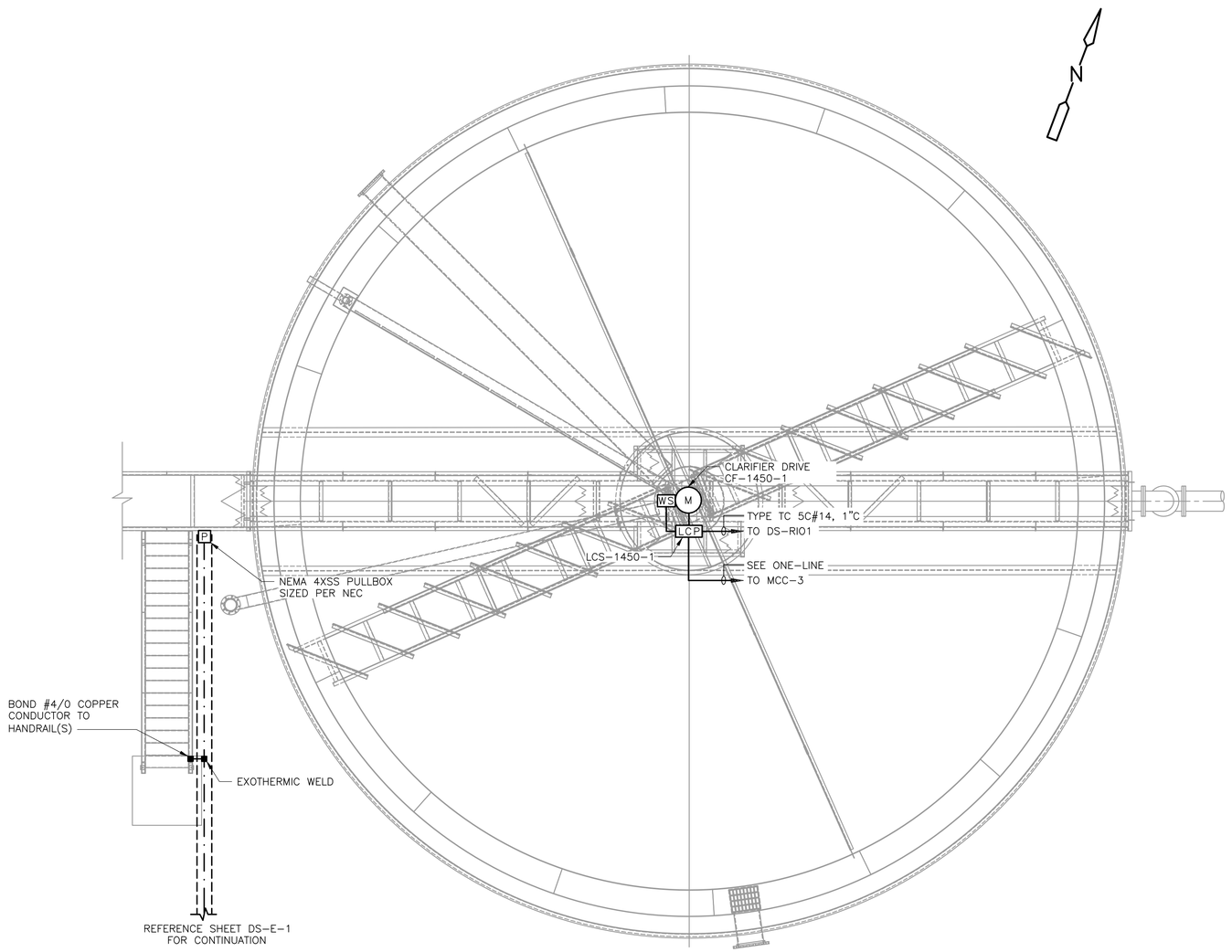
RENTAL PACKAGE PLANT BLOWERS
MODIFIED POWER AND CONTROL PLANS

PROJECT NO. 2048-264953
FILE NAME: DSEB2ABBPL.DWG

SHEET NO.
DS-EB-2A

GENERAL ELECTRICAL NOTES:

1. REFER TO SHEET DS-E-6 FOR ONE-LINE DIAGRAM.
2. REFER TO SHEET DS-E-8 FOR PANELBOARD SCHEDULE.
3. CONDUIT SEALS ARE NOT ILLUSTRATED. PROVIDE CONDUIT SEAL-OFF(S) AS REQUIRED BY NEC CHAPTER 5 SPECIAL OCCUPANCIES.



PACKAGE PLANT CLARIFIER POWER AND CONTROL

PLAN

1/4" = 1'- 0"

2 1 0 2 4

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CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

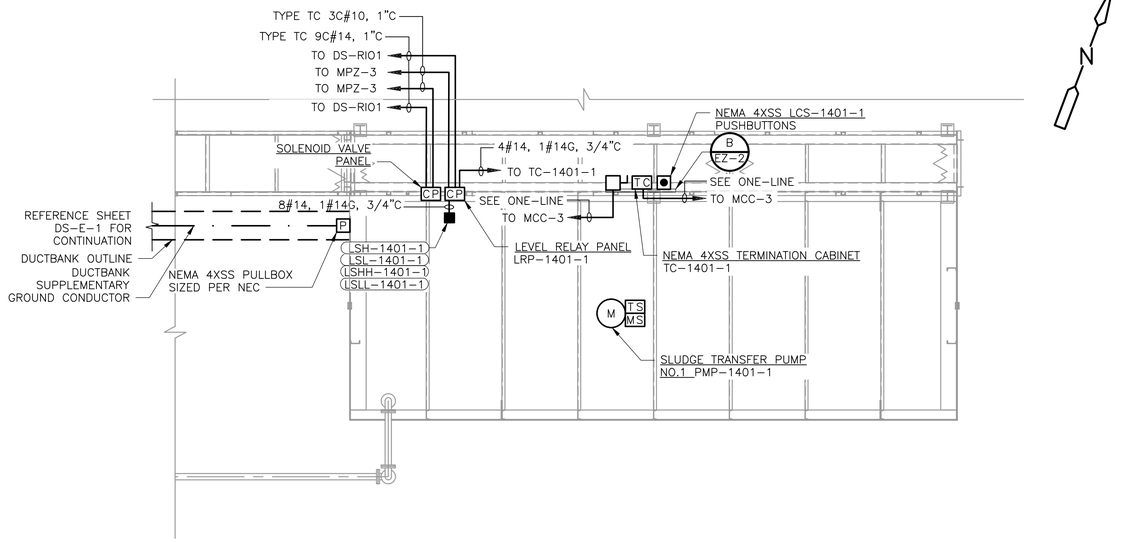
DOVE SPRINGS WWTP
PACKAGE PLANT CLARIFIER
POWER AND CONTROL PLANS

PROJECT NO. 2048-264953
FILE NAME: DSEB3ABPL.DWG

SHEET NO.
DS-EB-3

GENERAL ELECTRICAL NOTES:

1. REFER TO SHEET DS-E-6 FOR ONE-LINE DIAGRAM.
2. REFER TO SHEET DS-E-8 FOR PANELBOARD SCHEDULE.
3. CONDUIT SEALS ARE NOT ILLUSTRATED. PROVIDE CONDUIT SEAL-OFF(S) AS REQUIRED BY NEC CHAPTER 5 SPECIAL OCCUPANCIES.



PACKAGE PLANT SLUDGE PUMP POWER AND CONTROL

PLAN

1/4" = 1'- 0"

2 1 0 2 4

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DOVE SPRINGS WWTP
REHABILITATION

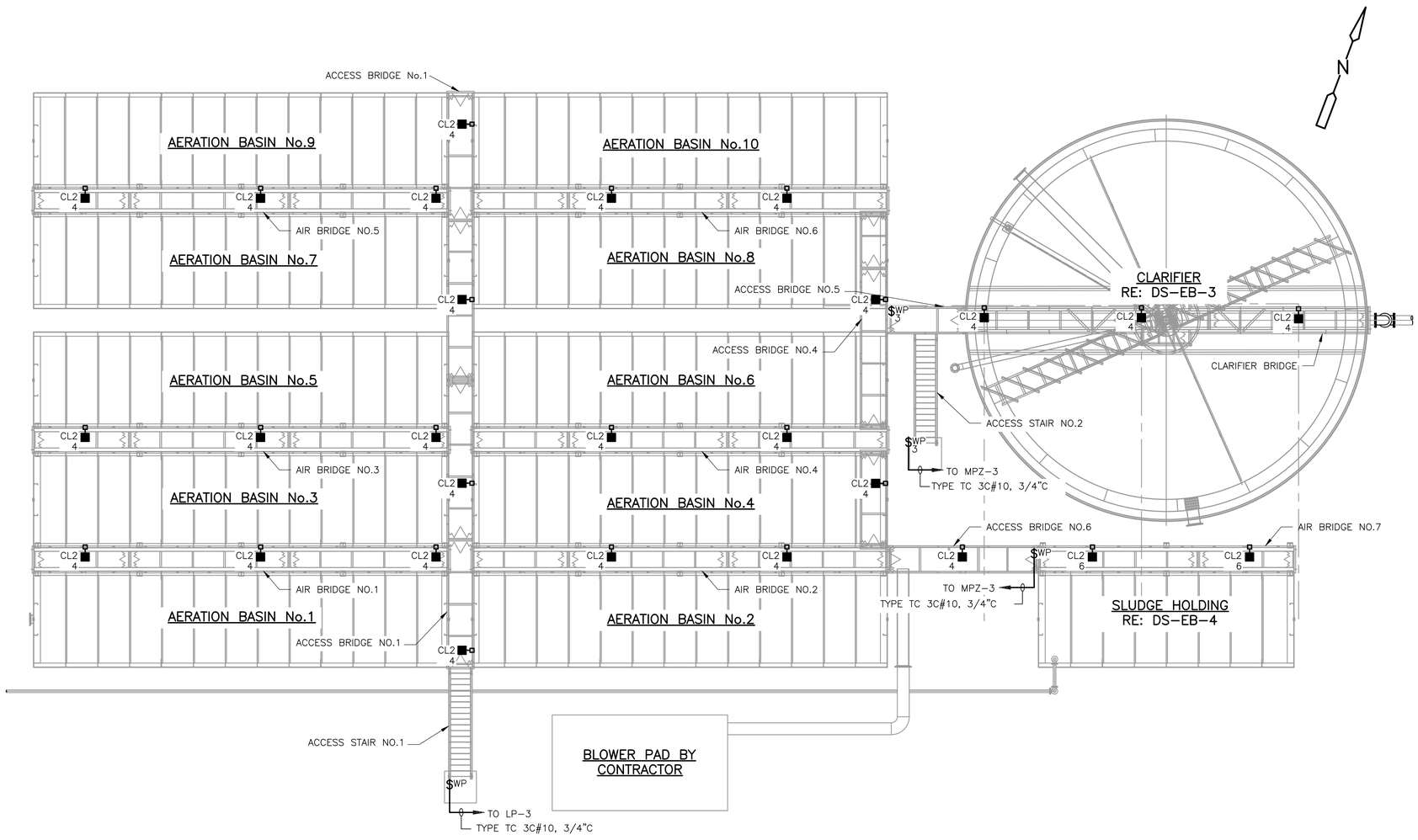
DOVE SPRINGS WWTP
PACKAGE PLANT SLUDGE PUMP
POWER AND CONTROL PLANS

PROJECT NO. 2048-264953
FILE NAME: DSEB4PSPL.DWG

SHEET NO.
DS-EB-4

GENERAL ELECTRICAL NOTES:

1. REFER TO SHEET DS-E-7 AND DS-E-8 FOR PANELBOARD SCHEDULE.
2. CONDUIT SEALS ARE NOT ILLUSTRATED. PROVIDE CONDUIT SEAL-OFF(S) AS REQUIRED BY NEC CHAPTER 5 SPECIAL OCCUPANCIES.



PACKAGE PLANT LIGHTING

PLAN

1/8" = 1'- 0"

4 2 0 4 8

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1	01/09/24	SS	JCS	REVISED PER ADDENDUM NO. 4

DESIGNED BY: –
DRAWN BY: –
SHEET CHK'D BY: –
CROSS CHK'D BY: –
APPROVED BY: J. SAENZ
DATE: DECEMBER 2023

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CITY OF GEORGETOWN, TEXAS

DOVE SPRINGS WWTP
REHABILITATION

DOVE SPRINGS WWTP
PACKAGE PLANT LIGHTING PLAN

PROJECT NO. 2048-264953
FILE NAME: DSEB5-NEW.DWG

SHEET NO.
DS-EB-5