CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

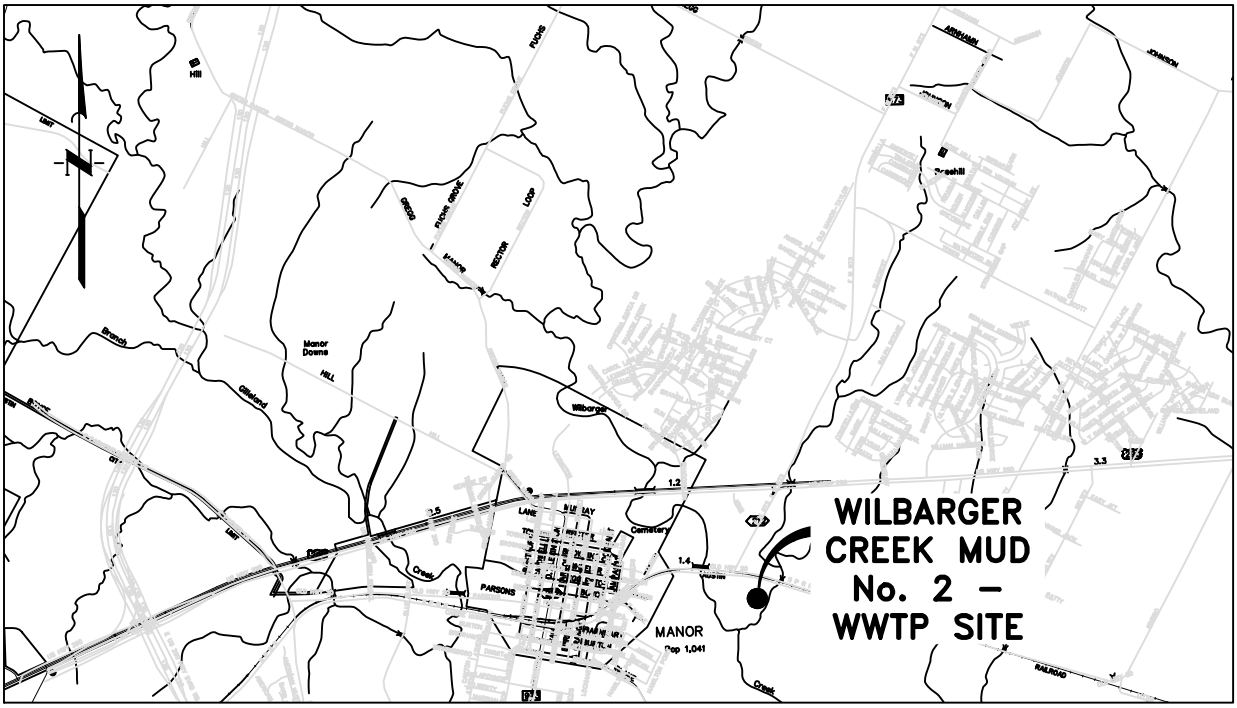
FOR CONSTRUCTION OF

WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD

FOR

WILBARGER CREEK M.U.D. No. 2

TRAVIS COUNTY, TEXAS



VICINITY MAP

Scale: 1" = 5000'

JULY 2026

Quiddity Job No. 0A651-0021-02

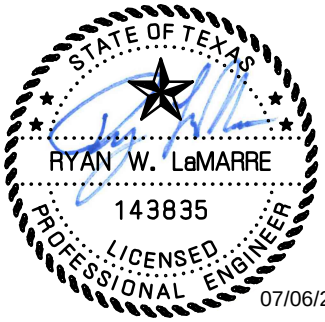
QUIDDITY

Texas Board of Professional Engineers and Land Surveyors Registration Nos. F-23290 & 10046100

CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS
FOR CONSTRUCTION OF
WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD
FOR
WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2
IN
TRAVIS COUNTY, TEXAS

SECTIONS:

02212	02230	02515	02613	02614	02800



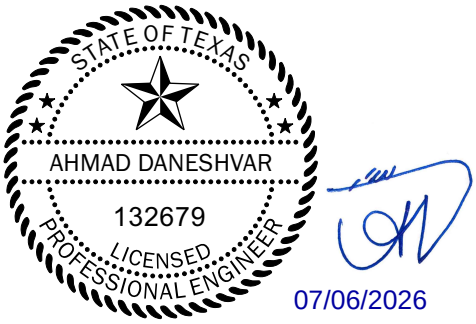
07/06/2026

DIVISION:

03

SECTIONS:

05512	07413	08900



07/06/2026

JULY 2026
Quiddity Job No. 0A651-0021-02

QUIDDITY

Texas Board of Professional Engineers and Land Surveyors Registration Nos. F-23290 & 10046100

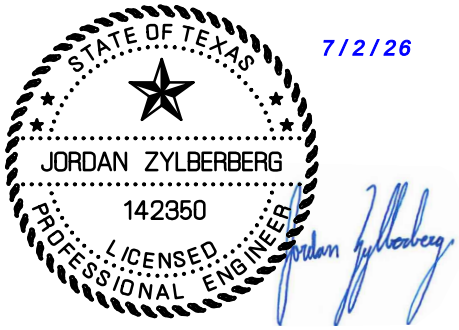
CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS
FOR CONSTRUCTION OF
WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD
FOR
WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2
IN
TRAVIS COUNTY, TEXAS

DIVISIONS:

04	09

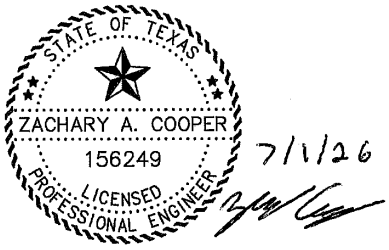
SECTIONS:

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01420	01500	01650	01710	01720	02110	02220
02221	02222	02226	02227	02530	02600	05501
07001	07112	07620	07920	08122	08331	08520
08711	08736	08801	11011	11144	11152	11171
11221	11310	11311	11313	11319	11320	11450
11540	11700	11720	11733	15011	15100	15101
15102	15103	15104	15105	15106	15107	15120
15190	15226	15413	15550	15551	15560	15600
15831	15860					



SECTIONS:

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15202	15249	15258				



JULY 2026
Quiddity Job No. 0A651-0021-02

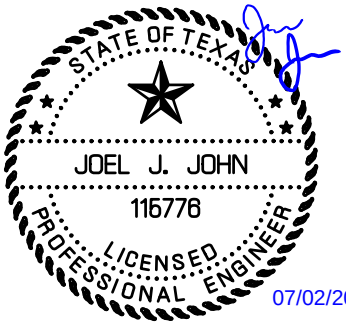
QUIDDITY

Texas Board of Professional Engineers and Land Surveyors Registration Nos. F-23290 & 10046100

CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS
FOR CONSTRUCTION OF
WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD
FOR
WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2
IN
TRAVIS COUNTY, TEXAS

DIVISION:

13

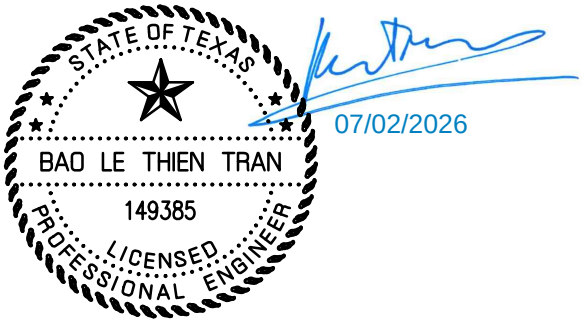


SECTIONS:

15700	15767	15990

DIVISION:

16



JULY 2026
Quiddity Job No. 0A651-0021-02

QUIDDITY

Texas Board of Professional Engineers and Land Surveyors Registration Nos. F-23290 & 10046100

CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS
FOR CONSTRUCTION OF
WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD
FOR
WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2
IN
TRAVIS COUNTY, TEXAS

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INVITATION TO BID

Sealed bids in duplicate addressed to Wilbarger Creek Municipal Utility District No. 2 ("Owner") will be received in the offices of Quiddity Engineering LLC, 912 South Capital of Texas Hwy, Suite 300, Austin, Texas 78746, until 10:00 a.m., Wednesday, November 18th, 2026, and then publicly opened and read via teleconference call for furnishing all plant, labor, material and equipment and performing all work required for the construction of the following (the "Project"):

WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD

The site where the Project will be constructed is located in Travis County, Texas, within the City of Manor's extra-territorial jurisdiction (ETJ), approximately 0.14 miles EAST of the intersection of Old Highway 20 and FM 973 (MAPSCO Page 530 S) at the following address: 12217 Old Highway 20, Manor, Texas 78653

All bidders must shall submit either a certified or cashier's check in the amount of at least two percent (2%) of the maximum total bid amount or a bid bond in the amount of at least five percent (5%) of the maximum total bid amount. The certified or cashier's check or bid bond must be payable to the Owner.

Plans, specifications, and bidding documents are available at www.civcastusa.com.

ATTENTION: Pursuant to Texas Government Code § 2252.908, unless you are a publicly traded entity or a wholly owned subsidiary of same, you must be able to provide Owner with printed and signed copies of a completed disclosure of interested parties form (Form 1295) and a certificate of filing at the time the bid is submitted to Owner. Failure to do so will result in the Owner's inability to execute the contract. To complete the disclosure of interest parties form, or for further information, please visit the Texas Ethics Commission's website at https://www.ethics.state.tx.us.

The requirements of Subchapter J, Chapter 552, Government Code, may apply to the contract for the Project and all bidders agree that the contract for the Project will provide that it can be terminated if the Contractor knowingly or intentionally fails to comply with a requirement of that subchapter.

There will be a pre-bid conference held via teleconference call on Wednesday, October 7th, 2026, at 10:00 a.m. Details for the teleconference call-in information will be provided to all plan holders on Wednesday, September 30th, 2026. **Attendance is not mandatory.**

The Owner reserves the right to reject any or all bids and waive any or all irregularities. No bid may be withdrawn until the expiration of **60 calendar days** from the date bids are open.

END OF SECTION

INSTRUCTION TO BIDDERS

1.0 INVITATION

a. The Work. Bids are invited on a general contract for all materials, equipment, and labor required for the construction of: **Wastewater Treatment Plant Expansion to 1.5 MGD.**

b. The Owner.

Wilbarger Municipal Utility District No. 2
c/o Armbrust & Brown, PLLC
100 Congress Ave, Suite 1300
Austin, Texas 78701
Attention: Mr. John Bartram
Telephone: (512) 435-2300

c. The Operator.

Crossroads Utility Services, LLC
2601 Forest Creek Drive
Round Rock, Texas 78665
Attention: Mr. Dennis Hendrix
Telephone: (512) 246-1400

d. The Engineer.

Quiddity Engineering, LLC
912 South Capital of Texas Hwy, Suite 300
Austin, Texas 78746
Attention: Mr. Jordan Zylberberg, P.E.
Telephone: (346) 231-0867

e. The Bookkeeper.

Bott & Douthitt, PLLC
P.O. Box 2445
Round Rock, Texas 78680
Attention: Ms. Mary Bott
Telephone: (512) 733-0700

2.0 RECEIPT OF BIDS

A. Sealed bids, in duplicate, will be received until 10:00 a.m., Wednesday, November 18th, 2026 in the offices of Quiddity Engineering, LLC, 912 South Capital of Texas Hwy, Suite 300, Austin, Texas 78746.

B. Bids received after this time will not be opened and will be delivered to the Owner for its consideration.

C. There will be a pre-bid conference via teleconference call at 10:00 a.m., Wednesday, October 7th, 2026. Details for the teleconference call-in information will be provided to all plan holders on Wednesday, September 30th, 2026. It will be each bidder's responsibility to ensure they receive the call-in details prior to the pre-bid conference. **Attendance is not mandatory**.

D. Bid opening will be held immediately after the time for receipt of bids has expired.

E. Bids will be opened publicly and read aloud via teleconference call. All interested parties are invited to attend. Details for the teleconference call-in information will be provided to all plan holders on Wednesday, November 11th, 2026, via Civcast. It will be each bidder's responsibility to ensure they receive the call-in details prior to the bid opening.

F. All bidders shall include a contract duration time on the Bid Form to be considered.

G. **ATTENTION: Pursuant to Texas Government Code § 2252.908, unless you are a publicly traded entity or a wholly owned subsidiary of same, you must be able to provide the Owner with printed and signed copies of a completed disclosure of interested parties form (Form 1295) and a certificate of filing at the time the bid is submitted to the Owner. Failure to do so will result in the Owner's inability to execute the contract. To complete the disclosure of interest parties form, or for further information, please visit the Texas Ethics Commission's website at https://www.ethics.state.tx.us.**

3.0 BIDDING DOCUMENTS

A. Bidding documents include all documents available during the bidding period, including, without limitation, the instruction to bidders, invitation to bid, standard form of contract, general and special conditions of the contract, technical specifications, drawings and addenda, if any.

B. Bidders may download copies of the bidding documents at www.civcastusa.com. Bidders must register on this website in order to view and/or download, plans and any attachments for this project. There is NO charge to view or download documents.

C. Bidding documents may be examined by appointment at the office of the Engineer.

4.0 SEPARATED CONTRACT PROVISIONS

A. The selected bidder must abide by all state and local laws regulating sales tax exemption for work being performed for tax exempt entities. Provisions are provided in Section 5.03 of the Special Conditions.

B. is the selected bidder will be responsible for obtaining all permits required by the work at no additional cost to the Owner, except as may specifically be exempted in the Bidding Documents.

5.0 EXAMINATION

A. Bidder shall carefully examine the bidding documents and the site to determine the actual conditions under which work will be done.

B. Data in the Bidding Documents pertaining to existing conditions is for convenience only and does not supplant obtaining firsthand information at the site.

C. Adjusting payments will not be authorized for work that could have been foreseen by a careful examination of the site.

D. Submission of a bid constitutes acceptance by the bidder of existing site conditions as a part of the requirements of this work.

6.0 COMPLETION TIME

A. Bidder shall fill in the blank on the bid form for the number of calendar days for substantial completion of the work after receipt of the written Notice to Proceed. Final Completion of the work shall be achieved within **60 calendar days** from the date of Substantial Completion.

B. Submission of a bid constitutes acceptance by the bidder of the completion time as a part of the requirements of this work.

7.0 QUESTIONS

A. In ample time to permit consideration before reply, submit questions about Bidding Documents to the Engineer. All questions must be submitted electronically on www.civcastusa.com. **Questions will not be considered or answered after 10:00 a.m., three (3) calendar days prior to bidding.**

B. Necessary replies will be issued to bidders of record as addenda, which become a part of the Bidding Documents. Oral instructions do not form a part of the Bidding Documents.

C. Bidders should contact the Engineer not less than 72 hours before bid opening to secure any addenda that may affect bidding.

8.0 SUBMITTAL

A. Submit bid and other required data in an opaque, sealed envelope. If submitted by mail, enclose bid envelope in another envelope addressed for mailing. Plainly identify the sealed envelope with the following information:

Do not open before 10:00 a.m., Wednesday, November 18th, 2026
Bid for: **Construction of Wastewater Treatment Plant Expansion to 1.5 MGD**
Owner: **Wilbarger Creek Municipal Utility District No. 2**
Bidder: _____

B. Submit bid on the bid form provided. Fill in all blanks. If no amount is to be included, insert three zeros in the space. Include all unit cost items and all alternatives shown on the bid form; failure to comply may be cause for rejections. No segregated bids or assignments will be considered.

C. Documents required to be submitted as part of an official bid include: Bid Form, Bid Security, and Certificate of Interested Parties Form 1295.

D. Do not alter the bid form with written memoranda or qualifications. Any explanation, alteration, or other statements proposed by the bidder must be written separately, signed independently, and included in the bid envelope. Bids may not be modified after submittal.

E. Sign in longhand below the typed name of the person authorized to bind the bidder to a contract. When the bidder is a corporation, the bid must be signed with the legal name of the corporation followed by the name of the State of Incorporation and the legal signature of a person authorized to bind the corporation to a contract.

F. ATTENTION: Pursuant to Texas Government Code § 2252.908, unless you are a publicly traded entity or a wholly owned subsidiary of same, you must be able to provide Owner with printed and signed copies of a completed disclosure of interested parties form (Form 1295) and a certificate of filing at the time the bid is submitted to Owner. Failure to do so will result in the Owner's inability to execute the contract. To complete the disclosure of interest parties form, or for further information, please visit the Texas Ethics Commission's website at https://www.ethics.state.tx.us.

All bidders to include the Owner's full name in box 2 of the TEC form, "Wilbarger Creek Municipal Utility District No. 2".

All bidders to enter "0A651-0021-02" into box 3 of the TEC form.

9.0 BID SECURITY

A. The bidder shall submit either a certified or cashier's check in the amount of at least two percent (2%) of the maximum total bid amount or a bid bond in the amount of at least five percent (5%) of the maximum total bid amount. The certified or cashier's check or bid bond must be payable to the Owner.

B. The bid security will be forfeited to the Owner by the bidder and shall be considered as payment for damages due to delay and other inconveniences suffered by the Owner as a result of such failure on the part of the bidder if the bidder fails to execute and deliver a contract, bonds, and insurance certificates and endorsements, as required.

10.0 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

A. Bidder must be capable of executing a satisfactory performance bond and payment bond for one hundred percent (100%) of the contract sum in accord with the Contract Documents.

11.0 WITHDRAWAL

A. Bids may be withdrawn any time before bid opening but may not be resubmitted.

B. Bids may not be withdrawn or modified after bid opening time unless the award of the contract has been delayed more than **60 calendar days**.

12.0 QUALIFICATIONS OF BIDDERS

A. The Owner may make any investigations deemed necessary to determine the bidder's ability to perform the work. When requested, bidders must furnish such information and data necessary for this purpose.

B. The Owner reserves the right to reject any bid if evidence submitted by or investigation of the bidder indicate that the bidder is not properly qualified in the opinion of the Owner, to complete the work satisfactorily.

C. The Contractor must satisfy all insurance, financial, and bonding requirements of the Owner.

D. The Contractor (company or personnel) must have a least five (5) years active experience in the installation of the exact products specified in this project.

E. The Owner may make any investigations deemed necessary to determine the bidder’s ability to perform the work, including the bidder’s ability to perform work including the contractor’s OSHA safety record. When requested, furnish such information and data necessary for this purpose.

13.0 AWARD OF CONTRACT

A. The Owner is not obligated to accept the lowest bid or any bid. The Owner reserves the right to reject any or all bids and to waive any informalities in bids or in bidding. The Owner may accept any bid deemed advantageous. The contract award may include full consideration of unit prices. alternates, subcontractors, and time of completion.

14.0 RETURN OF SIGNED CONTRACTS

A. By submitting a bid, each bidder agrees to return a signed contract with proper bonds, insurance certificates and endorsements, and any other items required under the Bidding Documents within **14 calendar days** after the Engineer has provided notice of award to the bidder. Should the bidder fail to return a properly executed contracts with the proper bonds, insurance certificates and endorsements, and any other items required under the Bidding Documents within **14 calendar days**, the Engineer may disqualify that bidder and recommend that the Owner enter into a contract with another bidder.

END OF SECTION

BID FORM

Bidding Firm: _____

Address: _____

City, State, Zip: _____

Date: _____

Telephone: _____

Owner: Wilbarger Creek Municipal Utility District No. 2

Address: c/o Armbrust & Brown, P.L.L.C.
100 Congress Ave., Suite 1300
Austin, Texas 78701
Attention: Mr. John Bartram
Telephone: (512) 435-2300

Bid Location: Quiddity Engineering, LLC
912 South Capital of Texas HWY, Suite 300
Austin, Texas 78746
Attention: Mr. Jordan Zylberberg, P.E.
Telephone: (346) 231-0867

Project: **WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD**

The undersigned bidder has carefully examined the Contract Documents and Technical Specifications, drawings and any other addenda or other information prepared for the Project (collectively, the "Bidding Documents") for the work herein above described and referred to in the Invitation to Bid (the "Work") and has carefully examined the site of the Work and will provide all necessary labor, superintendence, machinery, equipment, tools, materials, services and other means of construction to complete all the Work upon which he bids, as called for in Bidding Documents, and in the manner prescribed therein and according to the requirements of the Engineer as therein set forth for the amounts below. The Bidding Documents I have examined include the Project specifications and drawings for the subject project and addenda listed as follows:

1. Contract Documents and Technical Specifications dated July 2026

2. Drawings including 230 sheets dated July 2026

3. Addenda as acknowledged below:

No.	Date	No.	Date

In submitting this bid, I agree:

(1) To hold my bid open until **60 calendar days** following the bid opening date set forth in the Bidding Documents.

(2) To accept the provisions of the instructions to bidders regarding the disposition of the bid security.

(3) To enter into a contract with the Owner by executing an agreement on the basis of this bid and to furnish a performance bond, a payment bond, and a certificate of insurance and endorsements, as required by the Bidding Documents, all within 14 calendar days of receipt of notice award from the Engineer.

(4) To accomplish the work in accord with the Bidding Documents by furnishing all materials, equipment, and labor for proper construction and completion of the work.

(5) To have the work substantially completed within _____ **calendar days** from receipt of written notice to proceed, and to achieve final completion within **60 calendar days** after the date the work is substantially completed.

The following items shall include all the labor, equipment, and materials necessary for construction of Wastewater Treatment Plant Expansion to 1.5 MGD as shown on and described in the Bidding Documents.

Item No.	Description of Item with Unit Bid Price in Written Words	Unit	Approx. Quantity	Unit Price	Total Amount
1.	Bonds, insurance, and permits for all work associated with base bid items. Complete as specified for the sum of: @ _____ _____ Per Lump Sum	L.S.	1	$_____	$_____
2.	Move-in and set up for all work associated with the Project. Complete as specified for the sum of: @ _____ _____ Per Lump Sum	L.S.	1	$_____	$_____
3.	Allowance to modify the proposed improvements as described in the Bidding Documents due to unforeseen conditions not determinable at the time of bidding, complete as specified and approved by the Engineer and Owner on an as needed basis for the sum of: @ Two Hundred Thousand Dollars and Zero Cents _____ Per Lump Sum	L.S.	1	$ 200,000.00	$200,000.00

Item No.	Description of Item with Unit Bid Price in Written Words	Unit	Approx. Quantity	Unit Price	Total Amount

4. Construction of the wastewater treatment plant expansion work including but not limited to: lift station (excluding items noted in Bid Item No. 11), elevated headworks (excluding items noted in Bid Item No. 7), peak shaving basin and pump station (excluding items noted in Bid Item No. 8), rapid mix basin, aeration basins, clarifier, tertiary filters (excluding items noted in Bid Item No. 9), chlorine contact basins, sodium hypochlorite system, sodium bisulfite system, aluminum sulfate system, sludge holding tank, blowers (excluding items noted in Bid Item No. 12), electrical control building, non-potable water pump station, dewatering facility (excluding items noted in Bid Item No. 10), gates, valves, piping, fittings, protective coatings, electrical, lighting, controls, duct bank and pull boxes, site restoration, access road, sidewalks, grading, storm/drain facilities, temporary facilities (including bypass pumping), programming, construction materials testing, and all else specified on the construction drawings and contract documents necessary to construct, tie-in and make for a complete and operational system. Complete as specified for the sum of:

@_____

_____ L.S. 1 $_____ $_____

Per Lump Sum

5. Installation, maintenance, and record keeping of a Storm Water Pollution Prevention Plan (SWPPP), compete as specified for the sum of:

@_____

_____ L.S. 1 $_____ $_____

Per Lump Sum

6. Provision of a trench safety system for piping construction, complete as specified for the sum of:

@_____

_____ L.F. 1670 $_____ $_____

Per Linear Foot

7. Purchase and delivery of mechanical screen, washer compactor, and control panel as outlined in the scope of work included in Attachment No. 2 in the specifications for the sum of (not to exceed $425,760.00)

@_____

_____ L.S. 1 $_____ $_____

Per Lump Sum

8. Purchase and delivery of peak shaving basin pump as outlined in the scope of work included in Attachment No. 4 in the specifications for the sum of (not to exceed $46,995.00)

@_____

_____ L.S. 1 $_____ $_____

Per Lump Sum

Item No.	Description of Item with Unit Bid Price in Written Words	Unit	Approx. Quantity	Unit Price	Total Amount

9. Purchase and delivery of cloth media disks, motor actuated ball valve, manifolds, piping, and other accessories, hardware, and appurtenances, as well as on site inspection and start-up, as outlined in the scope of work included in Attachment No. 1 in the specifications for the sum of (not to exceed $85,000.00)

@_____

_____ L.S. 1 $_____ $_____

Per Lump Sum

10. Purchase and delivery of double disc diaphragm pumps, volute press, horizontal and inclined screw conveyor, polymer blending units, valves, control panels, press and conveyor supports, and all other accessories, hardware, and appurtenances as outlined in the scope of work included in Attachment No. 3 in the specifications for the sum of (not to exceed $1,705,00.00)

@_____

_____ L.S. 1 $_____ $_____

Per Lump Sum

11. Purchase and delivery of submersible lift station pumps as outlined in the scope of work included in Attachment No. 5 in the specifications for the sum of (not to exceed $167,238.10)

@_____

_____ L.S. 1 $_____ $_____

Per Lump Sum

12. Purchase and delivery of multi-stage centrifugal blower as outlined in the scope of work included in Attachment No. 6 in the specifications for the sum of (not to exceed $128,610.00)

@_____

_____ L.S. 1 $_____ $_____

Per Lump Sum

TOTAL BASE BID $_____

MAJOR EQUIPMENT MANUFACTURERS

Base Bid. Only the acceptable manufacturers listed shall be used in determining the BASE BID. **The bidder must indicate which manufacturer was used in the BASE BID by circling the manufacturers name and/or filling in the name on the substitution list. If a Substitution is given, an add or deduct amount must be filled in. Failure to do so may disqualify the Bid.**

Substitutions. Any manufacturer not used in the base bid tabulation, including those not listed as an acceptable manufacturer, may be listed as a substitution. The cost of any modifications required to use the substituted equipment shall be included in the equipment cost on page A-11.

The Bidder understands that after a contract is awarded, the Owner may select items of any other manufacturer listed in the following tabulation. If awarded the contract, the Bidder agrees to furnish and install any substitutions listed for the price indicated. The BASE BID will then be adjusted accordingly.

If a contract includes items of equipment of any manufacturer which may require any modification or deviation from the Bidding Documents, the undersigned agrees to prepare and submit detailed drawings to the Engineer showing all modifications in structures, piping, electrical and mechanical work, required to adapt the Bidding Documents to the equipment selected. The Bidder further understands that the Engineer will review said detailed drawings of modifications and either approve them or indicate thereon changes necessary to comply with the project requirements. Detailed drawings of modifications which are not approved will be revised then resubmitted to the engineer. The prices listed in the following tabulation are "installed" prices and take into consideration any of the changes that may be required**.**

LIST OF ACCEPTABLE BASE/SUPPLEMENTARY BID EQUIPMENT MANUFACTURERS

Description	Manufacturer
Wide Band Diffusers	EDI Sanitaire
Fine Bubble Diffusers	EDI Sanitaire
Slide Gate	Fontaine Hydro Gate Waterman
Air Lift Pumps	EDI Sanitaire
Clarifier	Evoqua Walker
Self-Priming Centrifugal Pumps (NPW Pump Station)	Gorman Rupp Griswold ITT Goulds
Peristaltic Pumps	Blue-White Waston-Marlow

LIST OF BASE/ALTERNATE BID EQUIPMENT MANUFACTURERS AND SUBSTITUTIONS

Equipment Item	Base/Alternate Bid Manufacturer	Manufacturer	Substitutions Add (Deduct) from Base/Alternate Bid
Wide Band Diffusers			
Fine Bubble Diffusers			
Slide Gate			
Air Lift Pumps			
Clarifier			
Self-Priming Centrifugal Pumps (NPW Pump Station)			
Peristaltic Pumps			

LIST OF SUBCONTRACTORS

1. Electrical _____
2. Coatings _____
3. Earthwork/Sitework _____
4. Masonry _____
5. Other _____

As bidder I acknowledge that:

1. The Owner reserves the right to reject any and all bids, and to waive any minor informality in any Bid of solicitation procedure. (A minor informality is one that does not affect the competitiveness of the bidders.)

2. The award of the Contract may be made on the BASE BID only or any combination of the BASE BID, ALTERNATIVE ITEMS, SUBCONTRACTORS, and selected SUBSTITUTIONS.

3. I have reviewed and understood all the required Bidding Documents needed to constitute a complete bid, and that to be considered a complete and valid bid, I must submit all items outlined in this bid form in a sealed envelope on or before the designated bid time and date.

4. The contract price may be increased or decreased, or the contract time reduced or extended to compensate for changes in the work as ordered by the Engineer and provided for in the Bidding Documents.

5. The requirements of Subchapter J, Chapter 552, Government Code, may apply to the contract and the bidder agrees that the contract will provide that it may be terminated if the Contractor knowingly or intentionally fails to comply with a requirement of that subchapter.

Furthermore, as bidder I certify that:

1. I am the only person or party associated with or having an interest in this bid and it is made without collusion involving any other person, partnership or corporation.

2. The amounts given in this bid have been carefully checked and are submitted as correct and final. Attached as bid security is either a certified or cashier's check, payable to Owner, in the amount of at least two percent (2%) of the maximum total bid amount or a bid bond, payable to Owner, in the amount of at least five percent (5%) of the maximum total bid amount.

3. I understand that the bid security accompanying this bid shall be returned to the undersigned unless, in case of the acceptance of this bid the undersigned should fail to enter into a written contract with the Owner and provide the performance and payment bonds, insurance certificates and endorsements, and any other items required by the Bidding Documents. In the event the undersigned should fail to enter into a written contract and provide all performance and payment bonds, insurance certificates and endorsements, and other required items within 14 calendar days after the Engineer has given written notice of the award of the bid to the undersigned, it is understood and agreed that the bid security shall be forfeited to the Owner and shall be considered as payment for damages due to delay and other inconveniences suffered by the Owner as a result of such failure on the part of the undersigned.

4. In the event notice of award of the bid is provided to the undersigned, the undersigned agrees to return a properly executed contract, performance and payment bonds, insurance certificates and endorsements, and any other items required by the Bidding Documents within 15 days after receipt of the notice of award of the bid.

Bidder's
Signature: _____

Title: _____ SEAL

Witness: _____

END OF SECTION

CERTIFICATE OF INTERESTED PARTIES

FORM 1295

Complete Nos. 1 - 4 and 6 if there are interested parties.
Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.

OFFICE USE ONLY

1 Name of business entity filing form, and the city, state and country of the business entity's place of business.

2 Name of governmental entity or state agency that is a party to the contract for which the form is being filed.

3 Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the services, goods, or other property to be provided under the contract.

4 Name of Interested Party	City, State, Country (place of business)	Nature of Interest (check applicable)	
		Controlling	Intermediary

5 Check only if there is NO Interested Party. ☐

6 UNSWORN DECLARATION

My name is _____, and my date of birth is _____.

My address is _____, _____, _____, _____, _____.
(street) (city) (state) (zip code) (country)

I declare under penalty of perjury that the foregoing is true and correct.

Executed in _____ County, State of _____ , on the _____ day of _____, 20_____.
(month) (year)

_____
Signature of authorized agent of contracting business entity
(Declarant)

ADD ADDITIONAL PAGES AS NECESSARY

Must file online at www.ethics.state.tx.us/File

STANDARD FORM OF CONTRACT

STATE OF TEXAS §

COUNTY OF TRAVIS §

THIS STANDARD FORM OF CONTRACT (this "Contract") is made and entered into this ___day of__ _____, A.D. 20_____, by and between **WILBARGER CREEK MUNICIPAL UTILITY DISTRICT No. 2** of the County of Travis and State of Texas, acting through Its Board of Directors thereunto duly authorized so to do, hereinafter termed OWNER, and_____of the City of_____, County of____ _____and State of _____, hereinafter termed CONTRACTOR.

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned, to be made and performed by the OWNER, and under the conditions expressed in the bond bearing even date herewith, CONTRACTOR, hereby agrees with OWNER to commence and complete the construction of certain improvements described as follows (the "Project"):

CONSTRUCTION OF WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD
FOR
WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2
($XXX,XXX.XX)
BASE BID

and all extra work in connection therewith, under the terms as stated in this Contract and, at his (or their) own proper cost and expense, to furnish all the materials, supplies, machinery, equipment, tools, superintendence, labor, insurance, and other accessories and services necessary for execution and completion of the Project in accordance with the Contract Documents (collectively, the "Work")..

The CONTRACTOR hereby agrees to commence work within ten (10) days after the date written notice to do so shall have been given to him, and to substantially complete the same within **____ calendar days** after the date of the written notice to commence work and achieve final completion within **60 calendar days** after substantial completion, subject to such extensions of time as are provided by the Contract Documents.

The OWNER agrees to pay the CONTRACTOR in current funds the price or prices shown in the Bid, which forms a part of this Contract, such payments to be subject to the Contract Documents.

Terms used in this Contract but not defined herein shall have the meaning indicated in the General Conditions. This Contract, together with the other Contract Documents, constitute the entire agreement between Owner and Contractor with respect to the Work. All prior negotiations, representations, and agreements with respect thereto not incorporated in the Contract Documents are hereby cancelled. If any provision or part of the Contract Documents is held to be illegal, invalid, or unenforceable under present or future Applicable Laws, it is the intention of the parties that the remainder of the Contract Documents

not be affected thereby, and it is also the intention of the parties that, in lieu of each provision of the Contract Documents that is illegal, invalid, or unenforceable, there be added as a part of the Contract Documents a provision as similar in terms to the illegal, invalid, or unenforceable provision as possible that is legal, valid, and enforceable. The terms and conditions of the Contract Documents, which contemplate a period of time beyond final completion or termination, will survive final completion or termination and will not be merged therein or otherwise terminated. No consent or waiver, express or implied, to or of any default of any covenant or provision of the Contract Documents by any party will be construed as a consent or waiver to or any other default of the same or any other covenant or provision. This Contract and the Contract Documents will be governed by and interpreted and enforced in accordance with the laws of the State of Texas. This Contract and the Contract Documents are made and will be enforceable in Travis County, Texas.

In consideration of the award and execution of this Contract, and in consideration of the waiver of its right to attorney's fees by Owner, Contractor knowingly and intentionally waives its right to attorney's fees under Section 271.153 of the Texas Local Government Code in any administrative proceeding, alternative dispute resolution proceeding, or litigation arising out of or connected to this Contract. Each party represents and warrants that it has the full right, power, and authority to execute this Contract and all related documents. Each person executing this instrument on behalf of a party represents that he or she is an authorized representative of and has the authority to sign this document on behalf the respective party. Although drafted by Owner, this Contract and the other Contract Documents, in event of any disputes over its meaning or application, shall be interpreted fairly and reasonably, and neither more strongly for nor against either party.

IN WITNESS WHEREOF, the parties of these presents have executed this Contract in the year and day first above written.

WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2	
OWNER	CONTRACTOR
By:_____	By:_____
ATTEST:	ATTEST:
_____	_____

STATE OF TEXAS §

COUNTY OF TRAVIS §

BEFORE ME, the undersigned authority, on this day personally appeared_____ _____, known to me to be the persons whose names are subscribed to the foregoing instrument and acknowledged to me that they executed the same for the purposes and considerations therein expressed and in the capacity therein and herein stated, and as the act and deed of said _____.

GIVEN UNDER MY HAND and seal of office, this _____ day of_____, 20____.

_____

Notary Public - Signature

STATE OF TEXAS §

COUNTY OF TRAVIS §

BEFORE ME, the undersigned authority, on this day personally appeared_____ _____, known to me to be the persons whose names are subscribed to the foregoing instrument and acknowledged to me that they executed the same for the purposes and considerations therein expressed and in the capacity therein and herein stated, and as the act and deed of said _____.

GIVEN UNDER MY HAND and seal of office, this_____ day of,_____ 20____.

_____

Notary Public - Signature

STATE OF TEXAS §

COUNTY OF TRAVIS §

BEFORE ME, the undersigned authority, on this day personally appeared_____ _____, known to me to be the persons whose names are subscribed to the foregoing instrument and acknowledged to me that they executed the same for the purposes and considerations therein expressed and in the capacity therein and herein stated, and as the act and deed of said _____.

GIVEN UNDER MY HAND and seal of office, this_____ day of,_____ 20____.

_____
Notary Public - Signature

STATE OF TEXAS §

COUNTY OF TRAVIS §

BEFORE ME, the undersigned authority, on this day personally appeared_____ _____, known to me to be the persons whose names are subscribed to the foregoing instrument and acknowledged to me that they executed the same for the purposes and considerations therein expressed and in the capacity therein and herein stated, and as the act and deed of said _____.

GIVEN UNDER MY HAND and seal of office, this _____ day of_____, 20___.

_____
Notary Public - Signature

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GENERAL CONDITIONS OF CONTRACT

1. DEFINITIONS OF TERMS

1.01 OWNER, CONTRACTOR AND ENGINEER

The OWNER, the CONTRACTOR and the ENGINEER are those persons or organizations identified as such in the Contract (defined below) and are referred to throughout the Contract Documents (defined below) as if singular in number and masculine in gender. The term ENGINEER means the ENGINEER or his duly authorized representative. The ENGINEER shall be understood to be the ENGINEER of the OWNER, and nothing contained in the Contract Documents shall create any contractual or agency relationship between the ENGINEER and the CONTRACTOR.

1.02 CONTRACT DOCUMENTS

The Contract Documents shall consist of the Invitation to Bid, Instruction to Bidders, the Contract, the General Conditions of the Contract, the Special Conditions of the Contract, the Prevailing Wage Rate, the Payment Bond, the Performance Bond, the Specifications, the completed and accepted bid submitted by Contractor (the "Bid"), any other drawings, written instruments, or documents approved by the parties in writing relating to the work, and all charge orders, exhibits, addenda, amendments, or modifications to any of such documents.

The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. In case of conflict between any of the Contract Documents, priority of interpretation shall be in the following order: the Contract, the Performance and Payment Bonds, the Bid, the Special Conditions of the Contract, the Invitation to Bid and Instruction to Bidders, construction drawings, the Specifications, and the General Conditions of Contract.

1.03 SUBCONTRACTOR

The term Subcontractor, as employed herein, includes only those having a direct contract with the CONTRACTOR and it includes one who furnishes material worked to a special design according to the Contract Documents, but does not include one who merely furnishes material not so worked.

1.04 WRITTEN NOTICE

Written notice shall be deemed to have been duly served if 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 if delivered at or sent by registered mail to the last business address known to him who gives the notice.

1.05 WORK

The CONTRACTOR shall provide and pay for all materials, supplies, machinery, equipment, tools, superintendence, labor, services, insurance, and all water, light, power, fuel, transportation and other facilities, accessories, and services necessary for the execution and completion of the Project in accordance with the Contract Documents (collectively, the "Work"). Unless otherwise specified, all materials shall be new and both workmanship and materials shall be of a good quality. The CONTRACTOR shall, if required, furnish satisfactory evidence as to the kind and quality of materials. Materials or work described in words which so applied have a well known technical or trade meaning shall be held to refer to such recognized standards.

1.06 EXTRA WORK

The term "Extra Work" as used in the Contract Documents shall be understood to mean and include all work that may be required by the ENGINEER or OWNER to be done by the CONTRACTOR to accomplish any change, alteration or addition to the Work shown upon the construction drawings or reasonably implied by the Specifications, and not covered by the CONTRACTOR'S Bid, except as provided under "Changes and Alterations", herein.

1.07 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.

1.08 CALENDAR DAY

"Calendar Day" is any day of the week or month, no days being excepted. No allowance will be made for inclement weather if the CONTRACTOR was able or would have been able to prosecute the principal units of work for a period of not less than seven (7) hours between 7:00 a. m. and 6:00 p. m.

1.09 SUBSTANTIALLY COMPLETED

By the term "substantially completed" is meant that the Project has been made suitable for use or occupancy or is in condition to serve its intended purpose, but still may require minor miscellaneous work and adjustment.

2. RESPONSIBILITIES OF THE ENGINEER AND THE CONTRACTOR

2.01 OWNER-ENGINEER RELATIONSHIP

The ENGINEER will be the OWNER'S representative during the term of the Contract Documents. The duties, responsibilities and limitations of authority of the ENGINEER as the OWNER'S representative during construction are as set forth in the Contract Documents and shall not be extended or limited without written consent of the OWNER and ENGINEER. The ENGINEER will advise and consult with the OWNER, and all of OWNER'S instructions to the CONTRACTOR shall be issued through the ENGINEER.

2.02 OBSERVATION OF THE WORK

The ENGINEER shall make periodic visits to the site to familiarize himself generally with the progress of the executed Work and to determine if such Work generally meets the essential performance and design features and the technical and functional engineering requirements of the Contract Documents; provided and except, however, that the ENGINEER shall not be responsible for making any detailed, exhaustive, comprehensive or continuous on-site inspection of the quality or quantity of the Work or be in any way responsible, directly or indirectly, for the construction means, methods, techniques, sequences, quality, procedures, programs, safety precautions or lack of same incident thereto or in connection therewith. Notwithstanding any other provision of the Contract or any other Contract Document, the ENGINEER shall not be in any way responsible or liable for any acts, errors, omissions or negligence of the CONTRACTOR, any subcontractor or any of the CONTRACTOR'S or subcontractor's agents, servants or employees or any other person, firm or corporation performing or attempting to perform any of the Work.

2.03 PAYMENTS FOR WORK

The ENGINEER shall review CONTRACTOR'S applications for payment and supporting data, determine the amount owed to the CONTRACTOR and approve, in writing, payment to CONTRACTOR in such amounts; such approval of payment to CONTRACTOR constitutes a representation to the OWNER of ENGINEER'S professional judgment that the Work has progressed to the point indicated to the best of his knowledge, information and belief, but such approval of an application for payment to CONTRACTOR shall not be deemed as a representation by ENGINEER that ENGINEER has made any examination to determine how or for what purpose CONTRACTOR has used the moneys paid on account of the Contract price.

2.04 INITIAL DETERMINATIONS

The ENGINEER initially shall determine all claims, disputes and other matters in question between the CONTRACTOR and the OWNER relating to the execution or progress of the Work or the interpretation of the Contract Documents and the ENGINEER'S decision shall be rendered in writing within a reasonable time. Should the ENGINEER fail to make such decision within a reasonable time, appeal to arbitration may be taken as if his decision had been rendered against the party appealing.

2.05 OBJECTIONS

In the event the ENGINEER renders any decision which, in the opinion of either party hereto, is not in accordance with the meaning and intent of the Contract Documents, either party may file with the ENGINEER within thirty days his written objection to the decision, and by such action may reserve the right to submit the question so raised to arbitration as hereinafter provided.

2.06 LINES & GRADES

Unless otherwise specified, the ENGINEER or his representative shall furnish all lines and grades. Whenever necessary, the Work shall be suspended to permit performance of this work, but such suspension will be as brief as practicable and the CONTRACTOR shall be allowed no extra compensation therefore. The CONTRACTOR shall give the ENGINEER ample notice of the time and place where lines and grades will be needed. All stakes, marks, etc. shall be carefully preserved by the CONTRACTOR, and in case of careless destruction or removal by him or his employees, such stakes, marks, etc. shall be replaced at the CONTRACTOR'S expense.

2.07 CONTRACTOR'S DUTY AND SUPERINTENDENCE

The CONTRACTOR shall give adequate attention to the faithful prosecution and completion of the Contract and shall keep on the Work, during its progress, a competent superintendent and any necessary assistants. The superintendent shall represent the CONTRACTOR in his absence and all directions given to him shall be as binding as if given to the CONTRACTOR.

The CONTRACTOR is and at all times shall remain an independent contractor, solely responsible for the manner and method of completing his Work under the Contract Documents, with full power and authority to select the means, method and manner of performing such Work, so long as such methods do not adversely affect the Project, the OWNER and ENGINEER being interested only in the result obtained and conformity of such Project to the Contract Documents.

Likewise, the CONTRACTOR shall be solely responsible for the safety of himself, his employees and other persons, as well as for the protection of the safety of the Work and the property of himself or any other person, as a result of his operations hereunder. Construction drawings and Specifications as well as any additional information concerning the Work passing from or through the ENGINEER shall not be interpreted as requiring or allowing CONTRACTOR to deviate from the Contract Documents, the intent of such drawings, Specifications, and any other such instructions being to define with particularity the agreement of the parties as to the Work the CONTRACTOR is to perform. CONTRACTOR shall be fully and completely liable, at his own expense, for design, construction, installation and use, or non-use, of all items and methods incident to performance of the contract, and for all loss, damage or injury incident thereto, either to person or property, including, without limitation, the adequacy of all temporary supports, shoring, bracing, scaffolding, machinery or equipment, safety precautions or devices, and similar items or devices used by him during performance of the Work.

Any review of Work in progress, or any visit or observation during construction, or any clarification of construction drawings and Specifications, by the ENGINEER, or any agent, employee, or representative of either of them, whether through personal observation on the Project site or by means of approval of shop drawings for temporary construction or construction processes, or by other means or method, is agreed by the CONTRACTOR to be for the purpose of observing the extent and nature of Work completed or being performed, as measured against the Contract Documents, or for the purpose of enabling CONTRACTOR to more fully understand the Contract Documents so that the completed Work will conform thereto, and shall in no way relieve the CONTRACTOR from full and complete responsibility for the proper performance of his Work on the Project, including but without limitation the propriety of means and methods of the CONTRACTOR in performing said contract, and the adequacy of any designs, construction drawings or other facilities for accomplishing such performance. Deviation by the CONTRACTOR from Contract Documents that may have been in evidence during any such visitation or observation by the ENGINEER, or any of his representatives whether called to the CONTRACTOR'S attention or not shall in no way relieve CONTRACTOR from his responsibility to complete all Work in accordance with the Contract Documents.

2.08 CONTRACTOR'S UNDERSTANDING

It is understood and agreed that the CONTRACTOR has, by careful examination, satisfied himself as to the nature and location of the Work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the character of equipment and facilities needed preliminary to and during the prosecution of the Work, the general and local conditions, and all other matters which can in any way affect the Work under the Contract Documents. CONTRACTOR also understands and agrees that any soil reports and log borings are available for CONTRACTOR'S information only. The report is not a warranty of subsurface conditions, nor is it a part of the Contract Documents. The CONTRACTOR is expected to examine the site and such reports and then decide for himself the character of the materials to be encountered. No verbal agreement or conversation with any officer, agent or employee of the OWNER or ENGINEER either before or after the execution of the Contract, shall affect or modify any of the terms or obligations herein contained.

OWNER and ENGINEER disclaim any responsibility for the accuracy, true location and extent of the surface and subsurface investigations that have been prepared by others. OWNER and ENGINEER further disclaim responsibility for interpretation of that data by CONTRACTOR, i.e. projecting soil-bearing values, rock profiles, soil stability and the presence, level and extent of underground water or underground facilities.

2.09 CHARACTER OF WORKERS

The CONTRACTOR agrees to employ only orderly and competent persons, skillful in the performance of the type of Work required under the Contract Documents, to do the Work; and agrees that whenever the ENGINEER shall inform him in writing that any persons on the Work are, in his opinion, incompetent, unfaithful or disorderly, such persons shall be discharged from the Work and shall not again be employed on the Work without the ENGINEER'S written consent.

2.10 CONTRACTOR'S BUILDINGS

The building of structures for housing men, or the erection of tents or other forms of protection, will be permitted only at such places as the ENGINEER shall direct, and the sanitary conditions for the grounds in or about such structures shall at all times be maintained in a manner satisfactory to the ENGINEER.

2.11 SANITATION

Necessary sanitary conveniences for the use of laborers on the Work, properly secluded from public observation, shall be constructed and maintained by the CONTRACTOR in such manner and at such points as shall be approved by the ENGINEER, and their use shall be strictly enforced.

2.12 SHOP DRAWINGS

The CONTRACTOR shall submit to the ENGINEER, with such promptness as to cause no delay in his own Work or in that of any other Contractor, four checked copies, unless otherwise specified, of all shop and/or setting drawings and schedules required for the Work of the various trades, and the ENGINEER shall pass upon them with reasonable promptness, making desired corrections. The CONTRACTOR shall make any corrections required by the ENGINEER, file with him two corrected copies and furnish such other copies as may be needed. The ENGINEER'S approval of such drawings or schedules shall not relieve the CONTRACTOR from responsibility for deviations from drawings or specifications, unless he has in writing called the ENGINEER'S attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules. It shall be the CONTRACTOR'S responsibility to fully and completely review all shop drawings to ascertain their effect on his ability to perform the required contract Work in accordance with the Contract Documents and within the contract time.

Such review by the ENGINEER shall be for the sole purpose of determining the sufficiency of said drawings or schedules to result in the Work in conformity with the Contract Documents, and shall not relieve the CONTRACTOR of his duty as an independent contractor as previously set forth, it being expressly understood and agreed that the ENGINEER does not assume any duty to pass upon the propriety or adequacy of such drawings or schedules, or any means or methods reflected thereby, in relation to the safety of either person or property during CONTRACTOR'S performance hereunder.

2.13 PRELIMINARY APPROVAL

The ENGINEER shall not have the power to waive the obligations of the Contract Documents for the furnishing by the CONTRACTOR of good material, and of his performing good Work as herein described, and in full accordance with the Contract Documents. No failure or omission of the ENGINEER to discover, object to or condemn any defective Work or material shall release the CONTRACTOR from the obligations to fully and properly perform the contract, including without limitation, the obligation to at once tear out, remove and properly replace the same at any time prior to final acceptance upon the discovery of said defective Work or material; provided, however, that the ENGINEER shall, upon request of the CONTRACTOR, inspect and accept or reject any material furnished, and in event the material has been once accepted by the ENGINEER, such acceptance shall be binding on the OWNER, unless it can be clearly shown that such material furnished does not meet the specifications for this Work.

Any questioned Work may be ordered taken up or removed for re-examination, by the ENGINEER, prior to final acceptance, and if found not in accordance with the specifications for said Work, all expense of removing, re-examination and replacement shall be borne by the CONTRACTOR, otherwise the expense thus incurred shall be allowed as EXTRA WORK, and shall be paid for by the OWNER; provided that, where inspection or approval is specifically required by the specifications prior to performance of certain Work, should the CONTRACTOR proceed with such Work without requesting prior inspection or approval he shall bear all expense of taking up, removing, and replacing this Work if so directed by the ENGINEER.

2.14 DEFECTS AND THEIR REMEDIES

It is further agreed that if the Work or any part thereof, or any material brought on the site of the Work for use in the Work or selected for the same, shall be deemed by the ENGINEER as unsuitable or not in conformity with the specifications, the CONTRACTOR shall, after receipt of written notice thereof from the ENGINEER, forthwith remove such material and rebuild or otherwise remedy such Work so that it shall be in full accordance with the Contract Documents.

2.15 CHANGES AND ALTERATIONS

The CONTRACTOR further agrees that the OWNER may make such changes and alterations as the OWNER may see fit, in the line, grade, form, dimensions, construction drawings or materials for the Work herein contemplated, or any part thereof, either before or after the beginning of the construction, without affecting the validity of the Contract Documents and the accompanying Performance and Payment Bonds.

If such changes or alterations diminish the quantity of the Work to be done, they shall not constitute the basis for a claim

for damages, or anticipated profits on the Work that may be dispensed with, except as provided for unit price items under Section 5 "Measurement and Payment". If the amount of Work is increased, and the Work can fairly be classified under the specifications, such increase shall be paid for according to the quantity actually done and at the unit price, if any, established for such Work under the Contract Documents, except as provided for unit price items under Section 5 "Measurement and Payment;" otherwise, such additional Work shall be paid for as provided under Extra Work. In case the OWNER shall make such changes or alterations as shall make useless any Work already done or material already furnished or used in said Work, then the OWNER shall recompense the CONTRACTOR for any material or labor so used, and for any actual loss occasioned by such change, due to actual expenses incurred in preparation for the Work as originally planned.

3. GENERAL OBLIGATIONS AND RESPONSIBILITIES

3.01 KEEPING OF DRAWINGS AND SPECIFICATIONS ACCESSIBLE

The ENGINEER shall furnish the CONTRACTOR with five (5) sets of all drawings and specifications without expense to him, and the CONTRACTOR shall keep one copy of the same constantly accessible on the Work, with the latest revisions noted thereon.

3.02 OWNERSHIP OF DRAWINGS

All drawings, specifications and copies thereof furnished by the ENGINEER as a part of the Contract Documents shall not be reused on other work, and, with the exception of the signed contract sets, are to be returned to him on request at the completion of the Work. All models are the property of the OWNER.

3.03 RIGHT OF ENTRY

The OWNER reserves the right to enter the property or location on which the Work herein contracted for are to be constructed or installed, by such agent or agents as he may elect, for the purpose of inspecting the Work, or for the purpose of constructing or installing such collateral work as said OWNER may desire.

3.04 COLLATERAL CONTRACTS

The OWNER agrees to provide by separate contract or otherwise, all labor and material essential to the completion of the Work specifically excluded from the Contract Documents, in such manner as not to delay the progress of the Work, or damage said CONTRACTOR, except where such delays are specifically mentioned elsewhere in the Contract Documents.

3.05 DISCREPANCIES AND OMISSIONS

It is further agreed that it is the intent of the Contract Documents that all Work must be done and all material must be furnished in accordance with the generally accepted practice, and in the event of any discrepancies between the separate contract documents, the priority of interpretation defined under "Contract Documents" shall govern. In the event that there is still any doubt as to the meaning and intent of any portion of the Contract Documents, the ENGINEER shall define which is intended to apply to the Work.

3.06 EQUIPMENT, MATERIALS AND CONSTRUCTION PLANT

The CONTRACTOR shall be responsible for the care, preservation, conservation, and protection of all materials, supplies, machinery, equipment, tools, apparatus, accessories, facilities, all means of construction, and any and all parts of the Work, whether the CONTRACTOR has been paid, partially paid, or not paid for such Work, until the entire Work is completed and accepted.

3.07 DAMAGES

In the event the OWNER is damaged in the course of the Work by the act, negligence, omission, mistake or default of the CONTRACTOR, or should the CONTRACTOR unreasonably delay the progress of the Work being done by others on the job so as to cause loss for which the OWNER becomes liable, then the CONTRACTOR shall reimburse the OWNER for such loss.

3.08 PROTECTION AGAINST ACCIDENT TO EMPLOYEES AND THE PUBLIC

The CONTRACTOR shall at all times exercise reasonable precautions for the safety of employees and others on or near the Work and shall comply with all applicable provisions of Federal, State, and local safety laws and building and construction codes, including any rules adopted by Owner. All machinery and equipment and other physical hazards shall be guarded in accordance with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America except where incompatible with Federal, State, or local laws, regulations, or rules. The CONTRACTOR shall provide such machinery guards, safe walkways, ladders, bridges, gangplanks, and other safety devices. The safety precautions actually taken and their adequacy shall be the sole responsibility of the CONTRACTOR, acting at his discretion as an independent contractor.

3.09 PERFORMANCE AND PAYMENT BONDS

Unless otherwise specified, it is further agreed by the parties to the Contract that the CONTRACTOR will execute separate performance and payment bonds, each in the sum of one hundred (100) percent of the total contract price, in standard forms for this purpose, guaranteeing faithful performance of the Work and the fulfillment of any guarantees required, and further guaranteeing payment to all persons supplying labor and materials or furnishing him any equipment in the execution of the Work, and it is agreed that the Contract shall not be in effect until such performance and payment bonds are furnished and approved by the OWNER.

Unless otherwise approved in writing by the OWNER, the surety company underwriting the bonds shall be acceptable according to the latest list of companies holding certificates of authority from the Secretary of the Treasury of the United States.

Unless otherwise specified, the cost of the premium for the performance and payment bonds shall be included in the CONTRACTOR'S Bid.

Also said surety company (a) must be authorized to do business in the State of Texas as evidenced by licensing through the State Board of Insurance; (b) must be authorized to issue payment and performance bonds in the amount required for the contract as indicated by the records of the State Board of Insurance; and (c) must have a rating of at least "B+" in the current Best's Key Rating Guide.

If the surety company does not have any such rating due to the length of time it has been a surety company, the surety company must demonstrate eligibility to participate in the surety bond guarantee program of the Small Business Administration and must be an approved surety company listed in the current United States Department of Treasury Circular 570. The performance and payment bonds shall meet the criteria contained in the rules and regulations promulgated by the United States Department of Treasury with respect to performance and payment bonds for federal jobs, including specifically the rules related to the underwriting limitation.

The person executing a Performance and Payment Bond must be licensed as a Texas Local Recording Agent through the State Board of Insurance as required by the laws of the State of Texas and such licensing must be recorded in the office of the State Board of Insurance.

The person executing the Performance and Payment Bonds must hold an appointment from the surety company to execute performance and payment bonds and bind such surety, and such appointment must be recorded in the office of the State Board of Insurance.

Unless otherwise specified, the cost of the premium for the Bonds shall be included in the CONTRACTOR'S Bid.

3.10 LOSSES FROM NATURAL CAUSES

Unless otherwise specified, all loss or damage to the CONTRACTOR arising out of the nature of the Work to be done, or from the action of the elements, or from any unforeseen circumstance in the prosecution of the same, or from unusual obstructions or difficulties which may be encountered in the prosecution of the Work, shall be sustained and borne by the CONTRACTOR at his own cost and expense.

3.11 PROTECTION OF ADJOINING PROPERTY; INDEMNIFICATION

The said CONTRACTOR shall take proper means to protect the adjacent or adjoining property or properties in any way encountered, which might be injured or seriously affected by the Work to be undertaken under the Contract, from any damage or injury by reason of said Work; and he shall be liable for any and all claims for such damage on account of his failure to fully protect all adjoining property. THE CONTRACTOR AGREES TO INDEMNIFY, TO THE FULLEST EXTENT OF THE LAW, SAVE AND HOLD HARMLESS THE OWNER AND ENGINEER AGAINST ANY CLAIM OR CLAIMS FOR DAMAGES DUE TO ANY INJURY TO ANY ADJACENT OR ADJOINING PROPERTY, ARISING OR GROWING OUT OF THE PERFORMANCE OF THE CONTRACT; BUT ANY SUCH INDEMNITY SHALL NOT APPLY TO ANY CLAIM OF AN KIND ARISING OUT OF THE EXISTENCE OR CHARACTER OF THE WORK.

3.12 PROTECTION AGAINST CLAIMS OF SUBCONTRACTORS, LABORERS, MATERIALMEN AND FURNISHERS OF MACHINERY, EQUIPMENT AND SUPPLIES;.INDEMNIFICATION.

THE CONTRACTOR AGREES THAT HE WILL INDEMNIFY, TO THE FULLEST EXTENT OF THE LAW, AND SAVE THE OWNER AND ENGINEER HARMLESS FROM ALL CLAIMS GROWING OUT OF THE LAWFUL DEMANDS OF SUBCONTRACTORS, LABORERS, WORKMEN, MECHANICS, MATERIALMEN AND FURNISHERS OF MACHINERY AND PARTS THEREOF, EQUIPMENT, POWER TOOLS, AND ALL SUPPLIES, INCLUDING COMMISSARY, INCURRED IN THE FURTHERANCE OF THE PERFORMANCE OF THE CONTRACT. When so desired by the OWNER, the CONTRACTOR shall furnish satisfactory evidence that all obligations of the nature hereinabove designated have been paid, discharged or waived. If the CONTRACTOR fails so to do, then the OWNER may at the option of the CONTRACTOR either pay directly any unpaid bills, of which the OWNER has written notice, or withhold from the CONTRACTOR'S unpaid compensation a sum of money deemed reasonably sufficient to liquidate any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged, whereupon payments to the CONTRACTOR shall be resumed in full, in accordance with the terms of the Contract Documents, but in no event shall the provisions of this sentence be construed to impose any obligation upon the OWNER by either the CONTRACTOR or his Surety.

3.13 <u>INTELLECTUAL PROPERTY RIGHTS AND INDEMNIFICATION</u>

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.

b. CONTRACTOR shall not furnish or provide to OWNER any Materials or Work that infringes a third party's intellectual property rights (whether it be claims of improper use of confidential information, patent infringement, copyright infringement, or the like). CONTRACTOR shall not disclose or provide to OWNER any information, ideas, concepts, improvements, discoveries, inventions, or forms of expression of ideas which CONTRACTOR does not own or otherwise have the right to disclose or provide to OWNER.

c. CONTRACTOR represents and warrants that the Materials and the Work shall be free from third party claims of ownership and that OWNER'S right to own, use, or otherwise disclose such Materials and Work shall be free from third party claims of infringement of intellectual property rights (whether it be claims of improper use of confidential information, patent infringement, copyright infringement, trademark infringement or the like).

d. CONTRACTOR represents and warrants to OWNER that all information, ideas, concepts, improvements, discoveries, inventions, or forms of expression of ideas disclosed or provided to OWNER shall be free from third party claims of ownership and that OWNER'S right to own, use, or otherwise disclose such information, ideas, concepts, improvements, discoveries, inventions, or forms of expression of ideas shall be free from third party claims of infringement of intellectual property rights (whether it be claims of improper use of confidential information, patent infringement, copyright infringement, trademark infringement or the like).

e. CONTRACTOR represents and warrants that all processes or methods utilized by CONTRACTOR to complete the Work to OWNER are free from infringement of third party intellectual property rights (whether it be claims of improper use of confidential information, patent infringement, copyright infringement, or the like) and that all products provided by CONTRACTOR to OWNER are free from third party claims of infringement of intellectual property rights, including allegations that the product infringes the claims of the United States process patent in violation of the Process Patents Amendment Act of 1988. CONTRACTOR shall cooperate fully and promptly with OWNER with respect to any notice of infringement or request for disclosure or response to a request for disclosure generated or received by OWNER in connection with CONTRACTOR'S Work pursuant to the Process Patents Amendment Act of 1988. To the extent that CONTRACTOR obtains products from third parties which it intends to provide to OWNER, CONTRACTOR shall obtain agreements from CONTRACTOR'S vendors to cooperate in connection with requests for disclosure generated or received by OWNER pursuant to the Process Patents Amendment Act of 1988.

f. TO THE FULLEST EXTENT OF THE LAW, CONTRACTOR SHALL DEFEND, PROTECT, INDEMNIFY, AND HOLD HARMLESS OWNER, ENGINEER, AND THEIR RESPECTIVE DIRECTORS, OFFICERS, PARTERNS, AGENTS, REPREENTATIVES, EMPLOYEES, CONSULTANTS, AND SUBCONTRACTORS (COLLECTIVELY, "INDEMNITEES") FROM AND AGAINST ALL LIABILITY, CLAIMS, DEMANDS AND CAUSES OF ACTION BROUGHT BY THIRD PARTIES (AND ALL COSTS, EXPENSES, DAMAGES, LIABILITIES OR JUDGMENTS SUSTAINED OR INCURRED BY THE INDEMNITEES IN CONNECTION THEREWITH, INCLUDING THE COSTS OF INVESTIGATION AND REASONABLE ATTORNEY'S FEES) ARISING OUT OF OR RELATING TO: (I) CONTRACTOR'S BREACH OF ANY REPRESENTATION OR WARRANTY, WHETHER EXPRESS OR IMPLIED, REGARDING INTELLECTUAL PROPERTY RIGHTS; (II) ALLEGATIONS THAT THE INDEMNITEES, BY USE OF THE MATERIALS OR THE WORK, INFRINGES ANY THIRD PARTY'S INTELLECTURAL PROPERTY RIGHTS (WHETHER IT BE CLAIMS OF IMPROPER USE OF CONFIDENTIAL INFORMATION, PATENT INFRINGEMENT, COPYRIGHT INFRINGEMENT, TRADEMARK INFRINGEMENT OR THE LIKE); (III) ALLEGATIONS THAT A THIRD PARTY OWNS INFORMATION, IDEAS, CONCEPTS, IMPROVEMENTS, DISCOVERIES, INVENTIONS, OR FORMS OF EXPRESSION OF IDEAS DESCRIBED OR PROVIDED BY CONTRACTOR TO THE INDEMNITEES; (IV) ALLEGATIONS THAT THE INDEMNITEES' OWNERSHIP OR USE OF INFORMATION, IDEAS, CONCEPTS, IMPROVEMENTS, DISCOVERIES, INVENTIONS, OR FORMS OF EXPRESSION OF IDEAS DISCLOSED OR PROVIDED BY CONTRACTOR TO THE INDEMNITEES INFRINGE A THIRD PARTY'S INTELLECTUAL PROPERTY RIGHTS; (V) ALLEGATIONS THAT THE PROCESSES UTILIZED BY CONTRACTOR IN PROVIDING ITS SERVICES TO THE INDEMNITEES INFRINGE THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (INCLUDING A VIOLATION OF THE PROCESS PATENTS AMENDMENT ACT OF 1988); OR (VI) THE COSTS, EXPENSES, INCLUDING REASONABLE ATTORNEY'S FEES INCURRED BY THE INDEMNITEES, IN ENFORCING THE INTELLECTURAL PROPERTY INDEMNITY INCLUDED IN THIS PARAGRAPH. THIS CONTRACTUAL OBLIGATION OF INDEMNIFICATION SHALL APPLY EVEN IF THE THIRD PARTY ALLEGES OR ESTABLISHES THAT AN INDEMNITEES WAS PARTIALLY NEGLIGENT OR OTHERWISE AT FAULT (E.G., THAT AN INDEMNITEE WAS NEGLIGENT IN RETAINING CONTRACTOR'S SERVICES AND ACCEPTING MATERIALS, WORK, INFORMAITON, IDEAS, CONCEPTS, IMPROVEMENTS, DISCOVERIES, INVENTIONS, OR FORMS OF EXPRESSION OF IDEAS FROM CONTRACTOR, OR THAT AN INDEMNITEE WAS NEGLIGENT IN FAILING TO ASCERTAIN WHETHER THE MATERIALS, WORK, INFORMATION, IDEAS, CONCEPTS, IMPROVEMENTS, DISCOVERIES, INVENTIONS, OR FORMS OF EXPRESSION OF IDEAS INFRINGED THE RIGHTS OF THIRD PARTIES).

3.14 LAWS AND ORDINANCES; INDEMNIFICATION

The CONTRACTOR shall at all times observe and comply with all applicable Federal, State and local laws, ordinances and regulations including any rules or regulations adopted by Owner ("Applicable Laws"), which in any manner affect the Contract or the Work, and SHALL INDEMNIFY, TO THE FULLEST EXTENT OF THE LAW, AND SAVE HARMLESS THE INDEMNITEES AGAINST ANY CLAIM ARISING FROM THE VIOLATION OF THE APPLICABLE LAWS WHETHER BY THE CONTRACTOR OR HIS EMPLOYEES, EXCEPT WHERE SUCH VIOLATIONS ARE CALLED FOR BY THE PROVISIONS OF THE CONTRACT DOCUMENTS.

CONTRACTOR is responsible for obtaining all required permits required to accomplish the Work. If the CONTRACTOR observes that the Contract Documents are at variance therewith, he shall promptly notify the ENGINEER in writing, and any necessary changes shall be adjusted as provided in the contract for changes in the Work. If the CONTRACTOR performs any Work knowing it to be contrary to the Applicable Laws, and without such notice to the ENGINEER, he shall bear all costs arising therefrom. OWNER is a body politic and corporate, and the law from which it derives its powers, insofar as the same regulated the objects for which, or the manner in which, or the conditions under which the OWNER may enter into contract, shall be controlling, and shall be considered as part of the Contract Documents, to the same effect as thought embodied herein.

3.15 ASSIGNMENT AND SUBLETTING

The CONTRACTOR further agrees that he will retain personal control and will give his personal attention to the fulfillment of the Contract Documents and that he will not assign by Power of Attorney, or otherwise, or sublet said contract without the written consent of the ENGINEER, and that no part or feature of the Work will be sublet to anyone objectionable to the ENGINEER or the OWNER. The CONTRACTOR further agrees that the subletting of any portion or feature of the Work, or materials required in the performance of the Contract Documents, shall not relieve the CONTRACTOR from his full obligations to the OWNER, as provided by the Contract Documents.

3.16 INDEMNIFICATION

TO THE FULLEST EXTENT OF THE LAW, THE CONTRACTOR SHALL DEFEND, INDEMNIFY, AND HOLD HARMLESS THE INDEMNITEES FROM AND AGAINST ALL DAMAGES, CLAIMS, LOSSES, DEMANDS, SUITS, JUDGEMENTS AND COSTS, INCLUDING REASONABLE ATTORNEYS' FEES AND EXPENSES, ARISING OUT OF OR RESULTING FROM THE PERFORMANCE OF THE WORK, PROVIDED THAT ANY SUCH DAMAGES, CLAIM, LOSS, DEMAND, SUIT, JUDGEMENT, COST OR EXPENSE:

a. IS ATTRIBUTABLE TO BODILY INJURY, SICKNESS, DISEASE OR DEATH OR TO INJURY TO OR DESTRUCTION OF TANGIBLE PROPERTY (OTHER THAN THE WORK ITSELF) INCLUDING THE LOSS OF USE RESULTING THEREFROM;

b. IS ATTRIBUTABLE TO THE FAILURE OF THE WORK TO BE FIT FOR ITS INTENDED PURPOSE; AND

c. IS CAUSED IN WHOLE OR IN PART BY ANY NEGLIGENT ACT OR OMISSION OF THE CONTRACTOR, ANY SUBCONTRACTOR, ANYONE DIRECTLY OR INDIRECTLY EMPLOYED BY ANY ONE OF THEM OR ANYONE FOR WHOSE ACTS ANY

OF THEM MAY BE LIABLE, REGARDLESS OF WHETHER OR NOT IT IS CAUSED IN PART BY AN INDEMNITEE.

IN THE EVENT THAT A STATUTE, RULE OF LAW, OR EQUITABLE PRINCIPLE APPLICABLE TO ANY INDEMNITY OR INSURANCE CLAUSE CONTAINED IN THE CONTRACT DOCUMENTS IS DETERMINED OR HELD TO RENDER EITHER CLAUSE VOID AND UNENFORCEABLE AGAINST A PARTY, THEN IN SUCH EVENT THE CLAUSE OR CLAUSES SHALL BE MODIFIED AND READ, CONSTRUED AND ENFORCED AS TO SUCH PARTY TO THE FULLEST EXTENT REQUIRED BY THE APPLICABLE PROVISION AND LIMITED ONLY TO THE EXTENT NECESSARY TO BRING SUCH CLAUSE INTO COMPLIANCE WITH APPLICABLE LAW.

THESE INDEMNIFICATION OBLIGATIONS EXTEND TO LOSSES FOR INJURIES OCCASIONED AFTER COMPLETION OF THE WORK, AS WELL AS DURING THE PROGRESS OF THE WORK. THE OBLIGATIONS IN THIS SECTION APPLY WHETHER ALLEDGED OR ACTUAL NEGLIENT ACTS OR OMISSIONS OF AN INDEMNITEE CAUSED THE LOSS IN WHOLE OR IN PART. THESE OBLIGATIONS INCLUDE, WITHOUT LIMITATION, CLAIMS BY CONTRACTOR'S CREW OR EMPLOYEES AGAINST THE INDEMNITEES. THIS SECTION WILL SURVIVE THE EXPIRATION OR TERMINATION OF THE CONTRACT AND WILL BE BINDING ON CONTRACTOR UNTIL THE TIME LOSS IS BARRED BY AN APPLICABLE STATUTE OF LIMITATIONS.

3.17 INSURANCE

Notwithstanding any other provision in the CONTRACT DOCUMENTS, OWNER shall not be required provide any insurance whatsoever regarding the WORK or the PROJECT. CONTRACTOR shall maintain such insurance as will protect CONTRACTOR, OWNER and ENGINEER from claims under Worker's Compensation Acts, and any amendments thereof, and from any other claims for property damage, damages from personal injury, including death, which may arise from the Work, whether such Work be by himself or by any subcontractor or anyone directly or indirectly employed by either of them. In this connection, CONTRACTOR agrees to carry and maintain, at CONTRACTOR'S sole expense, such insurance as specified herein or as may be specified by OWNER in writing. Such insurance shall remain in effect at least until final payment and at all times thereafter when CONTRACTOR may be responsible for correcting, removing, or replacing defective Work.

CONTRACTOR shall require that all insurance policies in any way related to the Work and maintained by CONTRACTOR, as well as by all subcontractors of every tier, be endorsed specifically to name the Indemnitees as additional insureds, excluding, however, Worker's Compensation Insurance, and to provide that each underwriter waives its right of subrogation against the additional insureds. All of the aforesaid policies shall be further endorsed to provide that they are primary coverages and not in excess of any other insurance available to the Indemnitees, and without rights of contribution or recovery against any of the insureds or from any such other insurance available to the Indemnitees. Evidence of such specific endorsements shall be furnished with CONTRACTOR's Certificate of Insurance.

Irrespective of the requirements as to insurance to be carried, the insolvency, bankruptcy, or failure of any insurance company carrying insurance for CONTRACTOR, or any subcontractor of any tier, or failure of any insurance company to pay claims accruing shall not be held to waive any of the provisions of the CONTRACT DOCUMENTS.

CONTRACTOR's compliance with these provisions and the limits of liability shown for each of the insurance coverages to be provided by CONTRACTOR shall not be deemed to constitute a limitation of CONTRACTOR's liability for any claims, suits or actions or in any way limit, modify or otherwise affect CONTRACTOR's indemnification obligations.

Provision of the required insurance coverages and the actual certificates and endorsements is a condition precedent to the obligations of OWNER under the CONTRACT DOCUMENTS, and if CONTRACTOR shall at any time fail to provide the required insurance coverages, certificates of insurance, or endorsements, such failure shall constitute a material breach of CONTRACTOR's obligations under the CONTRACT DOCUMENTS. If CONTRACTOR does not purchase or maintain all of the bond and insurance required of CONTRACTOR by the CONTRACT DOCUMENTS, OWNER shall have the right (but not the obligation) to obtain such, at CONTRACTOR's expense.

In the event OWNER elects to pursue a claim under any applicable builder's risk policy, CONTRACTOR shall cooperate with OWNER, OWNER's insurance carriers, and their agents and representatives in asserting, substantiating or investigating any insurance claim, whether potential or actual, that OWNER may have in connection with Builder's Risk insurance.

a. The CONTRACTOR and SUBCONTRACTORS shall provide and maintain Workers' Compensation insurance coverage as required by all applicable Federal, State, Maritime, Railroad or other laws and in accordance with Section 110.110 of Chapter 28 of the Texas Administrative Code and as follows:

1) Definitions.

(a) Certificate of Coverage ("certificate"). A copy of a certificate of insurance, a certificate of authority to self-insure issued by the Texas Workers' Compensation Commission (the "TWCC"), 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.

(b) 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.

(c) Persons providing services on the Project ("subcontractor" in Section 406.096 of the Texas Labor Code. 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. "Service" does not include activities unrelated to the Project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

2) The CONTRACTOR shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreement, which meets the statutory requirements of Texas Labor Code, §401.011(44) for all employees of the CONTRACTOR providing services on the Project, for the duration of the Project.

3) The CONTRACTOR must provide a certificate of coverage to the Owner prior to being awarded the contract.

4) 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 Owner, showing that the coverage has been extended.

5) The CONTRACTOR shall obtain from each person providing services on the Project, and provide to the OWNER:

(a) A certificate of coverage, prior to that person beginning Work on the Project, so that the OWNER will have on file certificates of coverage showing coverage for all persons providing services on the Project.

(b) No later than seven (7) 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.

6) The CONTRACTOR shall retain all required certificates of coverage on file for the duration of the Project and for one year thereafter.

7) The CONTRACTOR shall notify the OWNER 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.

8) The CONTRACTOR shall post on each Project site a notice, in the text, form and manner prescribed by the TWCC, informing all persons providing services on the Project that they are required to be covered, and stating how a person may verify current coverage and report failure to provide coverage.

9) The CONTRACTOR shall contractually require each person with whom it contracts to provide service on a Project to:

(a) Provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of the Texas Labor Code §401.011(44) for all its employees providing services on the Project, for the duration of the Project.

(b) 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.

(c) Provide to 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;

(d) Obtain from each other person with whom it contracts, and provide to the CONTRACTOR:

(1) A certificate of coverage, prior to the other person beginning Work on the Project.

(2) A new certificate of coverage showing extension of the coverage period, 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.

(e) Retain all required certificates of coverage on file for the duration of the Project and for one year thereafter.

(f) Notify the OWNER in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, or any change that materially affects the provision of coverage of any person providing services on the Project.

(g) Contractually require each other person with whom it contracts to perform as required by paragraphs (a) - (g), with the certificate of coverage to be provided to the person for whom they are providing services.

10) By signing the Contract or providing or causing to be provided a certificate of coverage, the CONTRACTOR is representing to the OWNER that all employees by 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 TWCC'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.

11) 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 (10) days after receipt of notice of breach from the OWNER.

b. Comprehensive General Liability including CONTRACTOR'S Liability, Contractual Liability, Independent CONTRACTOR'S Liability, Completed Operations and Products Liability, extended at least one year after the date of acceptance; all on occurrence basis with Personal Injury Coverage and broad form Property Damage including Completed Operations and removal of the XCU exclusion relating to Explosion, Collapse and Underground Property Damage. Contractual liability shall have deleted the exclusion pertaining to Third Party Beneficiaries.

1) Commercial General Liability

(a)	**General Aggregate**	**$2,000,000**
(b)	**Products - Comprehensive/Operations Aggregate**	**$2,000,000**
(c)	**Personal & Advertising Injury/Aggregate**	**$1,000,000**
(d)	**Each Occurrence**	**$1,000,000**
(e)	**Fire Damage (Any one fire)**	**$ 50,000**
(f)	**Medical Expense (Any one person)**	**$ 5,000**

2) Comprehensive Automobile Liability

Combined Single Limit	**$1,000,000**

3) Excess Umbrella Liability (in excess of items 1 & 2 above): Minimum coverage of $2,000,000 combined single limit.

4) OWNER's Protective Liability Insurance: In the same amounts as General Liability or as required by law, whichever is greater, to cover bodily injury including death and property damage.

5) Property Insurance (Builder's Risk): To the full insurable completed value of entire Work on all-risk basis for all above ground structures, excluding pavement.

6) The Indemnitees shall be named as additional insured on the Comprehensive Automobile Insurance Policy, and the Excess Umbrella Liability Insurance Policy. The Indemnitees shall also be named as an additionally insured on the Comprehensive General Liability Insurance Policy. Contractual Liability Insurance (covering Contractor's indemnity obligations under the Contract Documents – In the amount of $1,000,000 per occurrence, $2,000,000 General Aggregate.

7) 30-Day Notice of Cancellation:
All policies of insurance that the CONTRACTOR is required under the terms of the Contract Documents to secure and maintain shall be endorsed to provide that the insurance company shall notify the OWNER, ENGINEER, CONTRACTOR, and Subcontractors and Sub-subcontractors, at least thirty (30) days prior to the effective date of any cancellation or modification of such policies. Prior to the date on which CONTRACTOR or any Subcontractor or approved Sub-Subcontractor commences performance of its part of the Work, CONTRACTOR shall cause to be furnished to OWNER certificates of insurance evidencing the insurance coverage required to be maintained by CONTRACTOR and each such Subcontractor and Sub-subcontractor in connection with the performance of the Work. As and when OWNER may direct, copies of the actual insurance policies or renewals or replacements thereof shall be submitted to OWNER. All copies of policies, if any, and certificates of insurance submitted to OWNER shall be in a form and content acceptable to OWNER and ENGINEER..

8) Waiver of Subrogation:
CONTRACTOR shall obtain all policies of insurance that are in any way related to the Work and that are required to be and maintained by CONTRACTOR, all Subcontractors and all Sub-subcontractors, to include clauses providing that each underwriter shall waive all of its rights of subrogation against OWNER and ENGINEER..

9) Any additional expense for the modification or endorsements to the insurance policy required in this section shall be paid by the CONTRACTOR without additional payment by the OWNER.

3.18 CERTIFICATE OF INSURANCE; ENDORSEMENTS

Before commencing any of the Work, CONTRACTOR shall file with the OWNER valid Certificates of Insurance acceptable to the OWNER and the ENGINEER and endorsements evidencing all of the insurance requirements under the Contract Documents for Contractor and any Subcontractors and Sub-subcontractors. Such Certificates shall contain a provision that coverage's afforded under the policies will not be canceled until at least thirty (30) days prior written notice has been given to the OWNER. The CONTRACTOR shall also file with the OWNER valid Certificates of Insurance and endorsements covering all Subcontractors and Sub-subcontractors.

4. PROSECUTION AND PROGRESS

4.01 TIME AND ORDER OF COMPLETION

It is the meaning and intent of the Contract Documents, unless otherwise herein specifically provided, that the CONTRACTOR shall be allowed to prosecute his Work at such times and seasons, in such order of precedence, and in such manner as shall be most conducive to economy of construction: provided, however, that the order and the time of prosecution shall be such that the Work shall be substantially completed as a whole and in part, in accordance with the Contract Documents and a Project schedule approved by the parties in writing; provided, also, that when the OWNER is having other Work done, either by contract or by his own force, the ENGINEER may direct the time and manner of constructing the Work done under the Contract Documents, so that conflict will be avoided and the construction of the various Work being done for the OWNER shall be harmonized.

The CONTRACTOR shall submit, at such times as may reasonably be requested by the ENGINEER, schedules which shall show the order in which the CONTRACTOR proposes to carry on the Work, with dates at which the CONTRACTOR will start the several parts of the Work, and estimated dates of completion of the several parts

4.02 EXTENSION OF TIME

Should the CONTRACTOR be delayed in the completion of the Work by any act or neglect by the Indemnitees, or by changes ordered in the Work, or by strikes, lockouts, fires, and unusual delays by common carriers, or unavoidable cause or causes beyond the CONTRACTOR'S control, or by any cause which the ENGINEER shall decide justifies the delay, then, as CONTRACTOR'S sole remedy, an extension of time shall be allowed for completing the Work, sufficient to compensate for the delay, the amount of the extension to be determined by the ENGINEER, provided, however, that the CONTRACTOR shall give the ENGINEER prompt notice in writing of the cause of such delay.

The CONTRACTOR has reviewed the calendar day contract time for the Work considering the time of the year proposed for the Work. The ENGINEER will not extend the calendar days for rainfall which are normal for the time of the year when the Project is scheduled.

The Contractor and Owner agree that the following table represents the statistical average number of rain days in the area of the Project and are to be expected. When delays due to rain are requested by the Contractor, only the number of days in excess of those shown below will be allowed as an extension of time. All rain days must be verified with the Field Project Representative and must be of sufficient impact that Work cannot be performed. Partial months will be evenly pro-rated and all rain days will be applied over the entire contract period of performance, not on a monthly basis.

Month	Average Rain Days	Month	Average Rain Days
January	5	July	4
February	4	August	4
March	3	September	5
April	3	October	6
May	4	November	6
June	4	December	5

4.03 HINDRANCES AND DELAYS

No claims shall be made by the CONTRACTOR for damages resulting from hindrances or delays from any cause (except where the Work is stopped by order of the OWNER) during the progress of any portion of the Work embraced in the Contract Documents. In case said Work shall be stopped by the act of the OWNER, then such expense as in the judgment of the ENGINEER is caused by such stoppage of said Work shall be paid by the OWNER to the CONTRACTOR.

5. MEASUREMENT AND PAYMENT

5.01 QUANTITIES AND MEASUREMENTS

No extra or customary measurements of any kind will be allowed, but the actual measured and/or computed length, area, solid contents, number and weight only shall be considered, unless otherwise specifically provided.

5.02 ESTIMATED QUANTITIES

The Contract Documents are intended to show clearly all Work to be done and material to be furnished hereunder. Where the estimated quantities are shown for the various classes of Work to be done and material to be furnished under the Contract Documents, they are approximate and are to be used only as a basis for estimating the probable cost of the Work and for comparing the bids offered for the Work. It is understood and agreed that the actual amount of Work to be done and material to be furnished under the Contract Documents may differ somewhat from these estimates, and that where the basis for payment under the Contract Documents is the unit price method, payment shall be for the actual amount of such Work done and material furnished.

Where payment is based on the unit price method, the CONTRACTOR agrees that he will make no claim for damages, anticipated profits or otherwise on account of any differences which may be found between the quantities of Work actually done, the material actually furnished under the Contract Documents and the estimated quantities contemplated and contained in the Bid; provided, however, that in case the actual quantity of any major item should become as much as 20% more than, or 20% less than the estimated or contemplated quantity for such items, then either party to the Contract, upon demand, shall be entitled to a revised consideration upon the portion of the Work above or below 20% of the estimated quantity.

A "Major Item" shall be construed to be any individual bid item incurred in the proposal that has a total cost equal to or greater than five (5) percent of the total contract cost, computed on the basis of the proposal quantities and the contract unit prices.

Any revised consideration is to be determined by agreement between the parties, otherwise by the terms of the Contract, as provided under "Extra Work".

5.03 PRICE OF WORK

In consideration of the furnishing of all the necessary labor, equipment, and material, and the completion of all Work by the CONTRACTOR, and on the completion of all Work and of the delivery of all material embraced in this Contact in full conformity with the specifications and stipulations herein contained, the OWNER agrees to pay the CONTRACTOR the prices set forth in the Bid. The CONTRACTOR hereby agrees to receive such prices in full for furnishing all material and all labor required for the aforesaid Work, also for all expense incurred by him, and for well and truly performing the same and the whole thereof in the manner and according to the Contract Documents.

5.04 PARTIAL PAYMENTS

On or before the 10th day of each month, the CONTRACTOR shall prepare and submit to the ENGINEER for approval or modification a statement showing as completely as practicable the total value of the Work done by the CONTRACTOR up to and including the last day of the preceding month; said statement shall also include the value of all sound materials delivered on the site of the Work that are to be fabricated into the Work.

The OWNER shall then pay the CONTRACTOR on or before the 25th day of the current month the total amount of the approved statement, less 10 percent of the amount thereof, which 10 percent shall be retained until final payment, and further less all previous payments and all further sums that may be retained by the OWNER under the terms of this Contract. It is understood, however, that in case the whole Work be near to completion and some unexpected and unusual delay occurs due to no fault or neglect on the part of the CONTRACTOR, the OWNER may upon written recommendation of the ENGINEER pay a reasonable and equitable portion of the retained percentage to the CONTRACTOR; or the CONTRACTOR at the OWNER'S option, may be relieved of the obligation to fully complete the Work and, thereupon, the CONTRACTOR shall receive payment of the balance due him under the contract subject only to the conditions stated under "Final Payment".

Partial payments will be made only during the contract construction period. Should the Project not be substantially completed within the period specified by the Contract Documents, the OWNER is not obligated to make partial payments as otherwise required.

5.05 USE OF COMPLETED PORTIONS

The OWNER shall have the right to take possession of and use any completed or partially completed portions of the Work, notwithstanding the time for completing the entire Work or such portions may not have expired but such taking possession and use shall not be deemed an acceptance of any Work not completed in accordance with the Contract Documents. If such prior use increases the cost of or delays the Work, the CONTRACTOR shall be entitled to such extra compensation, or extension of time, or both, as the ENGINEER may determine.

The "substantial completion" of the Project or a portion of the Project and the possession or use of such portion by Owner

prior to final completion and acceptance of the entire Project shall not excuse the CONTRACTOR from performing all of the Work undertaken, whether of a minor or major nature, and thereby completing the Project in accordance with the Contract Documents.

5.06 WARRANTY

The CONTRACTOR warrants to the ENGINEER and the OWNER that all materials and equipment furnished under the Contract Documents will be new and of good quality. No material used by the CONTRACTOR for any temporary purpose will be incorporated in the permanent structure without written consent of the ENGINEER. The CONTRACTOR also warrants that all Work will be of good quality, free from faults and defects, conforming to Contract Documents.

All Work not conforming to these standards will be considered defective. If required, the CONTRACTOR must furnish satisfactory evidence of the kind and quality of materials and equipment.

5.07 GUARANTEE

Upon completion of the Work, the CONTRACTOR will provide his written guarantee in a form satisfactory to the ENGINEER. It will guarantee all the Work to be free of faulty materials and improper workmanship. The CONTRACTOR agrees to replace, without cost to the OWNER, any Work found to be improper or imperfect and to make good all damage to other Work caused by such replacement. The guarantee period for the Work is one year from Work completion, as determined by the ENGINEER'S certificate of completion. Additional guarantees for specific items may also be required. These guarantees must be approved by the ENGINEER before acceptance and final payment is made.

The CONTRACTOR will supply the OWNER with copies of all guarantees and warranties, which have been made to the CONTRACTOR by suppliers or subcontractors, with an assignment of these guarantees and warranties to the OWNER. Assignments will not relieve the CONTRACTOR of his responsibility in case of a supplier's or subcontractor's failure to fulfill guarantee or warranty provisions.

Neither certificate of substantial completion, nor final payment, nor any provision in Contract Documents relieves the CONTRACTOR of responsibility for faulty materials or workmanship during guarantee periods.

The CONTRACTOR shall notify the ENGINEER thirty (30) days prior to the expiration of the one year guarantee and schedule an inspection with the ENGINEER. The CONTRACTOR will not be relieved of his Guarantee responsibilities until such time as all deficiencies found during the inspection have been corrected. If the CONTRACTOR fails to notify the ENGINEER of the expiration of the one year guarantee period, the guarantee shall remain in effect until the ENGINEER is notified and a Final Inspection is conducted and all deficiencies have been corrected.

5.08 FINAL COMPLETION AND ACCEPTANCE

Within ten (10) days after the CONTRACTOR has given the ENGINEER written notice that the Work has been completed, or substantially completed, the ENGINEER and the OWNER shall inspect the Work and within said time, if the Work be found to be completed or substantially completed in accordance with the Contract Documents, the ENGINEER shall issue to the OWNER and the CONTRACTOR his Certificate of Substantial Completion, and thereupon it shall be the duty of the OWNER within ten (10) days to issue a Certificate of Acceptance of the Work to the CONTRACTOR or to advise the CONTRACTOR in writing of the reason for non-acceptance.

5.09 FINAL PAYMENT

Prior to Final Payment, CONTRACTOR must furnish a written guarantee (5.07) and all close-out documents required under this Section 5.09. Upon the issuance of the Certificate of Completion, the ENGINEER shall proceed to make final measurements and prepare final statement of the value of all Work performed and materials furnished under the terms of the Contract Documents and shall certify same to the OWNER, who shall pay to the CONTRACTOR on or before the 30th day after the date of the first meeting of Owner's Board of Directors after receipt of the Certificate of Completion and all other documents required prior to Final Payment, the balance due the CONTRACTOR under the terms of the Contract Documents, provided he has fully performed his contractual obligations under the terms of the Contract Documents; and said payment shall become due in any event upon said performance by the CONTRACTOR. Neither the Certificate of Acceptance nor the final payment, nor any provision in the Contract Documents, shall relieve the CONTRACTOR of the obligation for fulfillment of any warranty which may be required.

5.10 PAYMENTS WITHHELD

The OWNER may, on account of subsequently discovered evidence, withhold or nullify the whole or part of any certificate to such extent as may be necessary to protect himself from loss on account of:

a. Defective Work not remedied.
b. Claims filed or reasonable evidence indicating probable filing of claims.
c. Failure of CONTRACTOR to make payments properly to subcontractors or for material or labor.
d. Damage to another contractor.
e. Reasonable doubt that the Work can be completed for the unpaid balance of the contract amount.
f. Reasonable indication that the Work will not be completed within the contract time.

When the above grounds are removed or the CONTRACTOR provides a Surety Bond satisfactory to the OWNER, which will protect the OWNER in the amount withheld, payment shall be made for amounts withheld because of them.

5.11 DELAYED PAYMENTS

Should the OWNER fail to make payment to the CONTRACTOR of the sum named in any partial or final statement, when payment is due, then the OWNER shall pay the CONTRACTOR, in addition to the sum shown as due by such statement, interest thereon as provided under Section 2251.025, Texas Government Code, which shall fully liquidate any injury to the CONTRACTOR growing out of such delay in payment, but the right is expressly reserved to the CONTRACTOR in the event payments be not promptly made, as provided under "Partial Payments", to at any time thereafter treat the contract as abandoned by the OWNER and recover compensation, as provided under "Abandonment of Contract", unless such payments are withheld in accordance with the provisions of "Payments Withheld".

6. EXTRA WORK AND CLAIMS

6.01 CHANGE ORDERS

Without invalidating the Contract, the OWNER may, at any time or from time to time, order additions, deletions or revisions to the Work; such changes will be authorized by Change Order to be prepared by the ENGINEER for execution by the OWNER and the CONTRACTOR. The Change Order shall set forth the basis for any change in contract price, as hereinafter set forth for Extra Work, and any change in contract time which may result from the change.

In the event the CONTRACTOR shall refuse to execute a Change Order which has been prepared by the ENGINEER and executed by the OWNER, the ENGINEER may in writing instruct the CONTRACTOR to proceed with the Work as set forth in the Change Order and the CONTRACTOR may make claim against the OWNER for Extra Work involved therein, as hereinafter provided.

6.02 MINOR CHANGES

The ENGINEER may authorize minor changes in the Work not inconsistent with the overall intent of the Contract Documents and not involving an increase in Contract Price. If the CONTRACTOR believes that any minor change or alteration authorized by the ENGINEER involves Extra Work and entitles him to an increase in the Contract Price, the CONTRACTOR shall make written request to the ENGINEER for a written Field Order.

In such case, the CONTRACTOR by copy of his communication to the ENGINEER or otherwise in writing shall advise the OWNER of his request to the ENGINEER for a written Field Order and that the Work involved may result in an increase in the Contract Price.

Any request by the CONTRACTOR for a change in Contract Price shall be made prior to beginning the Work covered by the proposed change.

6.03 EXTRA WORK

It is agreed that the basis of compensation to the CONTRACTOR for Work either added or deleted by a Change Order or for which a claim for Extra Work is made shall be determined by one or more of the following methods:

Method (A)	-	By agreed unit prices; or
Method (B)	-	By agreed lump sum; or
Method (C)	-	If neither Method (A) nor Method (B) be agreed upon before the Extra Work is commenced, then the CONTRACTOR shall be paid the "actual field cost" of the Work, plus fifteen (15) percent.

In negotiations of pricing for the methods above, the Contractor shall be entitled to a fifteen per cent (15%) mark-up to cover overhead and profit as defined in Method C below. Should the services of a subcontractor be required to perform the Work, the Contractor will be entitled to a mark-up of five per cent (5%).

In the event said Extra Work be performed and paid for under Method (C), then the provisions of this paragraph shall apply and the "actual field cost" is hereby defined to include the cost to the CONTRACTOR of all workmen, such as foreman, timekeepers, mechanics and laborers, and materials, supplies, teams, trucks, rentals on machinery and equipment, for the time actually employed or used on such Extra Work, plus actual transportation charges necessarily incurred, together with all power, fuel, lubricants, water and similar operating expenses, also all necessary incidental expenses incurred directly on account of such Extra Work, including Social Security, Old Age Benefits and other payroll taxes, and, a proportion of premiums on Performance and Payment Bonds and Maintenance Bonds, Public Liability and Property Damage and Workmen's Compensation, and all other insurance as may be required by law or ordinance, or directed by the OWNER, or by them agreed to. The ENGINEER may direct the form in which accounts of the "actual field cost" shall be kept and the records of these accounts shall be made available to the ENGINEER. The ENGINEER or OWNER may also specify in writing, before the Work commences, the method of doing the Work and the type and kind of machinery and equipment to be used; otherwise these matters shall be determined by the CONTRACTOR. Unless otherwise agreed upon, the prices for the use of machinery and equipment shall be determined by using 100 per cent, unless otherwise specified of the latest schedule of Equipment Ownership Expense adopted by the Associated General Contractors of America. Where practicable the terms and prices for the use of machinery and equipment shall be incorporated in the Written Extra Work Order. The fifteen (15) per cent of the "actual field cost" to be paid the CONTRACTOR shall cover and compensate him for his profit, overhead, general superintendence and field office expense, and all other elements of cost and expense not embraced within the "actual field cost" as herein defined, save that where the CONTRACTOR'S Camp or Field Office must be maintained primarily on account of such Extra Work; then the cost to maintain and operate the same shall be included in the "actual field cost".

No claim for Extra Work of any kind will be allowed unless ordered in writing by the ENGINEER. In case any orders or instruction, either oral or written, appear to the CONTRACTOR to involve Extra Work for which he should receive compensation or an adjustment in the construction time, he shall make written request to the ENGINEER for written order authorizing such Extra Work. Should a difference of opinion arise as to what does or does not constitute Extra Work, or as to the payment therefore, and the ENGINEER insists upon its performance, the CONTRACTOR shall proceed with to the Work after making written request for written order and shall keep an accurate account of the "actual field cost" thereof, as provided under Method (C).

6.04 TIME OF FILING CLAIMS

It is further agreed by both parties hereto that all questions of dispute or adjustment presented by the CONTRACTOR shall be in writing and filed with the ENGINEER within thirty (30) days after the ENGINEER has given any directions, order or instruction to which the CONTRACTOR desires to take exception. The ENGINEER shall reply within thirty (30) days to such written exceptions by the CONTRACTOR and render his final decision in writing. In case the CONTRACTOR should appeal from the ENGINEER'S decision, any demand for arbitration shall be filed with the ENGINEER and the OWNER in writing within ten (10) days after the date of delivery to CONTRACTOR of the ENGINEER'S final decision. It is further agreed that final acceptance of the Work by the OWNER and the acceptance by the CONTRACTOR of the final payment shall be a bar to any claims by either party, except where noted otherwise in the Contract Documents.

6.05 ARBITRATION

All questions of dispute under the Contract be submitted to arbitration at the request of either party to the dispute. The parties may agree upon one arbiter, otherwise, there shall be three, one named in writing by each party, and the third chosen by the two arbiters so selected; or if the arbiters fail to select a third within ten (10) days, he shall be chosen by a District Judge serving the County in which the major portion of the Project is located, unless otherwise specified. Should the party demanding arbitration fail to name an arbiter within ten (10) days of the demand, his right to arbitrate shall lapse, and the decision of the ENGINEER shall be final and binding on him. Should the other party fail to choose an arbiter within ten (10) days, the ENGINEER shall appoint such arbiter. Should either party refuse or neglect to supply the arbiters with any papers or information demanded in writing, the arbiters are empowered by both parties to take ex parte proceedings.

The arbiters shall act with promptness. The decision of any two shall be binding on both parties to the contract. The decision of the arbiters upon any question submitted to arbitration under the Contract Documents shall be a condition precedent to any right of legal action. The decision of the arbiter or arbiters may be filed in court to carry it into effect.

The arbiters, if they deem the case demands it, are authorized to award the party whose contention is sustained, such sums as they deem proper for the time, expense and trouble incident to the appeal, and if the appeal was taken without reasonable cause, they may award damages for any delay occasioned thereby. The arbiters shall fix their own compensation, unless otherwise provided by agreement, and shall assess the cost and charges of the arbitration upon either or both parties. The award of the arbiters must be made in writing.

7. ABANDONMENT OF CONTRACT

7.01 <u>TERMINATION FOR CONVENIENCE OF OWNER</u>

OWNER may terminate CONTRACTOR's performance under the Contract for OWNER's convenience at any time upon written notice to CONTRACTOR, whether or not CONTRACTOR is in default and, in such event, OWNER's only liability will be to pay CONTRACTOR the following amounts:

a. **The unpaid balance due CONTRACTOR for the Work actually performed and accepted, based on the schedules and tables, unit prices and lump sums enumerated in the CONTRACTOR's bid; and**

b. **All expenditures made and costs incurred by CONTRACTOR for the materials ordered by CONTRACTOR for the Work prior to the date of termination and not incorporated in the Work, less reasonable salvage or resale value, provided such materials conform to the plans and specifications included within the CONTRACT DOCUMENTS, and for labor performed on any such materials prior to the date of termination and associated labor insurance and labor payroll taxes.**

From the total of the items enumerated in Items a & b above inclusive, there shall be deducted all claims of OWNER against CONTRACTOR, including, without limitation, claims on account of delay or defects in materials and/or workmanship.

The amount payable under the provisions of this Section, plus the sum of all amounts previously paid under the Contract, shall in no event exceed the total Contract Price.

CONTRACTOR shall transfer and assign to OWNER in accordance with OWNER's instructions, all materials, supplies, Work in process, and other things for which CONTRACTOR is entitled to receive reimbursement hereunder, and all plans, drawings, working drawings, sketches, specifications, and information in connection with the Work, and shall take such action as may be necessary to secure to OWNER, at its election, the rights of CONTRACTOR under any or all orders and subcontracts made in connection with the Work.

If and as OWNER so directs or authorizes, CONTRACTOR shall sell at a price approved by OWNER, or retain at a price mutually agreeable, any such materials, supplies, Work in progress or other things as referred to above. The proceeds of any such sale or the agreed price shall be paid or credited to OWNER in such manner as OWNER may direct to reduce the amount payable by OWNER.

If requested by OWNER, CONTRACTOR shall endeavor to cancel any or all of its outstanding orders or subcontracts upon such terms as may be approved by OWNER.

Upon the performance of the obligations of the respective parties described herein, all obligations of the respective parties under the Contract shall be discharged, except such obligations as by their terms, express or implied, contemplate continued obligations after acceptance of the Work.

The remedies provided herein shall be cumulative of and not in lieu of all other remedies available to OWNER hereunder, or at law or in equity. Should OWNER elect to terminate the performance of CONTRACTOR hereunder, then such termination shall not waive, extinguish or otherwise affect the obligations and liabilities of the parties existing as of termination.

7.02 <u>DEFAULT</u>

If CONTRACTOR fails or refuses to supply enough properly skilled workers or proper equipment, or fails to commence, continue or complete the Work on a timely basis, or fails to make prompt payment when due to subcontractors or for materials, equipment or labor, or disregards the Laws and Regulations, or the instructions of OWNER or of the ENGINEER, or breaches any of the provisions of the CONTRACT DOCUMENTS, or breaches any of its representatives or warranties in the CONTRACT DOCUMENTS, or otherwise fails or refuses to perform or fulfill all or any part of its obligations under the CONTRACT DOCUMENTS, and any such failure, refusal or breach continues for a period of 5 calendar days after CONTRACTOR's receipt (and the Surety's receipt) of written notice from OWNER or the ENGINEER, then in any such case OWNER, without further notice to CONTRACTOR or Surety, may declare CONTRACTOR in default under the CONTRACT DOCUMENTS and may at its option employ any remedies provided for in the CONTRACT DOCUMENTS or otherwise available at law or in equity.

If a petition in bankruptcy is filed by or against CONTRACTOR, or if CONTRACTOR makes a general assignment for the benefit of creditors, or if a receiver is appointed on account of the insolvency of CONTRACTOR or to take charge of the Work or any part thereof, then CONTRACTOR shall be in default under the CONTRACT DOCUMENTS.
Nothing contained herein shall be interpreted as enlarging OWNER's legal duty to CONTRACTOR or to CONTRACTOR's agents, employees, subcontractors, or third parties, or altering the status of CONTRACTOR as an independent CONTRACTOR.

CONTRACTOR shall submit and does hereby submit to the personal jurisdiction of the state or federal courts having subject matter jurisdiction and sitting in the county where the contract is executed, for the adjudication of any suit brought to enforce OWNER's rights and remedies under the Contract.

In no event (including, without limitation, default by OWNER), shall OWNER's liabilities to CONTRACTOR ever exceed the total Contract Price, less all sums previously paid to CONTRACTOR.

7.03 REMEDIES FOR DEFAULT OF CONTRACTOR

In case Surety should fail to commence compliance with the notice for completion hereinbefore provided for, within 5 calendar days after service of such notice, then OWNER may elect to provide for completion of the Work. The OWNER, at its sole election and discretion, without prejudice to any other right or remedy available to it, without further notice to CONTRACTOR, and without notice to or release of any surety on any bond, may terminate the performance of CONTRACTOR under the CONTRACT DOCUMENTS and take possession of the Work and the Work Site, and, also at its sole election and discretion, may take possession of and use all or any part of CONTRACTOR's equipment and materials (without liability to CONTRACTOR for trespass or conversion) and may finish the Work by whatever method OWNER may deem expedient. Should OWNER deem it desirable, OWNER shall have the right to and CONTRACTOR hereby consents to the appointment of a receiver by any court with jurisdiction, without bond (or, if local rules require, a bond of nominal amount), to take charge of the Work, the Work Site, and all of CONTRACTOR's equipment, material, tools and other appliances on or near the Work Site and associated with the Work, at any time when CONTRACTOR is in default and such default has not been remedied or cured to the satisfaction of OWNER. OWNER may employ such receiver to continue the Work, receive any payments due to CONTRACTOR hereunder, pay all bills and invoices to subcontractors and material men due from CONTRACTOR, and otherwise perform CONTRACTOR's obligations hereunder, without discharging or limiting the liability of CONTRACTOR to OWNER or of any surety on any bond. In either such event, (i.e., whether or not OWNER obtains appointment of a receiver), CONTRACTOR shall not be entitled to receive any further payment hereunder until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses and damages (including, without limitation, all costs to complete the Work; fees and charges of engineers, attorneys, architects 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 shall be paid to CONTRACTOR. If such claims, costs, losses and damages exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER.

Should the cost to complete the Work exceed the contract price, and the CONTRACTOR and/or his Surety fail to pay the amount due the OWNER within the time designated, and there remains any machinery, equipment, tools, materials, or supplies, on the site of the Work, notice thereof, together with an itemized list of such equipment and materials, shall be mailed to the CONTRACTOR and his Surety at the respective addresses designated in the Contract Documents, provided, however, that actual written notice given in any manner will satisfy this condition. After mailing, or other giving of such notice, such property shall be held at the risk of the CONTRACTOR and his Surety subject only to the duty of the OWNER to exercise ordinary care to protect such property. After fifteen (15) days from the date of said notice the OWNER may sell such machinery, equipment, tools, materials or supplies and apply the net sum derived from such sale to the credit of the CONTRACTOR and his Surety. Such sale may be made at either public or private sale, with or without notice, as the OWNER may elect. The OWNER shall release any machinery, equipment, tools, materials or supplies, which remain on the Work, and belong to persons other than the CONTRACTOR or his Surety, to their proper owners. The books on all operations provided herein shall be open to the CONTRACTOR and his Surety. When exercising any rights or remedies under this section, OWNER shall not be required to obtain the lowest price for the Work performed.

The remedies provided herein shall be cumulative of and not in lieu of all other remedies available to OWNER hereunder, or at law or in equity. Should OWNER elect to terminate the performance of CONTRACTOR hereunder, then such termination

shall not waive, extinguish or otherwise affect the obligations and liabilities of the parties existing as of termination.

7.04 ABANDONMENT BY OWNER

In case the OWNER shall fail to comply with the terms of the Contract Documents, and should fail or refuse to comply with said terms within thirty (30) days after written notification by the CONTRACTOR, then the CONTRACTOR may suspend or wholly abandon the Work, and may remove there from all machinery, tools, and equipment, and all materials on the site of Work that have not been included in payments to the CONTRACTOR and have not been wrought into the Work. And thereupon the ENGINEER shall make an estimate of the total amount earned by the CONTRACTOR, which estimate shall include the value of all Work actually completed by said CONTRACTOR (at the prices stated in the attached proposal where unit prices are used), the value of all partially completed Work at a fair and equitable price, and the amount of all Extra Work performed at the prices agreed upon, or provided for by the terms of the Contract Documents, and a reasonable sum to cover the cost of any provisions made by the CONTRACTOR to carry the whole Work to completion and which cannot be utilized. The ENGINEER shall then make a final statement of the balance due the CONTRACTOR by deducting from the above estimate all previous payments by the OWNER and all other sums that may be retained by the OWNER under the terms of the Contract Documents and shall certify same to the OWNER who shall pay to the CONTRACTOR on or before thirty (30) days after the date of the notification by the CONTRACTOR the balance shown by said final statement as due the CONTRACTOR, under the terms of the Contract Documents.

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SPECIAL CONDITIONS OF THE CONTRACT

These Special Conditions of the Contract ("Special Conditions") amend the General Conditions by addition or deletion of certain provisions. The paragraph numbers for Special Conditions correspond with the affected paragraph numbers of the General Conditions. All other paragraphs of the General Conditions remain unaltered. Work-related specifications of a general nature can be found in Division 1 of the specifications.

SECTION 1.02 - CONTRACT DOCUMENTS

Add the following new paragraph to Section 1.02:

> The drawings for Construction of Wastewater Treatment Plant Expansion to 1.5 MGD are included in the Contract Documents.

SECTION 1.09 – SUBSTANTIALLY COMPLETED

Delete this section and replace with the following:

> By the terms "substantially completed" or "substantial completion" it is meant that all items of Work included in the Contract Documents have been completed, a manufacturer's startup sheet has been filed and accepted by the ENGINEER, all performance tests have been performed to the satisfaction of the ENGINEER, all demonstration periods have been successfully completed to the satisfaction of the ENGINEER, the Project is capable of serving its intended purpose, the Project may be operated continuously or in automatic mode as designed and as described in the Contract Documents without Operator intervention, and the remaining Work includes only Punch List (defined below) items prior to final payment.

SECTION 3.09 - PERFORMANCE AND PAYMENT BONDS

Replace the sixth paragraph with the following paragraph:

> The person executing a Performance and Payment Bond must be licensed as a Texas Local Recording Agent through the State Board of Insurance or may be a person (including a non-resident of Texas) holding a "General Lines" license registered with the State Board of Insurance.
>
> On the Payment Bond or an attachment to the bond, the name, mailing address, physical address, telephone number (including area code) of the surety company to which notice of claim must be sent shall be "clearly and prominently" displayed.

Add the following paragraph(s):

> Surety Companies executing bonds must have a rating of at least "A" in the current Best Key Rating Guide or appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of Texas. A bond that is made, given, tendered, or filed under Chapter 53, Property Code, or Chapter 2253, Government Code, may be executed only by a surety company that is authorized and admitted to write surety bonds in this state. If the amount of the bond exceeds $100,000, the surety must also: (1) hold a certificate of authority from the United States secretary of the treasury to qualify as a surety on obligations permitted or required under federal law; and (2) have obtained reinsurance for any liability in excess of $100,000 from a reinsurer that is authorized and admitted as a reinsurer in this state and is the holder of a certificate of authority from the United States Secretary of the Treasury to qualify as a surety or reinsurer on obligations permitted or required under federal law. In determining whether the surety on the bond or the reinsurer holds a certificate of authority from the United States Secretary of the Treasury, a party may conclusively rely on the list of companies holding certificates of authority as acceptable sureties on federal bonds and as acceptable reinsuring companies published in the Federal Register by the United States Department of the Treasury covering the date on which the bond

was executed. A purchaser, insurer of title, or lender acquiring or insuring an interest or title to real property may also conclusively rely on and is protected by a statement on a recorded bond or a sworn statement by the surety that is recorded and refers to the specific recorded bond and that states that, at the time the bond was executed, the surety: (1) was holder of a certificate of authority from the United States Secretary of the Treasury to qualify as a surety on obligations permitted or required under federal law; and (2) had reinsured any liability in excess of $100,000 by a reinsurer holding a certificate of authority described previously in (1).

SECTION 3.14 - LAWS AND ORDINANCES

Add the following paragraphs:

CONTRACTOR shall comply with all Applicable Laws governing prevailing wage rates. Prevailing wage rates are shown on page PW-1.

Contractor acknowledges that Texas Government Code Section 2252.908, as amended ("Section 2252.908") requires disclosure of certain matters by contractors entering into a contract with a local government entity such as Owner. Contractor confirms that it has reviewed Section 2252.908 and, if required to do so, will (1) complete a Form 1295, using the unique identification number specified on page 1 of the Contract, and electronically file it with the Texas Ethics Commission ("TEC"); and (2) submit the signed Form 1295, including the certification of filing number of the Form 1295 with the TEC, to Owner at or prior to the same time the Contractor executes and submits the Contract to Owner. Form 1295s are available on the TEC's website at https://www.ethics.state.tx.us/filinginfo/1295/ . The Contract is not effective until the requirements listed above are satisfied and any approval or award of the Bid or the Contract by Owner is expressly made contingent upon Contractor's compliance with these requirements. **The signed Form 1295 may be submitted to Owner in an electronic format.**

Contractor acknowledges that Texas Local Government Code Chapter 176, as amended ("Chapter 176") requires the disclosure of certain matters by contractors doing business with or proposing to do business with local government entities such as Owner. Contractor confirms that it has reviewed Chapter 176 and, if required to do so, will complete and return Form CIQ promulgated by the TEC, which is available on the TEC's website at https://www.ethics.state.tx.us/forms/conflict/, within seven days of the date of submitting the Contract to Owner or within seven days of becoming aware of a matter that requires disclosure under Chapter 176, whichever is applicable.

For purposes of Subchapter F of Chapter 2252 of the Texas Government Code (as amended, "*Subchapter F*"), Contractor represents and warrants that, neither Contractor, nor any of its parent companies, wholly- or majority-owned subsidiaries, or affiliates that exist to make a profit ("*Related For-Profit Entities*"), if any, are companies identified on a list prepared and maintained by the Comptroller under Sections 2252.153 or 2270.0201 of the Texas Government Code, as amended. The foregoing representation is made solely to comply with Subchapter F and excludes companies that the United States government has affirmatively declared to be excluded from its federal sanctions regime relating to Sudan, Iran, or a foreign terrorist organization. Contractor understands "affiliate" to mean any entity that controls, is controlled by, or is under common control with Contractor.

If required under Chapter 2271 of the Texas Government Code (as amended, "*Chapter 2271*"), Contractor represents and warrants that, at the time of execution and delivery of the Contract, neither Contractor, nor any of its Related For-Profit Entities, if any, boycott Israel or will boycott Israel during the term of the Contract. The foregoing verification is made solely to comply with Chapter 2271. As used in the foregoing verification, "boycott Israel" means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations

specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes.

If required under Chapter 2274 of the Texas Government Code (as amended, "*Chapter 2274*"), Contractor represents and warrants that, at the time of execution and delivery of the Contract, neither Contractor, nor any of its Related For-Profit Entities, if any, have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association or will discriminate during the term of the Contract against a firearm entity or firearm trade association. The foregoing verification is made solely to comply with Chapter 2274. As used in the foregoing verification, the terms "discriminate against a firearm entity," "firearm entity," and "firearm trade association" have the meanings ascribed to them in Section 2274.001 of the Texas Government Code, as amended.

If required under Chapter 2276 of the Texas Government Code (as amended, "*Chapter 2276*"), Contractor represents and warrants that, at the time of execution and delivery of the Contract, neither Contractor, nor any of its Related For-Profit Entities, if any, boycott energy companies or will boycott energy companies during the term of the Contract. The foregoing verification is made solely to comply with Chapter 2276. As used in the foregoing verification, "boycott energy companies" means, without an ordinary business purpose, refusing to deal with, terminating business activities with, or otherwise taking action that is intended to penalize, inflict economic harm on, or limit commercial relations with a company because the company: (1) engages in the exploration, production, utilization, transportation, sale, or manufacturing of fossil fuel-based energy and does not commit or pledge to meet environmental standards beyond applicable federal and state law or (2) does business with a company described in the preceding section (1).

CONTRACTOR must use the Storm Water Pollution Prevention Plan ("SWPPP") prepared by Engineer. CONTRACTOR's responsibilities under the SWPPP are as follows:

1. Obtain a signed certification statement from all Subcontractors responsible for implementing the erosion / sedimentation controls and other best management practices that are part of the SWPPP. This statement shall indicate that the Subcontractor understands the permit requirements. The certified statement forms shall be provided to Engineer and will attached to and become part of the SWPPP.
2. Fill out the TCEQ's "Construction Site Notice" form, which is Attachment 2 to the TPDES General Permit TXR150000 (form available from Owner, Engineer, or at http://www.tceq.state.tx.us/assets/public/permitting/waterquality/attachments/stormwater/txr152d2.pdf and post it near the main entrance of the Project site, or at multiple postings if the Work is linear. Mail a copy of the completed Construction Site Notice form to the local Municipal Separate Storm Sewer Systems (MS4) representative.
3. Maintain all erosion/sedimentation controls and other protective measures identified in the SWPPP in effective operating condition.
4. Perform inspections every five (5) Working Days and after every ½ inch rainfall event, noting the following observations on an inspection form provided by Owner or Engineer:

    - Locations of discharges of sediment or other pollutants from the Project site.
    - Locations of storm water / erosion / sedimentation controls that are in need of maintenance.
    - Locations of storm water / erosion / sedimentation controls that are not performing, failing to operate, or are inadequate.
    - Locations where additional storm water / erosion / sedimentation controls are needed.

5. Maintain a copy of the SWPPP (with all updates, as described below) and inspection reports at all times at the Project site.
6. Comply with any updates to the SWPPP that are made by Engineer to comply with TPDES permitting requirements, which includes noting changes in erosion / sedimentation controls and other best management practices that are part of the SWPPP and which may be necessary due to the results of inspection reports.
7. Upon completion of the Work, provide any TPDES records to OWNER or Engineer.

SECTION 5.03 - PRICE OF WORK

Add the following sentence to the last paragraph:

The OWNER, Wilbarger Creek Municipal Utility District No. 2 is a tax-exempt governmental entity, Tax ID No**.**

Add the following paragraph after the above sentence:

Owner is exempt from Texas sales and use taxes pursuant to Texas Tax Code §151.309 as a political subdivision of the State of Texas. Owner shall provide Contractor with a completed Texas Sales and Use Tax Exemption Certification as evidence of the applicability of such exemption and, accordingly, Contractor shall not collect Texas sales and use taxes from Owner with respect to this contract. Contractor and all subcontractors to Contractor shall issue a Texas Sales and Use Tax Exemption Certification with respect to, and shall not pay Texas sales and use taxes on, all purchases of the following items that are exempt from Texas sales and use taxes pursuant to Texas Tax Code § 151.311(i) tangible personal property that will be incorporated into Owner's realty; (ii) tangible personal property that is necessary and essential for the performance of this Contract and is consumed entirely on the job site; and (iii) taxable services for use in the performance of this Contract that are performed at the job site and are either integral to the performance of this Contract or expressly required to be provided by this contract. In addition, Contractor and all subcontractors to Contractor (i) shall not include any provision for Texas sales and use taxes with repect to such exempt items in any bid or contract amount, and (ii) shall pass on to Owner cost savings due to the exempt items in any bid or contract amount, and (iii) shall pass on to Owner cost savings due to the exempt status of such exempt items. Contractor's contracts with all subcontractors to Contractor shall include the foregoing provision regarding the exemption from Texas sales and use taxes.

SECTION 5.04 - PARTIAL PAYMENTS

Replace the first two paragraphs with the following:

On or before the final day of each month the CONTRACTOR shall prepare and submit to the ENGINEER for approval or modification a statement showing as completely as practicable the total value of the Work done by the CONTRACTOR up to and including the last day of the prior month; said statement shall also include the value of all sound materials delivered on the site, or to a local secured area, of the Work that are to be fabricated into the work. Invoices shall be provided for all materials on hand. The OWNER will pay for installed items at the contract unit price only as determined by the Schedule of Values.

The OWNER shall then pay the CONTRACTOR within 30 days after the first scheduled monthly Board meeting following a submitted, and approved by the Engineer, Pay Estimate, less 10 percent of the amount thereof up until 50% of the value of the Contract is complete, which 10 percent shall be retained until final payment, and further less all previous payments and all further sums that may be retained by the OWNER under the terms of this Contract. It is understood, however, that in case the whole Work be near to completion and some unexpected and unusual delay occurs due to no fault or neglect on the part of the CONTRACTOR, the OWNER may upon written recommendation of the ENGINEER pay a reasonable and equitable portion of the retained percentage to the CONTRACTOR; or the CONTRACTOR at the OWNER'S

option, may be relieved of the obligation to fully complete the Work and, thereupon, the CONTRACTOR shall receive payment of the balance due him under the Contract subject only to the conditions stated under "Final Payment."

Add the following paragraph:

Furthermore, should the progress of the Work fall substantially behind the CONTRACTOR's approved construction schedule, the value of the Work not completed on schedule as determined from the CONTRACTOR's approved schedule of values may be deducted from the moneys due on partial payments until such time as the CONTRACTOR regains its construction schedule or provides evidence that the delays are beyond its control.

SECTION 5.07 – GUARANTEE

Add the following paragraph:

If the Work includes the construction of a lift station, pump station, wastewater treatment plant, water plant or water well that requires the use of proposed equipment or facilities prior to the substantial completion of the overall Project, the one-year guarantee may start for individual equipment or facilities when the equipment or facility can be used for its intended purpose provided that: 1) a manufacturer's start-up sheet has been filed and accepted by the Engineer, 2) all performance tests have been performed to the satisfaction of the Engineer, 3) the Engineer has certified the partial facilities to be substantially completed, and 4) the facilities may be operated continuously or in automatic mode, and without Operator intervention. To be operated continuously and unattended requires that upstream and downstream components will not be endangered by equipment or facilities operation. The Owner will not maintain facilities that are put into use by the Contractor prior to completion of the four (4) items above. The start date for the guarantee will be no sooner than the date the Engineer has certified that all four (4) conditions have been met. If the Contractor fails to request an early guarantee date, the date of Final Acceptance shall be used.

SECTION 5.08 - FINAL COMPLETION AND ACCEPTANCE

Replace with the following paragraphs:

The CONTRACTOR shall notify the ENGINEER when, in the CONTRACTOR'S opinion, the Work is substantially completed in accordance with the Contract Documents and when so notifying the ENGINEER, the CONTRACTOR shall furnish to the ENGINEER in writing a detailed list of unfinished Work ("Punch List"). Within ten (10) days after the CONTRACTOR has given the ENGINEER written notice that the Work has been substantially completed and furnished the Punch List, the ENGINEER and the OWNER shall inspect the Work and, if the Work be found to be substantially completed in accordance with the Contract Documents, the ENGINEER shall issue to the OWNER and the CONTRACTOR within ten (10) days his Certificate of Substantial Completion and an updated Punch List for final acceptance, or will advise the CONTRACTOR in writing of the items required to achieve Substantial Completion.

The CONTRACTOR shall notify the ENGINEER when, in the CONTRACTOR'S opinion, the Work is finally completed in accordance with the Contract Documents and all of the Punch List items have been completed. Within ten (10) days after the CONTRACTOR has given the ENGINEER written notice that Punch List items have been completed for final acceptance, the ENGINEER and the OWNER shall inspect the work. If the Work is found to be finally completed in accordance with the Punch list and Contract Documents, the

Engineer shall issue to the OWNER and the CONTRACTOR his recommendation of final acceptance and thereupon it shall be the duty of the OWNER within thirty (30) days to issue a Certificate of Acceptance of the Work to the CONTRACTOR or to advise the CONTRACTOR in writing of the reason for non-acceptance.

Final Payment shall not be made to the CONTRACTOR until the OWNER has accepted the Project in writing and all conditions to final acceptance have been satisfied.

The Contractor is to ensure the construction will comply with all Applicable Laws of governing governmental entities and agencies with jurisdiction, i.e., Texas Commission on Environmental Quality, Travis County, and/or City of Manor. Furthermore, the Contractor recognizes the construction will comply with the specifications of such governing governmental entities and agencies and procuring the approval and acceptance of such governing governmental entities and agencies is the responsibility of the Contractor.

SECTION 5.09 – FINAL PAYMENT

Add the following paragraphs:

Final payment will be due and payable 41 days after recordation of a valid Affidavit of Completion with respect to the Work in the form attached as Exhibit "D", provided that:

.1 An approved statement for final payment and all required supporting documentation has first been submitted by CONTRACTOR and reviewed by OWNER and Engineer, such review to be conducted within 30 days of receipt of all required supporting documentation;

.2 CONTRACTOR has completed the Punch List in accordance with the Contract Documents;

.3 CONTRACTOR has corrected any deficiencies in the Work discovered after Substantial Completion and prior to final payment, whether or not such deficiencies would have been included on the Punch List if discovered earlier;

.4 An approved statement for final payment has been issued by Engineer and approved by OWNER;

.5 CONTRACTOR has delivered to OWNER all sworn statements, Conditional Waivers and Releases on Progress Payment, and Unconditional Waivers and Releases on Progress Payment as required by Section 5.04 of the General Conditions for all prior partial payments;

.6 CONTRACTOR has delivered to OWNER a Conditional Release and Waiver on Final Payment in the form attached as Exhibit "E" from all Subcontractors and Suppliers through final payment;

.7 CONTRACTOR has, simultaneous with final payment, executed and delivered to OWNER an Unconditional Waiver and Release on Final Payment in the form attached as Exhibit "F";

.8 CONTRACTOR has executed and delivered a General Contractor's Affidavit in the form attached as Exhibit "A" stating that invoices for labor, services, or materials covered by all previous payments under the Contract have been paid in full;

.9 CONTRACTOR has delivered to OWNER all operating manuals, warranties, permits, licenses, certificates, or other documents or items relating to the Project or other deliverables required by the Contract Documents, including the Assignment of Guaranties and Warranties in the form attached as Exhibit "G" from all Subcontractors, suppliers, vendors, and manufacturers;

.10 Marked sets of the record documents together with all final samples and all final shop drawings reflecting as-built conditions that are generated by CONTRACTOR have been delivered to OWNER;

.11 Electronic drawings upon which CONTRACTOR will have transferred all changes in location of any concealed utilities, mechanical or electrical systems or components have been delivered to OWNER;

.12 CONTRACTOR has delivered to OWNER: a list of names, addresses, and telephone numbers of all Subcontractors, suppliers, and any other persons providing guaranties or warranties, all contracts and invoices without Subcontractors and suppliers, and the final payment due to such Subcontractors and suppliers;

.13 CONTRACTOR has submitted to OWNER, in a form reasonably satisfactory to OWNER, consent of surety, if any, to final payment; and

.14 All other reasonable requirements of OWNER have been satisfied.

If a Subcontractor or supplier refuses to furnish a release or waiver required by OWNER, CONTRACTOR may furnish a bond satisfactory to OWNER to indemnify OWNER against such lien. If such lien remains unsatisfied after payments are made, CONTRACTOR shall refund to OWNER all money that OWNER may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees. CONTRACTOR will, within 15 days after OWNER makes final payment, provide to OWNER original, a fully executed Unconditional Waiver and Release on Final Payment in the form attached as Exhibit "F" from all Subcontractors, Sub-subcontractors, and Suppliers (collectively, the "Final Releases"). OWNER may, at OWNER's option, make final payment into escrow at a title company in Austin, Texas in order to secure Final Releases from each Subcontractor or supplier simultaneously with the release of payment by the title company to each such Subcontractor or supplier.

SECTION 5.12 - LIQUIDATED DAMAGES

Add the following paragraphs:

Liquidated Damages. Time is of the essence during this Contract. The Owner will incur substantial expenses for inspection and contract administration services if the Project is not substantially completed or finally completed within the number of days specified in the Contract Documents. Accordingly, the Owner and Contractor understand and agree that the failure to complete on time or the early completion of this Project shall affect total payment to the Contractor for the Work performed. Owner and Contractor agree that the damages to Owner cannot be accurately measured. The liquidated damages are agreed by the parties as an estimate of damages that Owner will incur due to contractor's delay and is not a penalty. The liquidated damages hereunder are in addition to all other legal and equitable rights and remedies of Owner (other than monetary damages due to delay), including, but not limited to, the remedy to termination. The amount of $500.00 per calendar day will be assessed against the Contractor as liquidated damages for every extra day that the Project is substantially completed beyond the number of days specified in the Contract Documents and $500.00 per calendar day liquidated damages for each day that final completion occurs after the number of days specified in the Contract Documents.

Any damage amounts will be withheld from the Contractors pay estimates. The Contractor and his surety will be liable for any damages in excess of any amount due to the Contractor. Acceptance of any partial payment accompanying any estimate, without written protest, shall be an acknowledgment by the contractor that the number of accumulated calendar days and the amount of damages shown on such estimates are correct. Permitting the contractor to continue and finish the work, or any part of it, after the time fixed for its completion, or after the date to which the time of completion may have been

extended, or at anytime, shall in no way operate as a waiver on the part of the Owner of any of its rights under the contract.

SECTION 6.05 - ARBITRATION

Delete Section 6.05 Arbitration. There will be no arbitration.

END OF SECTION

EXHIBIT "A"

Form General Contractor's Affidavit

THE STATE OF TEXAS §
COUNTY OF _____ §

BEFORE ME, the undersigned authority, personally appeared _____, _____ of _____. ("*Contractor*"), who, being by me duly sworn, states and agrees as follows for good and valuable consideration:

1. My name is _____. I am _____ of Contractor. Contractor and Wilbarger Creek Municipal Utility District No. 2 ("*Owner*"), entered into a Standard Form of Contract dated _____ X, 20XX (the "*Contract*") for the construction of the Wastewater Treatment Expansion to 1.5 MGD at 12217 Old Highway 20, Manor, Travis County, Texas 78653, as more particularly described in the Contract (the "*Improvements*").

2. As an inducement for payment under the Contract, I, a duly authorized agent for Contractor, do hereby warrant and represent, for and on behalf of Contractor, that: (i) a full and complete list of all subcontractors, laborers and material suppliers who have, prior to the date set forth below, been engaged in the construction of or supplying material incorporated into the Improvements is set forth on the attached **Exhibit "A"**; and (ii) Contractor and all subcontractors, laborers, and material suppliers engaged in the construction of or supplying materials incorporated into the Improvements have been paid in full for all work performed and all materials supplied prior to the date set forth below. **CONTRACTOR AGREES TO INDEMNIFY AND HOLD HARMLESS OWNER FOR ALL COSTS, DAMAGES, AND EXPENSES INCURRED BY OWNER TO THE EXTENT THAT THE FOREGOING ASSERTIONS ARE INCORRECT OR MISLEADING INCLUDING, BUT NOT LIMITED TO, ANY COSTS OWNER MAY INCUR IN SATISFYING CLAIMS OR REMOVING LIENS, OR BOTH, DUE TO MATERIALMEN OR SUPPLIERS MAKING CLAIMS OR LIENS BY, THROUGH, OR UNDER CONTRACTOR FOR THE IMPROVEMENTS.**

[*Signature Page Follows*.]

EXECUTED this _____ day of _____, 20___.

CONTRACTOR NAME:

_____

By:_____

Name:_____

Title:_____

THE STATE OF TEXAS §
COUNTY OF _____ §

This instrument was ACKNOWLEDGED before me on _____, 20__, by _____, _____ of _____, on behalf of said corporation and limited partnership.

[SEAL]

_____
Notary Public, State of Texas

EXHIBIT "A"

LIST OF ALL SUBCONTRACTORS, LABORERS, AND MATERIAL SUPPLIERS

All subcontractors, laborers, and suppliers must sign beside paid amount to acknowledge their receipt of payment in full.

NAME OF SUBCONTRACTOR LABORER OR SUPPLIER	TYPE OF WORK	AMOUNT PAID
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

EXHIBIT "B"
FORM CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

Project: Construction of Wastewater Treatment Plant Expansion to 1.5 MGD
Job No.: 0A651-0021-02

The signer of this document is _____ of _____ ("*Contractor*"). On receipt by Contractor of a check from _____ (maker of check) in the sum of $_____ payable to _____ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in Contractor's position that Contractor has on the property of Wilbarger Creek Municipal Utility District No. 2 ("*Owner*") located at 12217 Old Highway 20, Manor, Travis County, Texas 78653 (the "*Property*") to the following extent: Construction of Wastewater Treatment Plant Expansion to 1.5 MGD.

This release covers a progress payment for all labor, services, equipment, or materials furnished to the Property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to Contractor.

Contractor warrants that Contractor has already paid or will use the funds received from this progress payment to promptly pay in full all of Contractor's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

[*Signature Page Follows*.]

Date: _____

CONTRACTOR NAME:

_____

By:_____

Name:_____

Title:_____

THE STATE OF TEXAS §
COUNTY OF _____ §

This instrument was executed and acknowledged before me on this ___ day of _____, 20__, by _____, known to me as the person whose name is subscribed above, as _____ [title] of _____ [Contractor], on behalf of and as the authorized act of said entity.

_____

Notary Public in and for the State of Texas

EXHIBIT "C"

Form Unconditional Waiver and Release on Progress Payment

NOTICE:

This document waives rights unconditionally and states that you have been paid for giving up those rights. It is prohibited for a person to require you to sign this document if you have not been paid the payment amount set forth below. If you have not been paid, use a conditional release form.

UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

Project: Construction of Wastewater Treatment Plant Expansion to 1.5 MGD
Job No.: 0A651-0021-02

The signer of this document is _____ of _____ ("*Contractor*"). Contractor has been paid and has received a progress payment in the sum of $_____ for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) on the property of Wilbarger Creek Municipal Utility District No. 2 ("*Owner*") located at 12217 Old Highway 20, Manor, Travis County, Texas 78653 (the "*Property*") to the following extent: Construction of Wastewater Treatment Plant Expansion to 1.5 MGD. Contractor therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in Contractor's position that Contractor has on the above referenced project to the following extent:

This release covers a progress payment for all labor, services, equipment, or materials furnished to the Property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

Contractor warrants that Contractor has already paid or will use the funds received from this progress payment to promptly pay in full all of Contractor's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

[*Signature Page Follows*.]

Date: _____

CONTRACTOR NAME:

_____

By:_____

Name:_____

Title:_____

THE STATE OF TEXAS §
COUNTY OF _____ §

This instrument was executed and acknowledged before me on this ___ day of _____, 20__, by _____, known to me as the person whose name is subscribed above, as _____ [title] of _____ [Contractor] on behalf of and as the authorized act of said entity.

_____

Notary Public in and for the State of Texas

EXHIBIT "D"
FORM AFFIDAVIT OF COMPLETION

DATE: _____, 20__

OWNER: _____

OWNER'S ADDRESS: _____

CONTRACTOR: _____

CONTRACTOR'S ADDRESS: _____

PROPERTY: See **Exhibit "A"** attached to this Affidavit of Completion.

IMPROVEMENTS: Certain improvements to the Property constructed by Contractor as provided in the construction contract between Owner and Contractor.

Owner entered into a construction contract with Contractor to construct the Improvements. Owner and Contractor intend to execute this Affidavit of Completion to evidence Contractor's completion of the Improvements under the construction contract.

The persons signing this Affidavit of Completion have been duly sworn. Under oath, they swear the following information is true:

1. The foregoing facts are true and correct and incorporated herein by this reference.

2. The Improvements were completed on _____, 20____, in accordance with the construction contract between Owner and Contractor. For purposes of this Affidavit of Completion, the terms "*completed*" and "*completion*" mean the actual completion of the work, including any extras or change orders, under the construction contract and any plans for such work, other than warranty or repair work.

ANY SUBCONTRACTOR OR OTHER LIEN CLAIMANT MAY NOT HAVE A LIEN ON RETAINED FUNDS UNLESS THE CLAIMANT FILES AN AFFIDAVIT CLAIMING A LIEN NO LATER THAN THE 30TH DAY AFTER THE DATE OF COMPLETION.

Contractor states that all of the funds that Owner has advanced to Contractor prior to this date have been used to pay persons who have furnished labor or materials for the Improvements. Contractor states that there are no disputes with, or debts owed to, any subcontractors or suppliers for the labor or materials furnished. Contractor has received no notice that any lien claimant has filed or intends to file a lien against the Property.

Owner states that Owner has received a written request to receive a copy of an affidavit of completion from the following persons who have furnished labor or materials for the Improvements, and from no other persons: [None].

This Affidavit of Completion is made in accordance with Section 53.106(a) of the Texas Property Code and to induce Owner to release retainage to pay Contractor all or part of the costs to construct the Improvements.

[SIGNATURE PAGES FOLLOW]

CONTRACTOR:

_____

By_____
Name:_____
Title:_____

STATE OF TEXAS §
§
COUNTY OF _____ §

SWORN TO AND SUBSCRIBED before me on _____, 20___ by _____.

[SEAL]

_____
Notary Public, State of Texas

STATE OF TEXAS §
§
COUNTY OF _____ §

SWORN TO AND SUBSCRIBED before me on _____, 20___ by _____.

[SEAL]

_____
Notary Public, State of Texas

OWNER:

_____

By_____
Name:_____
Title:_____

STATE OF TEXAS §
§
COUNTY OF _____ §

SWORN TO AND SUBSCRIBED before me on _____, 20___ by _____.

[SEAL]

_____
Notary Public, State of Texas

EXHIBIT "E"

FORM CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Project: Construction of Wastewater Treatment Plant Expansion to 1.5 MGD
Job No.: 0A651-0021-02

The signer of this document is _____ of _____ ("*Contractor*"). On receipt by Contractor of a check from _____ (maker of check) in the sum of $_____ payable to _____ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in Contractor's position that Contractor has on the property of Wilbarger Creek Municipal Utility District No. 2 ("*Owner*") located at 12217 Old Highway 20, Manor, Texas 78653 (the "*Property*") to the following extent: Construction of Wastewater Treatment Plant Expansion to 1.5 MGD.

This release covers the final payment to Contractor for all labor, services, equipment, or materials furnished to the Property or to _____ (person with whom signer contracted).

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to Contractor.

Contractor warrants that Contractor has already paid or will use the funds received from this final payment to promptly pay in full all of Contractor's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

Date: _____ _____

By: _____

Printed Name: _____

Title: _____

STATE OF TEXAS §

COUNTY OF _____ §

This instrument was executed and acknowledged before me on this ___ day of _____, 20__, by _____, known to me as the person whose name is subscribed above, as _____ [title] of _____ [company], on behalf of and as the authorized act of said entity.

_____

Notary Public, State of Texas

EXHIBIT "F"
Form Unconditional Waiver and Release on Final Payment

NOTICE:

This document waives rights unconditionally and states that you have been paid for giving up those rights. It is prohibited for a person to require you to sign this document if you have not been paid the payment amount set forth below. If you have not been paid, use a conditional release form.

UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

A. **Project.: Construction of Wastewater Treatment Plant Expansion to 1.5 MGD**
B. **Job No.: 0A651-0021-02**

The signer of this document has been paid in full for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) on the property of Wilbarger Creek Municipal Utility District No. 2 located at 12217 Old Highway 20, Manor, Texas 78653 and described on the attached **Exhibit "A"**, to the following extent: Construction of Wastewater Treatment Plant Expansion to 1.5 MGD.

The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

[*Signature Page Follows*.]

Date: _____, 20__

_____
(Company Name)

By:_____
Name:_____
Title:_____

STATE OF TEXAS §
COUNTY OF _____ §

This instrument was ACKNOWLEDGED before me on _____, 20__, by _____, _____ of _____, a _____, on behalf of the _____.

[SEAL]

_____
Notary Public, State of Texas

EXHIBIT "G"
ASSIGNMENT OF GUARANTIES AND WARRANTIES

THIS ASSIGNMENT OF GUARANTIES AND WARRANTIES (this "*Assignment*"), effective as of the ___ day of _____, 20__, is made by and between _____, a _____ ("*Assignor*"), and WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2, a political subdivision of the State of Texas ("*Assignee*").

W I T N E S S E T H:

WHEREAS, Assignor, as Contractor, and Assignee, as Owner, entered into that certain Standard Form of Contract dated _____, 20__ (as amended from time to time, and including all other Contract Documents and exhibits referenced therein, the "*Contract*") pursuant to which Assignor has constructed the Wastewater Treatment Plant Expansion to 1.5 MGD (the "*Project*") located at _____; and

WHEREAS, Assignor has agreed to assign to Assignee all warranties, guarantees and other assignable rights to which Assignor is entitled against any Subcontractors, Suppliers, Sub-subcontractors or any other vendors, suppliers, manufacturers, or parties that performed the Work or provided materials in order to complete the Project (as such terms are defined in the Contract) (collectively, the "*Assigned Rights*");

NOW, THEREFORE, for and in consideration of good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, and in further consideration of the mutual covenants and agreements herein contained, Assignor and Assignee hereby agree as follows:

1. Assignor hereby sells, transfers, assigns, and conveys to Assignee all the Assigned Rights.

2. Assignor warrants and represents to Assignee that the Assigned Rights are assignable without necessity of consent or approval by any third party. Nothing in this Assignment shall be construed to expand the scope or duration of the Assigned Rights.

3. This Assignment shall be binding upon and inure to the benefit of Assignee, Assignor and their respective successors and assigns. This is the entire agreement between the parties and cannot be changed or modified without the written approval of all of the parties hereto.

4. This Assignment may be executed in multiple counterparts, and each counterpart when fully executed and delivered by each of the signatories hereto shall constitute an original instrument, and all such multiple counterparts shall constitute but one and the same instrument.

IN WITNESS WHEREOF, Assignor and Assignee have executed this Assignment to be effective as of the day and year first above written.

ASSIGNOR

_____

By: _____
Name: _____
Title: _____

ASSIGNEE

WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2, a political subdivision of the State of Texas

By: _____
_____, President
Board of Directors

"General Decision Number: TX20260007 01/02/2026

Superseded General Decision Number: TX20250007

State: Texas

Construction Type: Heavy

Counties: Atascosa, Bandera, Bastrop, Bell, Bexar, Brazos, Burleson, Caldwell, Comal, Coryell, Guadalupe, Hays, Kendall, Lampasas, McLennan, Medina, Robertson, Travis, Williamson and Wilson Counties in Texas.

HEAVY (excluding tunnels and dams, not to be used for work on Sewage or Water Treatment Plants or Lift / Pump Stations in Bell, Coryell, McClennon and Williamson Counties) Construction Projects

Modification Number	Publication Date
0	01/02/2026

SUTX2011-006 08/03/2011

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER (Paving and Structures)	$ 12.56	
ELECTRICIAN	$ 26.35	
FORM BUILDER/FORM SETTER		
Paving & Curb	$ 12.94	
Structures	$ 12.87	
LABORER		
Asphalt Raker	$ 12.12	
Flagger	$ 9.45	
Laborer, Common	$ 10.50	
Laborer, Utility	$ 12.27	
Pipelayer	$ 12.79	
Work Zone Barricade Servicer	$ 11.85	
PAINTER (Structures)	$ 18.34	
POWER EQUIPMENT OPERATOR:		
Agricultural Tractor	$ 12.69	

Asphalt Distributor.....$ 15.55
Asphalt Paving Machine.....$ 14.36
Boom Truck.....$ 18.36
Broom or Sweeper.....$ 11.04
Concrete Pavement
Finishing Machine.....$ 15.48
Crane, Hydraulic 80 tons
or less.....$ 18.36
Crane, Lattice Boom 80
tons or less.....$ 15.87
Crane, Lattice Boom over
80 tons.....$ 19.38
Crawler Tractor.....$ 15.67
Directional Drilling
Locator.....$ 11.67
Directional Drilling
Operator.....$ 17.24
Excavator 50,000 lbs or
Less.....$ 12.88
Excavator over 50,000 lbs...$ 17.71
Foundation Drill, Truck
Mounted.....$ 16.93
Front End Loader, 3 CY or
Less.....$ 13.04
Front End Loader, Over 3 CY.$ 13.21
Loader/Backhoe.....$ 14.12
Mechanic.....$ 17.10
Milling Machine.....$ 14.18
Motor Grader, Fine Grade....$ 18.51
Motor Grader, Rough.....$ 14.63
Pavement Marking Machine....$ 19.17
Reclaimer/Pulverizer.....$ 12.88
Roller, Asphalt.....$ 12.78
Roller, Other.....$ 10.50
Scraper.....$ 12.27
Spreader Box.....$ 14.04
Trenching Machine, Heavy....$ 18.48

Servicer.....$ 14.51

Steel Worker
Reinforcing.....$ 14.00
Structural.....$ 19.29

TRAFFIC SIGNALIZATION:
Traffic Signal Installation
Traffic Signal/Light Pole
Worker.....$ 16.00

TRUCK DRIVER

Lowboy-Float.....$ 15.66
Off Road Hauler.....$ 11.88
Single Axle.....$ 11.79
Single or Tandem Axle Dump Truck.....$ 11.68
Tandem Axle Tractor w/Semi Trailer.....$ 12.81

WELDER.....$ 15.97

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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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.

Note: Executive Order 13658 generally applies to contracts subject to the Davis-Bacon Act that were awarded on or between January 1, 2015 and January 29, 2022, and that have not been renewed or extended on or after January 30, 2022. Executive Order 13658 does not apply to contracts subject only to the Davis-Bacon Related Acts regardless of when they were awarded. If a contract is subject to Executive Order 13658, the contractor must pay all covered workers at least $13.30 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 2025. The applicable Executive Order minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under Executive Order 13658 is available at www.dol.gov/whd/govcontracts.

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) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate 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. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the 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. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

a) a survey underlying a wage determination
b) an existing published wage determination

c) an initial WHD letter setting forth a position on
a wage determination matter
d) an initial conformance (additional classification
and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail 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 an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail 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 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.

==========

END OF GENERAL DECISION
"

Bond No. _____

PAYMENT BOND

STATE OF TEXAS §
§
COUNTY OF TRAVIS §

KNOW ALL PERSONS BY THESE PRESENTS:

THAT **(CONTRACTOR NAME)** of the City of _____, County of _____, and State of _____, as Principal, and **(SURETY CO NAME)** authorized under the Laws of the State of Texas, to act as surety on bonds for principals, as Surety, are held and firmly bound unto **WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2** (Owner), in the penal sum of _____ ($0.00) for the payment whereof, the said Principal and Surety bind themselves, and their officers, directors, successors and assigns, jointly and severally, pursuant to the following:

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated the ____ day of _____, 20__, for: Construction of Wastewater Treatment Plant Expansion to 1.5 MGD which contract is hereby referred to and make a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall pay all claimants supplying labor and material to it or to a subcontractor in the prosecution of the work provided for in said contract, 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, as amended, and all liabilities on this bond shall be determined in accordance with the provisions of said statute to the same extent as if it were copied at length herein.

Surety, for value received, stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract, or to work performed thereunder, or the plans, specifications, or drawings accompanying the same, shall in anyway affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract, or the work to be performed thereunder, or the plans, specifications or drawings accompanying same.

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

_____	_____
Principal	Surety
By:_____	By:_____
Title:_____	Title:_____
Address:_____	Address:_____
_____	_____
_____	_____
(SEAL)	(SEAL)

The name and address of the Resident Agent of Surety is:

_____

_____

_____

The name, mailing address, physical address and telephone number, including the area code, of the Surety to which any notice of claim should be sent:

_____

_____

_____

_____

Agency Name: _____

Agent: _____

Address: _____

_____

Telephone: (___) _____

Bond No. _____

PERFORMANCE BOND

STATE OF TEXAS §
§
COUNTY OF TRAVIS §

KNOW ALL PERSONS BY THESE PRESENTS:

THAT (**CONTRACTOR NAME)** of the City of _____, County of _____, and State of _____, as Principal, and **(SURETY CO. NAME)** authorized under the Laws of the State of Texas to act as surety on bonds for principals, as Surety, are held and firmly bound unto **WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2** (Owner), in the penal sum of _____ ($0.00) for the payment whereof, the said Principal and Surety bind themselves, and their officers, directors, shareholders, partners, successors and assigns, jointly and severally, pursuant to the following:

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated the ____ day of _____, 20__, for: Construction of Wastewater Treatment Plant Expansion to 1.5 MGD which contract is hereby referred to and make a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform the Work, as defined in and in accordance with the plans, specifications and contract documents, 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, as amended, and all liabilities on this bond shall be determined in accordance with the provisions of said statute to the same extent as if it were copied at length herein.

Surety, for value received, stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract, or to work performed thereunder, or the plans, specifications, or drawings accompanying the same, shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract, or the work to be performed thereunder, or the plans, specifications or drawings accompanying same.

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

_____	_____
Principal	Surety
By: _____	By: _____
Title: _____	Title: _____
Address: _____	Address: _____
_____	_____
_____	_____
(SEAL)	(SEAL)

The name and address of the Resident Agent of Surety is:

_____

_____

_____

The name, mailing address, physical address and telephone number, including the area code, of the Surety to which any notice of claim should be sent:

_____

_____

_____

_____

Agency Name: _____

Agent: _____

Address: _____

_____

Telephone: (___) _____

SECTION 01010
SUMMARY OF WORK

PART 1 – GENERAL

1.1. **The Work.** The work consists of providing the necessary labor, materials, equipment, supervision, and plant to construct the **Wastewater Treatment Plant Expansion to 1.5 MGD** for the Wilbarger Creek Municipal Utility District No. 2 in Travis County, Texas. The work includes rehabilitation, improvements, expansion, and construction at the wastewater treatment plant (WWTP).

The work includes, but is not limited to: demolition and replacement of Lift Station pumps to increase the firm pumping capacity of the lift stations to 2,083 gpm peak two hour flow; installation of a new mechanical screen and washer compactor at the headworks; expansion of the existing peak shaving basin with course bubble aeration; addition of peak shaving pump; construction of Rapid Mix Basin No. 2 with RAS Airlifts; construction of Aeration Basin No. 3 with fine bubble aeration; construction of Clarifier Loading Basin No. 3; construction of Clarifier No. 3 with RAS, WAS, Scum, and Loading Basins; expansion of the Tertiary Filtration system; demolition and replacement of the existing Parshall Flume; Chemical Feed expansion; construction of a Dewatering Facility and press feed pump station; site, grading, drainage, pavement and detention/water quality improvements; and all associated piping, valves, fittings, protective coatings, power, instrumentation, controls, and programming.

1.2 **The Project Site.** The project is located at 12217 Old Highway 20, Manor, Texas 78653, approximately 0.14 miles East of the intersection of Old Highway 20 and FM 973 (MAPSCO Page 530 S). The project is located in the City of Manor Extraterritorial Jurisdiction in Travis County, Texas.

1.3 **The Owner.**
Wilbarger Creek Municipal Utility District No. 2
c/o Armbrust & Brown, PLLC
100 Congress Avenue, Suite 1300
Austin, Texas 78701
Attention: Mr. John Bartram
Telephone: (512) 435-2300

The Operator.
Crossroads Utility Service, L.L.C.
2601 Forest Creek Dr.
Round Rock, Texas 78665
Attention: Mr. Dennis Hendrix
Telephone: (512) 246-1400

The Engineer.
Quiddity Engineering, LLC
912 South Capital of Texas Hwy, Suite 300
Austin, Texas 78746
Attention: Mr. Jordan Zylberberg, PE
Telephone: (346) 231-0867

The Bookkeeper.
Bott & Douthitt, PLLC
P.O. Box 2445
Round Rock, Texas 78680
Attention: Ms. Mary Bott
Telephone: (512) 733-0700

PART 2 – NOT USED

PART 3 – EXECUTION

3.1 WORK SEQUENCE

The Contractor shall submit construction schedules to the Engineer for approval in accordance with Section 01330 – Construction Progress Schedule.

3.2 PROGRESS REPORTING

Monthly progress meetings shall be held on dates mutually agreed to by the Engineer and the Contractor. These meetings may be held at the project site or the Engineer's office as determined by the Engineer. Items to be discussed at this meeting include progress of the work, upcoming work items, status of submittals, monthly pay estimates, etc.

3.3 USE OF PREMISES

Construction equipment and temporary storage of materials may be placed on Owner's property with approval from the Owner and/or as shown on the plans. If the Contractor requires additional space, it shall be the responsibility to obtain and pay for the additional space.

The Contractor shall NOT use any private property during construction unless the Contractor has obtained written permission from the property owner. The Contactor is responsible for obtaining an agreement with other property owners at no additional cost to the project. Any agreements shall be submitted to the Owner for their records.

Any damage to the existing facilities and/or utilities is to be restored and made operable within a 24-hour time frame at no additional cost to the Owner and/or the owner of the facility and/or utilities.

3.4 OWNER OCCUPANCY

During construction, the Owner must be able to use the existing facilities as much as possible without interruption. If the Owner occupies a part of the project, the one-year maintenance period of that part does not begin. The one-year maintenance period begins only after the Engineer has issued a Certificate of Substantial Completion.

3.5 DISPOSAL OF EXCESS MATERIAL

The Contractor must haul off all excess material to be disposed legally (unless explicitly noted otherwise on construction drawings). No material will be allowed to be disposed of at Owner's facilities without prior approval. It is the responsibility of the Contractor to properly transport and dispose any hazardous material.

3.6 SITE RESTORATION

Hydro-mulch seed and restore the wastewater plant site shown on the plans and any offsite construction disturbed by the work areas shown on the plans.

3.7 WORKING HOURS

Working hours shall be 7:00 a.m. to 6:00 p.m. Monday through Friday. The Contractor shall request approval of the Engineer a minimum of 48-hours prior to working on weekends and/or holidays.

3.8 AREA CLEANLINESS

The project site, driveways, adjacent sidewalks, and the surrounding subdivision streets affected by the Work must be returned to original condition or better upon completion. The streets and sidewalks or land shall be cleaned daily. Should the Owner or Engineer instruct the Contractor to clean the streets and sidewalks, the Contractor shall do so by the end of the same working day. If the Contractor fails to clean the streets and sidewalks by the end of the same working day, the Owner may hire a separate Contractor to clean the streets and sidewalks. The amount of that street cleaning may be deducted from the next Pay Estimate due to the Contractor.

3.9 SAFETY

Contractor shall be responsible for the safety of himself, his employees, and other persons during construction operations. All work shall be done in accordance with Occupational Safety and Health Administration, safety, and health regulations of the United States Government for construction, State of Texas laws and regulations and City of Manor and Travis County regulations.

3.10 PERMITS

All applicable City, County, State and Federal permits, fees, and licenses necessary for the pursuit of this work, with the assistance of the Engineer, if necessary, shall be obtained and paid for by the Contractor. The electrician for the work shall be licensed.

3.11 COORDINATION

The Contractor is responsible for all coordination with all utility companies, pipeline companies, ambulance, police, and fire departments during construction. The Contractor shall contact Mr. Nathan Walton at (713) 777-5337 48 hours before commencing work and 24 hours before any testing or placement of concrete. The Contractor shall give a minimum of 48-hour advance notice before working on weekends or holidays.

3.12 ACCESS

Access to Wastewater Treatment Plant site is allowed only from the access drive to the north of the site as shown in the plans.

END OF SECTION

SECTION 01070
CUTTING AND PATCHING

PART 1 – GENERAL

1.1 RELATED WORK

A. All sections of the contract documents, technical specifications, and Geotechnical Report are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.2 DESCRIPTION

A. Execute cutting (including excavating and backfilling), fitting or patching of the work required to:
1. Make several parts fit properly.
2. Uncover work to provide for installation of ill-timed work.
3. Remove and replace defective work.
4. Remove and replace work not conforming to requirements of the contract documents.
5. Remove samples of installed work as specified for testing.
6. Install specified work in existing construction.

B. In addition to contract requirements, upon written instruction of the Engineer:
1. Uncover work to provide for observation of covered work.
2. Remove samples of installed materials for testing.
3. Remove work to provide for alteration of existing work.

C. Do not endanger any work by cutting or altering the work or any part of it.

D. Do not cut or alter the work of another Contractor without written consent by the Engineer.

E. Prior to cutting which affects structural safety of the project, or the work of another Contractor, secure written approval by the Engineer.

1.3 PAYMENT FOR COSTS

A. Costs caused by ill-timed or defective work or work not conforming to the contract documents, including the cost of additional services of the Engineer, will be borne by the Contractor.

B. Work done on written instructions of the Engineer, other than defective or non-conforming work, will be paid by the Owner.

PART 2 - PRODUCTS

A. Materials required for replacement of the work removed must conform to the specifications for the type of work to be done.

PART 3 – EXECUTION

3.1 PREPARATION BEFORE CUTTING

A. Provide shoring, bracing, and support as required to maintain structural integrity of the project.

B. Provide protection for other portions of the project.

C. Provide protection from the elements.

3.2 PERFORMANCE

A. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances and finishes.

B. Execute cutting and demolition by methods which will prevent damage to other work and will prevent settlement.

C. Execute excavating and backfilling by methods which will prevent damage to other work and will prevent settlement.

D. Restore work which has been cut or removed and install new products to provide completed work in accord with requirements of the contract documents.

E. Refinish entire surfaces as necessary to provide an even finish. On continuous surfaces, refinish to the nearest intersections. For an assembly, refinish the entire item.

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 – PRIOR TO BEGINNING WORK

Submit the following items with the signed agreement form as a prerequisite to starting the work. Prepare the submittal with a merged project submittal cover sheet and submit to the Engineer in an electronic (pdf) format. All submittals will be submitted, reviewed, and returned electronically. The location of information concerning each submittal is referenced. Failure to make any required submittal in acceptable form within the time frame specified may be grounds for withholding payment.

A. Performance Bond. Bidding Documents, Contract Forms, General and Special Conditions.

B. Labor and Material Payment Bond. Bidding Documents, Contract Forms, General and Special Conditions.

C. Certificate of Insurance. General and Special Conditions.

D. List of Subcontractors. General and Special Conditions.

E. Schedule of Values. General Conditions and as specified in the section on Schedule of Values.

F. Material and Equipment List. Supplementary Conditions and specification sections.

G. Construction Schedule. General Conditions and as specified in the section on Construction Schedule.

PART 2 – DURING CONSTRUCTION

During the progress of the work make the following submittals in a timely manner to prevent any delay in the work.

A. Work Schedules. Submit progress schedules monthly in an electronic (pdf) format as evidence that the project will be ready for occupancy by the date of substantial completion.

B. Shop Drawings, Product Data, and Samples. Submit, in accordance with the section on Shop Drawings, Product Data and Samples included in Division 1, General Requirements. Provide equipment data submittals as outlined in individual equipment specifications.

C. Facility Start-Up.
1. Work schedule shall be updated to include all three periods of facility start-up activities as part of the baseline schedule.
2. Work schedule shall account for master operation and maintenance training.
3. Start-up plan, PCS Package(s), and demonstration plan submittals shall be administered under, product data and samples included in Division 1, General Requirements.

DIVISION 1 – GENERAL REQUIREMENTS

During Construction
- ☐ Construction Schedule (Including Progress Schedules)
- ☐ Construction Sequencing Plan
- ☐ Schedule and Tabulation of Submittals

- ☐ Pre-Construction Photos
- ☐ Testing Laboratory Reports
- ☐ Temporary Facilities Layout, Equipment, and Materials
- ☐ Manufacturer's Start-Up Reports For All Equipment
- ☐ Construction Site Safety Plan (For Record Only)
- ☐ Project Classified System (PCS) Packages (All PCS's)
- ☐ Operation and Maintenance Training Schedule

Bypass Pumping Systems (For Each Bypass System)

- ☐ Pumps & Performance Curves
- ☐ Sound Enclosures
- ☐ Piping Layout
- ☐ Piping Materials, Valves, Joints, & Restraints
- ☐ Instrumentation
- ☐ Emergency Plan, Equipment, & Contacts

DIVISION 2 – SITE WORK

- ☐ Excavation
- ☐ Demolition
- ☐ Dewatering Methods
- ☐ Hydro-Mulch Seeding and Other Site Restoration
- ☐ Fencing
- ☐ Laboratory Testing Results
- ☐ Select Fill
- ☐ Bank Sand Fill
- ☐ C-Sand Fill
- ☐ Structural Backfill
- ☐ Portland Cement Concrete Pavement and Subgrade Preparation
- ☐ Asphalt Pavement and Subgrade Preparation
- ☐ Flowable Fill
- ☐ Bollards
- ☐ Hose Bibb and Hose
- ☐ Valve Box and Cover
- ☐ Chemical Pull Boxes
- ☐ Inlets and Grates
- ☐ Storm Sewers

DIVISION 3 – CONCRETE

- ☐ Reinforcing Steel
- ☐ Concrete Mix Design
- ☐ Mill Certificates
- ☐ Bill of Materials
- ☐ Admixtures
- ☐ Water Stops
- ☐ Bonding Compound
- ☐ Curing Method and Compound

- ☐ Construction Joint Layout
- ☐ Construction and Expansion Joint Details
- ☐ Grout (All Types)
- ☐ Repair Mortar
- ☐ Sealants (All Types)

DIVISION 4 – MASONRY

- ☐ Concrete Masonry Unit Block and Color Chart
- ☐ Concrete Masonry Unit Block Samples
- ☐ Concrete Masonry Unit Block Manufacturer's Certificate
- ☐ Grout and Color Chart
- ☐ Grout Samples
- ☐ Mortar
- ☐ Waterproof Admixture
- ☐ Core Fill Insulation
- ☐ Protective Coating System/Waterproof Sealer
- ☐ Joint, Lintel, And Reinforcing Layouts

DIVISION 5 – METALS

- ☐ Miscellaneous Metals Including All Supports
- ☐ Pipe Supports (All Types)
- ☐ Control Panel Supports (And Similar Rack Type Supports)
- ☐ Grating
- ☐ Hatches
- ☐ Embed Plates
- ☐ Hose Rack
- ☐ Metal Siding

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

- ☐ Waterproofing
- ☐ Joint Sealant
- ☐ Pre-Engineered Canopy
- ☐ Flashing and Sheet Metal
- ☐ Standing Seam Metal Roof

DIVISION 8 – HARDWARE

- ☐ Hardware Schedule (All Types)
- ☐ Handrail and Kickplate
- ☐ Fiberglass Doors and Frames
- ☐ Overhead Coiling Door
- ☐ Windows, Glass, and Glazing

DIVISION 9 - COATING

☐ Coating Schedule
☐ Surface Preparation
☐ Blasting Material
☐ Application Rates
☐ Color Chart
☐ Product Data Sheets
☐ Safety Data Sheets
☐ Certificate of Sufficient Purchase (Quantities And Types)

DIVISION 11 – EQUIPMENT

Airlifts
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Blower (Multi-Stage Centrifugal)
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Clarifier (Pier Supported)
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Coarse Bubble Diffuser System (Single Drop Diffusers)
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Coarse Bubble Diffuser System (Wide Band)
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Fine Bubble Diffuser System
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Perforated Plate Screen
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals
Screenings Washer Compactor
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Self-Priming Centrifugal Pumps
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Submersible Non-Clog Centrifugal Pumps
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Multi-Stage Vertical Turbine Pumps
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Double Disc Diaphragm Pumps
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Peristaltic Pumps
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Cloth Media Disk Filter
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Volute Press
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Liquid Polymer Blending Unit
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Winch
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Screw Conveyor
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

DIVISION 13 – SPECIAL CONSTRUCTION

PLC
□ PLC Hardware Data Sheets
□ PLC Network Communications Card Data Sheets
□ PLC Expansion Modules Data Sheets
□ Bill of Material
□ Wiring & Control Diagrams
□ Manufacturer Certification for Entire PLC System

Instruments
□ Product Sheets
□ Wiring & Control Diagrams
□ Product Catalog (with highlighted selected options)

Control Panels
□ Bill of Materials
□ Panel Layout
□ Wiring Diagrams
□ Enclosure Dimensions
□ Nameplates
□ Internal and External Components (including AC Unit, Transformer, sunshield, beacon,etc)
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Network Hardware and Configuration
□ Product Sheets & Dimensional Drawings
□ Installation Drawings
□ Network Ethernet Switch Product Sheets
□ Firewall Product Data Sheet
□ Network Configuration Details (includes, firewall and switch configurations)
□ HMI PanelPC Product Datasheet

HMI Hardware and Software
□ HMI Package Product Data Sheet
□ HMI Gateway Server Product Data Sheet

DIVISION 15 - MECHANICAL

Single Wall HDPE Tanks
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Fiberglass Reinforced Plastic Tanks
□ Equipment Data
□ Manufacturer's Start-Up Report (post installation)
□ Manufacturer's Warranty (post installation)
□ Operation and Maintenance Manuals

Piping & Fittings
□ Piping (DIP) (including wall pipes)
□ Piping (HDG)
□ Piping (Welded Steel)
□ Piping (PVC)
□ Piping (HDPE)
□ Piping (GCMP)
□ Piping (Stainless Steel)
□ Piping (Polyethylene Tubing)
□ Fabricated Piping Layouts
□ Welding Certificates
□ Piping Insulation
□ Piping Identification Color Chart

Miscellaneous Equipment
□ Emergency Eye Wash/Shower
□ Wye Strainers
□ Hose Bib/Rack
□ Signage
□ Heat Tracing
□ Parshall Flume Liner

Fabricated Gates
□ Slide Gates
□ Weir Gates

FRP Weir Plates
□ Dimensional Drawings

Actuators
□ Dimensional Drawings
□ Wiring & Control Diagrams

Electric Unit Heaters
☐ Product and Fabrication Drawings and Datasheets
☐ Performance Data
☐ Electrical Data, Voltage, Phase, Frequency, Amps, Power
☐ Wiring & Control Diagrams
☐ Welding Certificates

Fans & Louvers
□ Product and Fabrication Drawings and Datasheets
□ Performance Data
□ Wiring & Control Diagrams
□ Welding Certificates

Pipe Specialties & Valves
□ Plug Valves
□ Gate Valves
□ Butterfly Valves
□ Ball Valves
□ Solenoid Valves
□ Air Release Valves
□ Pressure Relief Valves
□ Swing Check Valves
□ Thermoplastic Valves
□ Single & Double Arch Expansion Joints
□ Flanged Coupling Adapters
□ Flanged Coupling Adapter Restraint
□ Dismantling Joints
□ Sleeve Couplings

HVAC System
□ Electrical Data, Voltage, Phase, Frequency, MCA, MOCP
□ Dimensions, Weight
□ AHRI Cooling Performance
□ Supply Air Performance
□ Accessories datasheet
□ Drawings, Brochures
□ Testing, Balancing & Adjusting Reports
□ System Start Up Report

DIVISION 16 - ELECTRICAL

General
□ Electric Motors
□ Grounding
□ Power System Study
□ Disconnect Switches
□ Fuses
□ Surge Protection Devices
□ Panelboards
□ Switchboards
□ Low Voltage Transformers
□ Motor Control Center Modifications
□ Reduced Voltage Soft Starter Furnished with MCC
□ Lighting Fixtures
□ Variable Frequency Drives
□ Wires and Cables
□ Boxes and Enclosures
□ Wireways
□ Underground Pullboxes/Manholes
□ Wiring Devices
□ Thermal, thermal/magnetic, solid state circuit breakers
□ Conduits and Fittings
□ Automatic Controls
□ Ground-Fault Protection
□ Framings, Struts, Channels, and Supports
□ Underground Duct Bank Accessories
□ Operation and Maintenance Manuals

Motors
□ Rated Voltage
□ Phases
□ Frequency
□ Amps (full load)
□ Nominal speed (full load)
□ Winding Insulation
□ NEMA design letter and code letter
□ Temperature Rise
□ Bearing Type & life
□ Dimensions & Frame #

Lighting
□ Dimensions
□ Photometric Report
□ Zonal Cavity method of utilization table
□ Voltage, type and manufacturer of ballast

Wiring (Wire, Conduit, Fittings, Pull Boxes, Etc.):
□ Coating and Material of Conduit
□ Raceways
□ Wire Sizes & Classifications
□ Switches & Outlets
□ Wire (Type, Size, Strands, Insulation)
□ Wiring Devices
□ Pull Boxes
□ Junction and Terminal Boxes

Motor Control Center/ Switchgear/ Switchboard/ Panelboard
□ Equipment Nameplate
□ Rated Amps, Voltage, and Phase/Wire
□ Withstand Rating
□ Dimensions and Layout
□ Bill-of-Material
□ Accessories
□ Starters, Circuit Breakers, Motor Overloads
□ Wiring Diagram for Power and Controls
□ Manufacturer's Certification

C. Mill Certificates. Submit mill certificates on the following items as required by the specifications sections.
   1. Reinforcing Steel: Division 3 - Concrete
   2. Division 5 - Metals
   3. Tanks and Welded Steel: Division 15 - Mechanical

E. Application for Payment. Submit applications for partial payment as specified in the General and Supplementary Conditions and within the time specified in the agreement.

F. Change Order Proposal. A proposal for change order may be submitted to the Engineer whenever a need arises. The request must be in writing and must include sufficient information to assess the need for a change in the work, the contract time, or the contract sum.

PART 3 – PROJECT CLOSEOUT

With a written notice of completion submit the following items in the proper form as a condition of final acceptance of the work:

A. Project Record Documents. Submit in accordance with the section on Project Record Documents included in Division 1, General Requirements.

B. Guarantees, Warranties and Bonds. As required in the General and Supplementary Conditions and listed in various sections of the specifications.

C. Spare Parts and Maintenance Materials. As specified in various sections of the specifications.

D. Operation and Maintenance Manual. Prepare four (4) copies of an Operation and Maintenance Manual for the project.

1. Each copy shall be bound in standard-size, black, three (3) ring binder(s).
2. Provide index tabs for each portion of the manual, with a minimum of one (1) tab for each item of equipment in the List of Equipment Manufacturers and one (1) tab for electrical and motor control center facilities.
3. Provide "pouch" enclosures with three (2) ring binder edging to secure any drawings which are made a part of the manual.
4. If standard manufacturer literature is used, mark the appropriate portions that deal with the specific equipment installed in the project.
5. Where applicable, provide serial numbers of installed equipment.
6. Provide nameplate information of individual motors, pumps, engines, generator, hydropneumatic tanks, etc.
7. Provide a Table of Contents for each copy of the manual in the front of the first binder.
8. Provide a white label on the back of the binding of each binder with the following typed title:

WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD
for
WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2

OPERATIONS AND MAINTENANCE MANUAL

(This manual contains ?? parts/files)

9. Prepare two (2) CD or USB flash drive of the Operation and Maintenance Manual for review. See Section (E) for more on electronic files.
   i. Once Operation and Maintenance Manual has been approved by the Engineer the contractor is to provide a copy of all the information contained in the binders on to a CD or USB flash drive in a PDF format.
   ii. A protective case for the CD is to be provided. The Contractor is to label the front of the protective case with the typed title shown below. If a USB flash drive is submitted include a separate PDF file (labeled 00-Project Info.PDF) that contains the typed title below:

WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD
for
WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2

OPERATIONS AND MAINTENANCE MANUAL

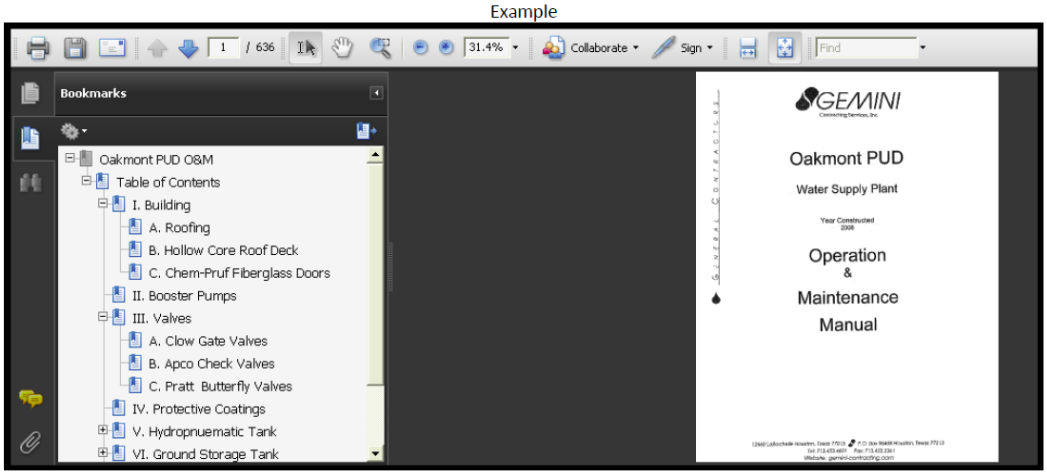
(This manual contains ?? parts/files)

E. Electronic Files.

O&M manuals shall be formatted as shown below:

Contractors: All O & M Manuals received subsequent to 11/30/2012 shall be provided in electronic format on USB Flash Drive (flash memory that is used for storing data or transferring it to or from a computer) In PDF format with bookmarks for the appropriate tabs. If file size exceeds 20 mb (20480kb) please split file (do not split in the middle of a section). If you are scanning the manual, scan at 300 dpi. Please label with O & M Manual title followed by the table of contents and bookmarked with the appropriate tabs see example below.

Example



Manuals received which are not bookmarked will not be accepted. When the manual is split into multiple files, use descriptive names such as the following:

Wilbarger Creek Municipal Utility District No. 2 WWTP Expansion to 1.5 MGD – O&M Manual – Part 1.PDF
Wilbarger Creek Municipal Utility District No. 2 WWTP Expansion to 1.5 MGD – O&M Manual – Part 2.PDF

The intent is to have as few files as possible without exceeding the file size limitation. Do this by merging small files or splitting large files. When possible, do not split large files in the middle of a section.

END OF SECTION

SECTION 01330
CONSTRUCTION PROGRESS SCHEDULE

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Specific requirements for the preparation, submittal, updating, status reporting and management of the construction Progress Schedule.

B. Provide Construction Schedules for Work included in the contract in accordance with requirements in this Section. Create a Construction Schedule using Critical Path Method (CPM) computer software capable of mathematical analysis of Precedence Diagramming Method (PDM) plans. Provide printed activity listings and bar charts in formats described in this Section.

C. Combine activity listings and bar charts with narrative report to form the Construction Schedule submittal for the Owner and the Owner's representatives.

D. Related Specification Sections include, but are not necessarily limited to:

1.2 MEASUREMENT AND PAVEMENT

No payment will be made for this item. Include the cost of construction scheduling in the overhead cost of this project.

1.3 QUALITY ASSURANCE

A. The person preparing and revising the construction Progress Schedule shall be experienced in the preparation of schedules of similar complexity.

B. Within five (5) calendar days from award of the Contract, Contractor shall submit to Owner's representative the name of the person responsible for the preparation, maintenance, updating and revision of all schedules.
   1. Qualifications necessary:
      a. At least two (2) years verifiable experience in the preparation and updating of complex construction schedules for projects of similar type, size and complexity.
      b. Proficient in the use of Microsoft© Project® 2010 or Primavera.

1.5 DEFINITIONS

A. The following definitions shall apply to this Specification Section:
   1. BASELINE SCHEDULE: The initial as-bid, detailed cost and resource loaded, Progress Schedule prepared by the Contractor to define its plan for constructing the Project as required by the Contract Documents, and accepted by the Owner or Owner's representative as meeting the requirements of the Contract Documents for specified constraints, sequences, milestones, and completion dates.
   2. PROGRESS SCHEDULE: The initially accepted Baseline Schedule, or subsequently approved Revised Baseline Schedules, updated each month to reflect actual start and finish dates of schedule activities and all time impact events whether caused by Contractor or Owner or factors beyond the control of either party.
   3. REVISED BASELINE SCHEDULE: The initially accepted Baseline Schedule revised to reflect only approved changes.

4. WORKING SCHEDULE: A schedule developed from the Progress Schedule, utilizing scheduling software features not allowed for Baseline and Progress Schedules at the Contractor's sole discretion, to indicate the contractor's plan for executing the Work, and providing for schedule recovery when approved time extensions are not sufficient to provide for timely completion due to Contractor inefficiencies beyond the control of the Owner or outside the risks accepted by the Owner.
5. LOOK-AHEAD SCHEDULES: A four-week rolling schedule derived from the working schedule.

1.6 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 300 for requirements for the mechanics and administration of the submittal process.
2. Scheduler qualifications.
3. Baseline Schedule: Submitted within {30} days after Effective Date of Agreement or{20} calendar days after the notice to proceed, whichever is less.
4. Monthly Progress Schedules.
5. Revised Baseline Schedules
6. Working Schedules
7. Look-Ahead Schedules.

1.7 GENERAL REQUIREMENTS

A. Contractor shall prepare and submit Baseline and Progress Schedules and updates and revisions to them as specified herein.
1. All scheduling to be performed in Microsoft© Project® 2010 or Primavera.
2. The Baseline and Progress Schedules shall be a calendar day-based Critical Path Method (CPM) network diagram with supporting data.

B. Disallowed Scheduling Software Features:
1. The following specific features are not allowed to be applied in the Baseline and Progress Schedules:
    a. Activity or event constraints, other than those specified by the Contract Documents.
    b. Leads and lags:
        i. Create specific activities with specific durations in-lieu-of leads and lags.
        ii. Durations shall have positive values.
    c. Default progress data:
        i. Start and finish dates shall not be automatically updated.
        ii. Update with actual start and finish dates documented from field reports.
        iii. Work activities shall be updated by actual Work progression.
        iv. Updating of activity percent complete and remaining duration shall be independent functions, not one parameter calculated from the other.
        v. Out-of-sequence progress shall be accounted for through retained logic, not a default option of progress override.
        vi. Multiple calendars
2. Any float suppression techniques or other software features that corrupts the pure mathematical model calculating the critical path.
    a. The following CPM schedule outputs will be rejected without further review:
        i. Schedules indicating the start of the critical path at a date point or activity beyond the date of Notice to Proceed, or schedules indicating a discontinuous critical path from Notice to Proceed to Contact completion.

ii. Schedules defining critical activities as those on a path or paths having some minimum value of float.
iii. Schedules with multiple critical paths.
iv. Schedules indicating a completion date beyond the contractual completion date.

3. Contractor, at Contractor's sole discretion, may employ the disallowed scheduling software features for Contractor's exclusive use in preparing a Working Schedule.

C. Float time:
1. Neither the Owner nor the Contractor owns the float; the project owns the float.
2. As such, liability for delay of the project completion date rests with the party actually causing delay to the project completion date.

D. By preparing and submitting the Baseline Schedule, the Contractor represents that it can and intends to execute the Work and portions thereof within the specified times and constraints and that its bid covers the costs associated with the execution of the Work in accordance with the Construction Schedule.

E. Contractor shall provide an electronic copy on USB Drive for the Baseline Schedule and Progress Schedule and all monthly updates of both to accompany hard copies of the schedules and tabular reports.
1. Electronic submittal shall be in a format compatible with Microsoft© Project® 2010 or Primavera
2. Contractor shall provide with the schedules, a procedural outline of the system shut-downs and proposed tie-ins, any activities to be coordinated with or performed by the Owner or its Operator, which shall be subject to approval of the Owner.

1.8 SUBMITTAL PACKAGES

A. Baseline Schedule:
1. CPM time-scaled network diagram:
a. Three (3) prints of each sheet.
b. Minimum sheet size: 11 IN x 17 IN.
c. Provide electronic format (USB Drive)
2. Supporting data: As required by the Engineer.

B. Three (3) sets of a list of project activities including the following:
1. Holidays that will be observed during construction.
2. Number of planned working days and shifts per week.

C. Monthly updates that include the following:
1. Narrative Schedule Report
2. Revised Baseline Schedule as appropriate.
a. Update to reflect approved Change Orders occurring since the prior update.
b. If no new approved Change Orders since prior update, provide a narrative report indicating such, and acknowledging the pertinence of the previously approved Baseline Schedule.
3. Updated Progress Schedule.
4. Explanation of changes in logic, duration of activities.
5. The number of opaque reproductions which Contractor requires, plus three (3) copies which will be distributed by the Owner's representative.
a. Do not submit fewer than three (3) copies.
6. Provide electronic format (USB Drive).

D. Look-Ahead Rolling Schedule:
   1. A four-week rolling schedule shall be provided by the Contractor at each progress meeting.
      a. The schedule shall provide an accurate representation of the work performed the previous week and work planned for the current week and subsequent two (2) weeks.
   2. The schedule shall be provided in a tabular format with bars representing work duration.
      a. The schedule shall refer to activity ID numbers on the Baseline and Progress Schedule.
      b. Activities that are on the critical path and activities that are behind schedule shall be noted by color, highlight, or underscore.
   3. Derived from the Working Schedule, if applicable.

E. Narrative Schedule Report:
   1. Schedule reports for Initial Baseline and Revised Baseline Schedules shall include the following minimum data for each activity:
      a. Preceding and succeeding activities.
      b. Activity description and number.
      c. Durations of activities:
         i. Original durations.
         ii. Remaining durations.
      d. Earliest start date (by calendar date).
      e. Earliest finish date (by calendar date).
      f. Actual start date (by calendar date).
      g. Actual finish date (by calendar date).
      h. Latest start date (by calendar date).
      i. Latest finish date (by calendar date).
      j. Float.
      k. Percentage of activity completed.
      l. Activity constraints specified by the Contract Documents.
      m. Type of Tabulation (Initial or Updated).
      n. Project Duration.
      o. Project Contractual Completion Date.
      p. The date of commencement of the Work as stated in the Notice to Proceed.
      q. If an updated (revised schedule, cite the new project completion date and project status and date of revision.
   2. Shall be organized in the following sequence with all applicable documents included:
      a. Contractor's transmittal letter.
      b. Work completed during the period.
      c. Identification of unusual conditions or restrictions regarding labor, equipment or material.
      d. Description of the current critical path.
      e. Changes to the critical path and scheduled completion date since the last schedule submittal.
      f. Description of problem areas.
      g. Current and anticipated delays:
         i. Cause of delay.
         ii. Impact of delay on other activities, milestones and completion dates.
         iii. Corrective action and schedule adjustments to correct the delay.
      h. Pending items and status thereof:
         i. Permits.
         ii. Change orders.
         iii. Time adjustments.
         iv. Non-compliance notices.

i. Reasons for an early or late scheduled completion date in comparison to the contract completion date.

1.9 START-UP, DEMONSTRATION, TRAINING, AND FINAL COMPLETION

A. The Baseline Schedule must include broad-based activities for start-up, operator training, and final completion.
1. The Baseline Schedule may not necessarily contain sufficient detail on all activities listed for star-up and demonstration.
2. At least 90 days prior to any activities, submit a detailed schedule in conformance with the requirements of this specification:
a. Identify task for the substantial completion notification.
b. Pre-demonstration period:
i. Identify equipment start-up for all major equipment.
ii. Identify all operator trainings required by individual Specification Sections.
iii. Complete submission of all required submittals.

B. Demonstration period: Identify the demonstration period for each project classified system.

1.10 SCHEDULING CONFERENCE

A. Contractor shall schedule and Owner's representative will conduct a scheduling conference with Contractor's project manager and construction scheduler.
1. Conference must take place within {10} business days after the Preconstruction Conference.
2. Owners representative will review the requirements of this Specification Section and other specified scheduling and sequencing requirements with Contractor.
3. Baseline Construction Schedule:
a. Provide five (5) copies of a Baseline Schedule in the form of an arrow or precedence diagram covering the following project phases and activities.
i. Schedule of Submittals of Shop Drawings and schedule dates for fabrication and delivery of key and long lead time items.
ii. Contractor's submittal information shall show intended submittal dates and shall include, as a minimum, the maximum allowable review period.
iii. The information shall provide sufficient durations for reasonable administration of re-submittals, fabrication and transportation to produce realistic delivery dates for those procurement items.
4. Owner's representative shall review the schedule and provide comments.
5. Provide approval of the schedule or request a meeting to review the schedule with Contractor within {seven (7)} days of receipt of the schedule.
6. If requested, Contractor shall participate in a review and evaluation of the schedule with Owner's representative.
7. Any revisions necessary as a result of this review shall be resubmitted for review by Owner's representative within {five (5)} business days.

B. Contractor shall submit a general time-scaled logic diagram displaying the major activities and sequence of planned operations.
1. Contractor shall be prepared to discuss the proposed work plan and schedule methodology that comply with the Contract requirements.
2. If Contractor proposes deviations to specified construction staging of the project, then the general time-scaled logic diagram shall also display the deviations and resulting time impacts.
3. Contractor shall be prepared to discuss the proposal.

C. Contractor shall provide the Preliminary Schedule of Values for the work to be performed.

D. Owner's representative will review the logic diagram, WBS coding structure, and activity identification system, and provide required Baseline Schedule changes to Contractor for implementation within {seven (7)} days following the Conference.

E. Scheduling Conferences are required on a weekly basis until agreement to the Baseline Schedule is reached.
1. Contractor to provide copies of the revised schedule.
2. Contractor to address specific comments from the previous meeting.
3. Contractor to revise the narrative as required.

1.11 BASELINE SCHEDULE

A. Schedule shall include, but not limited to, activities that show the following that are applicable to the project:
1. Project characteristics, salient features, or interfaces, including those with outside entities that could affect time of completion.
2. Project start date, scheduled completion date, Job Specific Milestones and contractual milestones.
3. Submittal development, delivery, review and approval, including those from Contractor, subcontractors and suppliers.
4. Procurement, delivery, installation and testing of materials, plants and equipment.
5. Testing and settlement periods.
6. Utility notification and relocation.
7. Erection and removal of falsework and shoring.
8. Finish work and final cleanup.
9. Project float as the predecessor activity to the scheduled completion date.

B. Schedule shall have not less than 20 activities, unless otherwise authorized by the Owner's representative.
1. The number of activities shall be sufficient to assure adequate planning of the project, to permit monitoring and evaluation of progress, and to do an analysis of time.
2. Schedule activities shall include the following:
   a. A clear and legible description.
   b. Start and finish dates.
   c. A duration of not less than one (1) working day, except for event activities, and not more than {20} working days, unless otherwise authorized by the Owner's representative.
   d. At least one (1) predecessor and one (1) successor activity, except for the project start and finish milestones.
   e. Required constraints: Only contractually required constraints may be inserted into the Baseline Schedule.

C. Early Completion Time:
1. Contractor may show early completion time on any schedule provided that the requirements of the contract are met.
2. Contractor may increase early completion time by improving production, reallocating resources to be more efficient, performing sequential activities concurrently or by completing activities earlier than planned.

D. Working durations shall be planned to incorporate the effects of normal weather impacts.

1.12 PROGRESS SCHEDULE

A. Develop Progress Schedule based on approved Baseline and Revised Baseline Schedules.
   1. All restrictions on use of constraints, leads and lags, resource leveling, etc., shall also apply to Progress Schedule.

B. The Progress Schedule will be updated once per month for monitoring progress.
   1. Contractor may submit one (1) additional update per month for its own convenience.

C. Indicate progress by making entries on the most recently accepted version of the network diagram and supporting data to show:
   1. Activities completed.
   2. Activities started.
   3. Remaining duration for each activity started but not yet completed.
   4. Percent complete based on value of work in place and value of equipment or material delivered and properly stored.
   5. Status of activity due to be completed by the next scheduled progress meeting.

D. Computerized Progress Schedule and percent completion of Work shall be used to verify Contractor's payment requests.
   1. Progress payments will not be processed by the Owner's representative unless the updated Progress Schedule has been submitted concurrently with a pay request and found acceptable by the Owner's representative.

1.13 REVISIONS TO PROGRESS SCHEDULE

A. Contractor shall submit a revised Progress Schedule within five (5) business days of the occurrence of any of the following:
   1. When contractor-caused delay in completion of any activity or group of activities indicates an overrun of the Contract Time or Control Dates by {30} working days or {10} percent of the remaining duration, whichever is less.
   2. When delays in submittals, deliveries, or work stoppages are encountered making necessary replanning or rescheduling of the Work
   3. When the schedule does not represent the actual progress of the Work.
   4. When a change order significantly affects the contract completion.

B. The revised Progress Schedule shall be the basis of a Working Schedule showing:
   1. How Contractor intends to return to schedule.
   2. How Contractor intends to avoid falling behind schedule on future activities.

C. Show changes on the network diagram and supporting data including:
   1. New activities and their duration.
   2. Modifications to existing activities.

D. Provide written narrative report as needed to define:
   1. Problem areas, anticipated delays, and impact on the current schedule.
   2. Corrective action recommended, and its effects.
   3. Major changes in scope.
   4. Revised projections of progress and completion.

E. Except as provided in the following subparagraphs 1 and 2, the cost of revisions to the Progress Schedule resulting from changes in the Work shall be included in the cost for the change in the work, and shall be based on the complexity of the revision or Change Order, man-hours expended in analyzing the change, and the total cost of the change.
   1. The cost of revision to the Construction Schedule not resulting from authorized changes in the Work shall be the responsibility of the Contractor.
   2. The cost of revision to the Construction Schedule for the Contractor's convenience shall be the responsibility of the Contractor.

F. The revised network diagram and supporting data for the Progress Schedule shall be submitted to the Owner's representative upon completion of the revisions, but not later than the next progress meeting.

G. Revisions to the Progress Schedule for the Contractor's convenience:
   1. Must be approved by the Owner's representative before Contractor changes the sequence Work.

1.14 TIME IMPACT ANALYSIS (TIA)

A. The accepted initial Baseline Schedule or subsequently accepted Revised Baseline Schedule shall be used for TIA.

B. Contractor shall submit a written TIA to the Owner's representative with each request for adjustment of Contract Time, or when Contractor or Owner's representative consider that an approved or anticipated change may impact the critical path or contract progress.

C. The TIA shall illustrate the impacts of each change or delay on the current scheduled completion date or internal milestone, as appropriate.
   1. The analysis shall use the Baseline or Revised Baseline Schedule (accepted Baseline Schedule) that has a data date closest to and prior to the event.
   2. If the Owner's representative determines that the accepted Baseline Schedule used does not appropriately represent the conditions prior to the event, the accepted Baseline Schedule shall be updated to the day before the event being analyzed.
   3. The TIA shall include an impact schedule developed from incorporating the event into the accepted Baseline Schedule by adding or deleting activities, or by changing durations or logic of existing activities as appropriate to the nature of the change event.
   4. If the impact schedule shows that incorporating the event modifies the critical path and scheduled completion date of the accepted Baseline Schedule, the difference between scheduled completion dates of the two (2) schedules shall be equal to the adjustment of Contract Time.

D. Contractor shall submit a TIA in duplicate within 15 calendar days of receiving a written request for a TIA from the Owner's representative.
   1. Contractor shall allow the Owner's representative two (2) calendar weeks after receipt to approve or reject the submitted TIA.
   2. All approved TIA schedule changes shall be shown on the next update schedule.

E. In the event of a TIA rejection:
   1. If a TIA submitted by the Contractor is rejected by the Owner's representative, the Contractor shall meet with the Owner's representative to discuss and resolve issues related to the TIA.
   2. If agreement is not reached, the Contractor will be allowed 14 calendardays from the meeting with the Owner's representative to give notice.
   3. Contractor shall only show actual as-built work, not unapproved changes related to the TIA, in subsequent update schedules.

4. If agreement is reached at a later date, approved TIA schedule changes shall be shown on the next update schedule.
5. Owner's representative will withhold remaining payment on the schedule contract item if a TIA is requested by Owner's representative and not submitted by Contractor within 14 calendar days.
6. The schedule item payment will resume on the next estimate after the requested TIA is submitted.
   a. No other contract payment will be retained regarding TIA submittals.

1.14 NARRATIVE SCHEDULE REPORT

A. Narrative Schedule Report shall list Activities Started This Month; Activities Completed This Month; Activities Continued This Month; Activities Continued This Month; Activities Scheduled to Start or Complete Next Month: Problems Encountered This Month; Actions Taken to Solve These Problems.

B. Narrative Schedule Report shall describe changes made to Construction Schedule Logic (i.e., changes in Predecessors and Lags); Activities Added to Schedule; Activities Deleted from Schedule; any other changes made to Schedule other than addition of Actual Start Dates and Actual Finish Dates and changes of Data Date and Remaining Durations for recalculation of Mathematical analysis.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01340
SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. Submit shop drawings, product data, and samples required by specification sections.

B. Shop drawings, product data, and samples are not considered a part of contract documents.

C. Schedule submissions at least 15 days before reviewed submittals will be needed.

1.2 CONTRACTOR RESPONSIBILITIES

A. Review shop drawings, product data and samples prior to submission. Verify:
   1. Field measurements
   2. Field construction criteria
   3. Catalog numbers and other data
   4. Conformance with submission requirements

B. Coordinate each submittal with contract documents and work schedules to prevent any delay in the work.

C. Contractor's responsibility for errors and omissions is not relieved by the Engineer's review of submittals.

D. At time of submission, and in writing, notify the Engineer of submittal deviations from contract documents. Contractor's responsibility for deviations from contract documents is not relieved by the Engineer's review of submittals unless the Engineer gives written acceptance of specific deviations.

E. Begin no work related to submittals until return of submittals with the Engineer's stamp and initials or signature indicating review.

F. Distribute copies after the Engineer's review.

1.3 ENGINEER'S DUTIES

A. Review submittals with reasonable promptness to prevent any delay in the work. Review for conformance with:
   1. Design concept of project
   2. Contract documents

B. Review of a separate item does not constitute review of an assembly in which the item functions.

C. Return to Contractor those submittals, which do not meet the requirements and require correction and resubmission.

D. Affix stamp and initials or signature certifying review of submittal.

E. Return reviewed submittals to Contractor for distribution.

1.4 PREPARATION REQUIREMENTS

A. Shop Drawings:
1. Preparation by a qualified detailer is required.
2. For Mechanical and Electrical work use the same sheet size as contract drawings.
3. Where necessary for clarity, identify details by reference to sheet and detail numbers on contract drawings.
4. Include on the drawing all information required for submission or submit transmittal letter containing required information.
5. Prepare all shop drawings in electronic (pdf) format.

B. Product Data:
1. Modify the manufacturer's standard schematic drawings to delete or supplement information as applicable.
2. For manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other descriptive data:
   a. Clearly mark each copy to identify pertinent materials, products, or models.
   b. Show dimensions and clearances required.
   c. Show performance characteristics and capacities.
   d. Show wiring diagram and controls.
3. Include on the data all information required for submission or submit transmittal letter containing required information.
4. Prepare all product data in electronic (pdf) format.

C. Samples:
1. Submit office samples of sufficient size and quantity to clearly illustrate:
   a. Functional characteristics of project or materials with integrally related parts and attachment devices.
   b. Full range of color samples.
2. Erect field samples and mock-ups at the project site in an acceptable location. Construct each sample complete, including work of all trades required in finished work.
3. Include in transmittal letter all information required for submission.
4. Prepare the number of samples specified.

1.5 SUBMISSION REQUIREMENTS

A. Accompany submittals with a transmittal letter in duplicate.

B. Include the following information for each submittal:
1. Date and revision dates
2. Project title and number
3. The names of the
   a. Engineer
   b. Contractor
   c. Subcontractor
   d. Supplier
   e. Manufacturer
4. Identification of project or material
5. Relation to adjacent structure or materials
6. Field dimensions clearly identified as such

7. Specification section number
8. Applicable standards, such as ASTM number or Federal Specification
9. A blank space on each shop drawing, approximately 5" x 5", for the Engineer's stamp.
10. Identification of deviations from contract documents
11. Contractor's stamp, initialed or signed, certifying review of submittal, verification of field measurements and compliance with contract documents.

C. Submit all shop drawings, product data, and samples for the following work at one time. Suitably organize and index in an electronic (pdf) file.

D. Naming convention: Name electronic (pdf) files starting with the number of the submittal followed by a hyphen and then a description of the product. The following are examples:
Submittal No. 1.0 – Schedule of Values
Submittal No. 20.0 – Miscellaneous Metals

1.6 RESUBMISSION REQUIREMENTS

A. Shop Drawings:
1. Revise initial drawings as required and resubmit as specified for initial submittal.
2. Indicate on drawings any changes, which have been made other than those, requested by the Engineer.
3. Naming convention: Name resubmitted electronic (pdf) files with the number of the resubmittal followed by a hyphen and a description of the product. The following are examples:
Submittal No. 1.1 – Schedule of Values R1
Submittal No. 1.2 – Schedule of Values R2
Submittal No. 20.1 – Miscellaneous Metals R1

B. Product Data and Samples
1. Submit new data and samples as required for initial submission.

1.7 DISTRIBUTION AFTER REVIEW

A. Distribute copies of shop drawings and product data which carry the Engineer's stamp to:
1. Contractor's file
2. Job site file
3. Record document file
4. Other prime contractors
5. Subcontractors
6. Supplier
7. Fabricator

B. Distribute samples as directed. After review, samples may be used in construction.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01370
SCHEDULE OF VALUES

PART 1 – GENERAL

1.1 SCOPE

This section includes requirements for the preparation and submittal of a Schedule of Values, including procedures to breakdown the Work into a sufficient quantity of individual line items to serve as an accurate basis for the Progress Payment Requests.

1.2 RELATED SECTIONS

All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor of complying with all requirements therein.

1.3 PREPARATION

A. Subdivide the Schedule of Values into major items based the numbered Bid Items on the Bid Form. This may include lump sum and unit cost Bid Items.
   1. For Lump Sum Bid Items:
      a. Unless specified in subsection 2.1(e) below, subdivide into logical portions of the Work, such as major work items or work in contiguous construction areas.
         i. At a minimum, itemize separate line item costs for work required by each section of the specifications.
         ii. Use the Construction Schedule as a guide to subdivide the Bid Items into individual line items. Directly correlate the line items in the Schedule of Values with tasks in the Construction Schedule.
         iii. Contractor may be required to breakdown costs to list major products or operations for each line item which has an installed value of more than $1,000.00, as directed by the Engineer.
      b. In order to be paid for materials on hand, provide a separate column in the Schedule of Values where the Progress Payment Application may include cost for materials or equipment purchased and stored onsite, but not yet installed, as provided for in the General Conditions and Special Conditions of the Contract. Contractor must indicate which line item in the payment application the materials on hand invoice submitted shall be recommended from. No recommendation will be considered without indication of an applicable line item.
      c. Where submittal of operation and maintenance data, or testing and startup are required, include separate line items as follows:
         i. Testing and startup valued at 5% of the of the related equipment, materials, and installation for that piece of equipment.
         ii. Submittal of operation and maintenance manuals valued at 5% of the sum of the related equipment, materials, installation, and testing and start-up for that piece of equipment.
      d. Separate site work items from major process area or building components. This includes separate line items for:
         i. Each major run of piping
         ii. Each duct bank
         iii. Below ground versus above ground conduit and wire
      e. Separate rehabilitation or improvement work from new construction

f. Breakdowns that appear to be “front-loaded” by the Engineer shall be rejected.

2. For Unit Price Bid Items:
   a. Show the line item value of the unit cost allowance as a product of the unit cost multiplied by the quantity indicated on the Bid Form.
   b. Items will be paid based on actual quantity complete and installed.

C. Make sum of total costs for all items listed in the schedule equal to the total contract sum.

D. The Schedule of Values, when reviewed by the Engineer and Owner, shall be used as the basis of recommending and approving payments along with establishing percentages of Work complete, and may be used to adjust the contract if any part of the Work is deleted.

E. The following template shall be used, as a minimum, by the Contractor for the preparation of the Schedule of Values:
   1. No specific template is provided.

1.4 SUBMITTAL

A. Within ten (10) calendar days of the Notice to Proceed, Contractor shall submit to the Engineer a Schedule of Values for review and approval.

B. Submit an electronic (.pdf) Schedule of Values in accordance with the procedures outlined in Section 01300 – Submittals.

C. The Schedule of Values must be submitted by the Contractor and approved by the Engineer prior to the cutoff date for the first Progress Payment Request. If the Schedule of Values is not approved by this date, then Progress Payment Request will not be processed or approved.

D. Should the Schedule of Values be returned “Revise & Resubmit”, resubmittal is due within five (5) calendar days of the receipt of the rejected Schedule of Values. Resubmit revised Schedule of Values in the same manner as the original Schedule of Values.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

END OF SECTION

SECTION 01410
LABORATORY SERVICES

PART 1 – GENERAL

1.1 PAYMENT

A. The Contractor will employ and pay for services of an independent testing laboratory to perform specified testing. No separate payment will be made. Include the cost of work in lump sum contract bid prices.

B. Employment of a testing laboratory in no way relieves the Contractor of his obligation to perform the work according to the contract documents.

1.2 RELATED WORK

A. General Conditions of the Contract for Construction. Inspections and testing required by laws, ordinances, rules and regulations, or orders of public authorities are the responsibility of the Contractor.

B. Specification Sections. Contained in the various specification sections are requirements for certification of products, testing, adjusting and balancing of equipment, and other tests and standards.

C. Division 2, Site Work. Subsurface exploration.

1.3 WORK INCLUDED

A. Testing is required in accordance with standard Specifications, City of Manor requirements, Travis County Requirements, and the Contract Documents.

B. Laboratory Services must include and provide reports for the following at a minimum:

1. Sampling mass fill material, building pad subgrade, building pad fill, trench backfill, and pavement subgrade. Prepare and test the samples for Atterberg Limits, and moisture density, and any other testing required per the specifications.
2. Sample cement sand backfill for utility trenches, mold specimens, and perform compressive strength tests in the laboratory.
3. Evaluate subgrade soil for proposed pavement subgrade.
4. Observe the chemical treatment process for the pavement subgrade.
5. Perform field gradation test of treated subgrade.
6. Measure the depth of the treated subgrade.
7. Observe proof rolling operations of the building pad and pavement subgrades; and perform density test of the mass fill, building subgrade, building pad select fill, trench backfill, and treated pavement subgrade. Determine the moisture content and percent compaction of the soils materials.
8. Obtain pocket penetrometer readings on soil cuttings removed during excavation at or near the bearing stratum to document the shear strength of the soil.
9. Perform compressive strength tests of the concrete test cylinders cast in the field.
10. Sample and test fresh concrete for each mix. Perform test for slump, air content, and concrete temp, and cast test specimens. The laboratory shall recommend the frequency of sets for test cylinder per number of cubic yards and shall be at a minimum as recommended by the American Concrete Institute. Samples must be taken to provide one (1) 7-day, two (2) 28-day, and one (1) 56-day compressive strength test result. Additional tests desired by the contractor will be at no additional cost to the Owner.

11. Sample fresh mortar materials from the project site and prepare lab molded mortar cubes for compressive strength tests.
12. Sample fresh grout during construction and cast grout prisms for compressive strength tests.
13. Sample flowable fill.

PART 2 – TESTING LABORATORY

The testing laboratory shall be **Terracon Consultants, Inc.**

2.1 QUALIFICATIONS

A. Standards.
1. Meet "Recommended Requirements for Independent Laboratory Qualification," latest edition, published by American Council of Independent Laboratories.
2. Meet basic requirements of ASTM E-329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction."
3. Submit copy of report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards during most recent tour of inspection, with memorandum of remedies of any deficiencies reported by inspection.

2.2 DUTIES

A. Cooperate with the Engineer and Contractor and provide qualified personnel promptly on notice.

B. Perform specified inspections, sampling and testing of materials and methods of construction:
1. Comply with specified standards, ASTM, other recognized authorities, and as specified.
2. Ascertain compliance with requirements of the contract documents.

C. Promptly notify the Engineer and Contractor of irregularities or deficiencies of work which are observed during performance of services.

D. Promptly prepare and distribute reports of inspections and tests as follows:
1. Engineer: Emailed copy & uploaded copy to construction management software
2. Contractor: Emailed copy & uploaded copy to construction management software
3. Owner: Emailed copy

E. Include the following information for each test as well as additional data specified in the applicable section:
1. Date of Test
2. Location of Test
3. Specified Standards
4. Test Results
5. Remarks

2.3 LIMITS OF AUTHORITY

The laboratory is not authorized to:

A. Release, revoke, alter, or enlarge on requirements of the contract documents.

B. Approve or accept any portion of the work.

C. Perform any duties of the Contractor.

PART 3 – CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel, provide access to the work, or to manufacturer's operations.

B. Provide to laboratory, preliminary representative samples of materials to be tested, in required quantities.

C. Furnish labor and equipment:
   1. To provide access to the work to be tested.
   2. To obtain and handle samples at the site.
   3. To facilitate inspections and tests.
   4. For laboratory's exclusive use for storage and curing of test samples.

D. Notify the laboratory at least 48 hours in advance of operations to allow for his assignment of personnel and scheduling of tests.

E. Arrange with the laboratory and pay for additional samples and tests required for the Contractor's convenience.

END OF SECTION

SECTION 01420
FIELD PROJECT REPRESENTATIVE SERVICES

PART 1 – GENERAL

1.1 SCOPE

This section summarizes the duties, responsibilities, and limitations of authority of the Field Project Representative (FPR) in connection with his observation of the work.

1.2 AUTHORITY

A. The definition of the Engineer's duties provides authority for observation of the work.

B. The FPR's authority to require special inspection or testing in connection with rejected work is also provided in the General Conditions. Furthermore, the provisions that, upon request by the Contractor, the FPR observe and accept or reject any material furnished are also granted in the General Conditions.

C. The provision for removing work for observation by the FPR is set forth in the General Conditions in the paragraph concerning uncovering of work.

PART 2 – DEFINITIONS

A. FPR. A representative of the Engineer or Owner will be assigned authority to observe the work.

B. Working Day. FPRs are generally not required to work on Saturdays, Sundays, or legal holidays. If the Contractor plans work on a Saturday or legal holiday, prior arrangements should be made for a FPR not later than two (2) days prior to the Saturday or legal holiday.

C. Unobserved Work. Any work performed on a Saturday, Sunday, or legal holiday without benefit of an observation by FPR may require removal and replacement if so directed by the FPR. Removal and replacement will be completed at no additional cost to the Owner.

PART 3 – DUTIES OF THE FIELD PROJECT REPRESENTATIVE

A. Assist the Contractor's superintendent in understanding the intent of the contract documents.

B. Conduct on-site observations of the work in progress as a basis for determining conformance of work, materials, and equipment with the contract documents.

C. Consider and evaluate suggestions or recommendations which may be submitted by the Contractor to the Engineer and report them with recommendations for the Engineer's final decision.

D. Be alert to the construction schedule and to conditions which may cause delay in completion, and report same to the Engineer.

E. Maintain liaison with the Contractor and all Subcontractors on the project only through the Contractor's superintendent.

F. Attend conferences held at the project site as directed by the Engineer. Report to the Engineer the results of such meetings.

G. Advise the Engineer in advance of the schedules of tests and observe that tests at the project site, which are required by the contract documents, are actually conducted. Observe, record, and report to the Engineer all details relative to the test procedure.

H. If inspectors representing local, state, or federal agencies having jurisdiction over the project visit the site, accompany such inspectors during their trips through the project. Record and report to the Engineer's office the results of these inspections.

I. Receive samples, which are required, to be furnished at the site; record date received, from whom, and notify the Engineer of their readiness for examination; record Engineer's approval or rejection; and maintain custody of approved samples.

J. Review applications for payment submitted by the Contractor and forward them with recommendations to the Engineer for disposition.

K. After substantial completion, check each incomplete or defective item as it is corrected.

L. If a situation arises during construction which requires that work be rejected, report such situation immediately to the Engineer.

M. The field project representative shall not:
1. Authorize deviations from the contract documents.
2. Personally conduct any tests.
3. Enter into the area of responsibility of the Contractor's superintendent.
4. Expedite the work for the Contractor.
5. Advise on or issue directions relative to any aspect of construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the work.
6. Authorize or suggest that the Owner occupy the project, in whole or in part, prior to substantial completion.
7. Issue a recommendation for payment.

END OF SECTION

SECTION 01500
TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

The facilities and controls specified in this section are considered minimum for the project. After obtaining approval, the Contractor can provide additional facilities and controls which he deems necessary for proper execution of the work and to meet his responsibilities for protection of persons and property.

PART 2 – BUILDINGS

A. Field Office. A temporary field office is not required.

B. Storage. Provide watertight storage facilities of suitable size with floor above ground level for all materials susceptible to weather damage. Storage of other materials on blocks off the ground is acceptable. Place materials to permit easy access for inspection and identification.

C. Other Buildings. The location or building of structures or the erection of tents or other forms of protection are allowed as approved.

PART 3 – UTILITIES

A. Job Telephone. A telephone is not required.

B. Temporary Connections. Arrange and secure all temporary connections for electricity, gas, and other services needed to do the work. The cost of connection and use is paid by the Contractor.

C. Existing Utilities. At no cost for use, connection is permitted to the existing water and sanitary sewer lines with approval of location by the Engineer.

PART 4 – SANITATION

Provide and maintain sanitary conveniences to satisfy requirements of local or state health authorities, ordinances, and laws. Obtain approval for location, secluded from public view. Provide a self-contained, above-ground, temporary toilet facility which is sealed and leak-proof.

PART 5 – ACCESS ROADS AND PARKING

Access and parking at the site is not limited by provisions other than those explained under USE OF PREMISES under SUMMARY OF WORK.

PART 6 – REMOVAL OF TEMPORARY FACILITIES AND CONTROLS

Prior to substantial completion, remove all temporary buildings, storage facilities, sanitary conveniences, and signs. Disconnect all temporary utility connections. Clear the area of unnecessary safety items and temporary controls. Remove or restore, as required, all temporary roads and parking areas. Clean up the entire area as specified in the section on Cleaning and Adjusting.

END OF SECTION

SECTION 01650
FACILITY START-UP

PART 1 – GENERAL

1.1 SCOPE

A. Facility start-up shall include procedures and actions, required of the Contractor, which are necessary to demonstrate equipment, controls, and treatment process functionality and completeness.

B. Definitions

1. Facility: All new equipment and systems constructed and/or installed as part of the Project.
2. Project Classified System (PCS): A defined part of the Project, consisting of an arrangement of items, such as equipment, structures, components, piping, wiring, materials, or incidentals, so related or connected to form an identifiable, unified, functional, operational, safe, and independent system. Each PCS must be approved by the Engineer.
3. Start-up Period: The period of time, of unspecified duration, after initial construction and installation activities are complete, during which Contractor, with assistance from manufacturer's representatives, performs the following items for each PCS, in sequence:
   a. Receipt of approval by Engineer of all related equipment submittals
   b. Completion of construction work to ensure that each PCS (i.e., all of its components) has reached a state where it is fully functional (including automatic control as demonstrated by the Control System Operational Readiness Test) and is ready to be placed into service.
   c. Equipment manufacturer start-up (as required by individual sections of this document).
   d. Performance testing (as required by individual sections of this document).
   e. Personnel training.
   f. Submittal of documentation of results of this period to Engineer for approval.
   g. Control System Operational Readiness Test (ORT): As defined in Section 13302 – Control System Testing, the Contractor shall successfully test the functionality and reliability of the instrumentation (installation, calibration, configuration), field wiring, control panels, and related components for each PCS. This test includes I/O testing (loop testing), and testing of automatic control strategies, alarms, and extreme events. Successful completion of this test is a pre-requisite for approval of its corresponding PCS and Start-up Period.
   h. The Start-up Period will not be approved as being complete until each individual PCS has been approved. The Contractor may determine that multiple start-up periods are required based on the construction sequencing of the facilities. The Contractor shall submit a start-up plan establishing the PCS's and Start-Up Groups.
   i. Start-Up Group: A group of PCSs associated with the completion of a specific phase of the construction sequencing plan.
4. Demonstration Period: The period of time, of specified duration, following the successful completion and approval of the Start-Up Period, during which the Contractor initiates process water flow through the Facility and operates each PCS in unison. Multiple Demonstration Periods may be required based on the construction sequencing plan and number of Start-Up Groups.
   a. Operation shall be completed without exceeding specified downtime limitations to prove the functional integrity of the mechanical equipment and components, electrical equipment and components, and the instrumentation and control of the respective equipment PCS's and components.
   b. Written approval of completion of this period by the Engineer is required in order for this period to be complete and accepted.

c. The Demonstration Period will not be approved as being complete until the Process Control System Functional Demonstration Test (see Section 13302- Control System Testing) has been successfully completed. The Contractor may determine that multiple Demonstration Periods are required based on the construction sequencing of the facilities. The Contractor shall include this in the start-up plan submittal.

d. Process Control System Functional Demonstration Test (FDT): As defined in Section 13302– Control System Testing, the Contractor shall successfully test the functionality and reliability of the Process Control System, including field devices, programmable logic controllers, remote input/output devices and panels, communication network, servers, HMI, and operator workstations. This test may commence and occur simultaneously with the Demonstration Period.

5. Substantial Completion: See Division 0, General Conditions. Successful completion of the Demonstration Period is one of the pre-requisites to achievement of Substantial Completion.

6. Commissioning: A period of undetermined length of time following Substantial Completion, during which the Owner is operating and maintaining the Facility and identifies any problems or issues with the Facility. The Contractor is responsible for responding to and addressing substantiated issues as part of the Facility's warranty.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor supplier or manufacturer of complying with the requirements herein.

1.3 REFERENCES

A. Reference Standards:
1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. Anti-Friction Bearing Manufacturers Association (AFBMA)
4. Hydraulic Institute (HI)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. National Electric Code (NEC)
7. National Electrical Manufacturers Association (NEMA)

1.4 SUBMITTALS

A. See Section 01340 – Shop Drawings, Product Data and Samples for requirements for the mechanics and administration of the submittal process.

B. Schedule: Submit updated overall project schedule clearly showing Facility Start-up activities as part of the baseline schedule. See Section 01330 – Construction Progress Schedules for schedule requirements.

C. Start-up Plan:
1. Submit a log showing each PCS's equipment subject to this specification, listing what is to be accomplished and documented during start-up. Provide a place for the Contractor to record date and person accomplishing and approving the required work.
2. Submit templates for recording loop checks, instrumentation configuration, performance test results
3. Facilitate a workshop with the Owner and Engineer to review the plan.
4. The Start-Up Period will not proceed until this submittal has been approved.

D. Master operation and maintenance training schedule:
   1. Submit at least 30 days prior to first training session for Owner's personnel.
   2. Schedule to include:
      a. Target date and time for Owner witnessing of each system initial start-up.
      b. Target date and time for Operation and Maintenance training for each system, both field and classroom.
      c. Target date for initiation of Demonstration Period.
      d. Include holidays observed by Owner.
   3. Facilitate a scheduled planning and coordination meeting 60 calendar days prior to first anticipated training session.
      a. Provide a status report and schedule-to-complete for requirements prerequisite to manufacturer's training.
      b. Identify initial target dates for individual manufacturer's training sessions.
   4. Owner reserves the right to insist on a minimum 7 days' notice of rescheduled training session not conducted on master schedule target date for any reason.
   5. Schedule to be resubmitted until approved.

E. Draft PCS Package: The Contractor shall submit for approval a separate package for each PCS upon completion of all field start-up activities, that documents:
   1. Pre-startup field checks.
   2. Manufacturer's installation inspection reports.
   3. Start-up reports, including results of field tests and performance tests as specified.
   4. Approved loop check form.
   5. Certified instrument calibration/configuration form.
   6. Documentation of Owner personnel training and electronic files of training materials.

F. Demonstration Plan
   1. Submit a detailed plan of activities and steps for the Demonstration Period that includes staffing responsibilities, data to be collected, procedure for notification and documentation of problems that necessitate stoppage of the test.
   2. Facilitate a workshop with the Owner and Engineer to review the plan
   3. The Demonstration Period will not proceed until this submittal has been approved.

1.5 SEQUENCING AND SCHEDULING

A. The sequencing and scheduling of facility start-up activities shall be organized and coordinated so that operational performance requirements can be determined by each Project Classified System (PCS). The Contractor shall submit a list of PCS's, with the start-up plan, organized chronologically by Start-Up Group. A sample is provided below:
   1. Phase 1:
      a. Exist Headworks Expansion
      b. Aeration Basin No. 3
      c. Clarifier No. 3
      d. Exist Blowers Expansion
      e. NPW Pump Station
      f. Exist Chemical Storage Area Expansion
      g. WAS Airlifts
      h. Exist Tertiary Filters Expansion
      i. Dewatering Facility
      j. Press Feed Pumps

2. Phase 2:
    a. Exist Peak Shaving Basin Expansion
    b. Exist Peak Shaving Basin Pump Station Expansion
    c. Exist Chlorine Contact Basin Improvements
    d. Exist Sludge Holding Tank Improvements
3. Phase 3:
    a. Exist On-Site Lift Station Expansion and Force Main Improvements

1.6 COST OF START-UP

A. Contractor to pay all costs associated with Facility start-up as defined herein, including costs for repeated testing and correction of deficiencies.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 GENERAL

A. Facility Start-up is divided into three periods:
1. Pre-Startup Period including activities to verify that the construction work is complete and ready for start-up.
2. Start-Up Period including:
    a. Receipt of the approval of submittals.
    b. Completion of construction work to bring each PCS to a state of readiness of operation and functionality
    c. Manufacturer's inspection and certification of installation.
    d. Start-up of equipment for each PCS.
    e. Performance testing for each PCS.
    f. Process Control System Operational Readiness Test, including Instrument Loop Checking and Instrument calibration/configuration.
    g. Training of personnel.
    h. Approval by the Engineer of each PCS submittal.
    i. Approval by the Engineer of a successfully completed Pre-Startup Period.
    j. Authorization by the Engineer to commence the Demonstration Period.
3. Demonstration Period including:
    a. Receipt of approval by the Engineer of the Start-Up Period
    b. Demonstration of functional integrity of the Facility to Owner's representative and/or Owner.
    c. Approval by the Engineer of a successfully completed Demonstration Period.

3.2 PRE-STARTUP

A. Completion of the Work and Notification to Engineer
1. Contractor shall notify the Engineer in writing when the work on a designated PCS has progressed to the point that the new facilities are at a state of readiness and completion for functional operation, the installation of each piece of equipment has been inspected and approved by the equipment manufacturer's representative, and all submittals related to that PCS have been approved. Contractor shall provide written notification to the Engineer at least 72 hours prior to when a PCS is ready for startup.

B. Pre-startup of Equipment

1. Verify cleanliness of connecting piping systems.
2. Test vacuum or pressure integrity of all closed systems.
3. Disinfect potable water systems.
4. Test tankage for leaks using treated product water or potable water.
5. Complete tagging and identification systems.
6. Loop checking of field devices, panels, and wiring
7. Configuration of field instruments and devices
8. Calibrate and verify functionality of all safety equipment.
9. Manually rotate or move moving parts to assure freedom of movement.
10. "Bump" start electric motors to verify proper rotation.
11. Ensure that shaft or belt protective covers are in place and properly secured.
12. Coordinate with and gain approval by Owner for discharges of waste flows from startup activities, including the anticipated volumes, flow rates, duration of flows, and water quality characteristics.
13. The Manufacturer shall perform an inspection to verify the proper installation of the equipment and its conformance with the Contract Documents and the manufacturer's requirements. The inspection shall be performed by a factory-trained representative of the Manufacturer. Results shall be documented by the Manufacturer's representative and shall be on factory letterhead, without restrictions or qualifications, signed by the individual conducting the inspection and provided to the Engineer.
14. The electrical switchgear/motor control center / local control panel has been inspected by the Engineer and the electrical subcontractor verifies that it is ready for use.
15. Proper alignment of the equipment to the motor, equipment to suction and discharge piping and overall stability of the equipment. Contractor shall remove suction and discharge bolts to check for pipe strain prior to start-up and in the presence of the Field Project Representative. Any misalignment of more than ¼" when uncoupled shall be remedied by the Contractor prior to starting the equipment. Verify the grout installation follows Manufacturer's recommendations.
16. Proper lubricants were used and the fluid or grease quantities are within the manufacturer's recommendations. Verify the oil drip rate on lineshaft turbines complies with the manufacturer's recommendations and that the solenoid valves open upon the equipment receiving a call signal.
17. For pumps:
    a. Verify that any seal flushing system is operational with the predetermined pressure and flow. If packing is used, ensure that it is not over-compressed. Mechanical seal alignment should be verified for conformity with the seal manufacturer's tolerances. Verify that any interlocking solenoid valves are operational and tied into the control circuitry.
    b. Verify that there is a sufficient volume and depth of liquid on the suction side of the pumps to adequately perform the tests. The depth of the liquid must match the normal operating depth that the pump will experience while in operation.
    c. The downstream components are constructed and capable of receiving the pumped liquid. Temporary facilities may be used if provided by the Contractor but must approximate the actual duty conditions the pump will see in normal operation.
    d. Verify the impellers spin freely prior to electrification.
    e. Verification of an unobstructed suction, open and working discharge valves and piping. The Contractor is responsible for removing any foreign material or debris from the cans or suction side of the pumps before operation of any pumps.
    f. Verify that air release or pressure relief valves are functioning properly.
    g. Prime pumps if not self-priming or submerged.

3.3 START-UP PERIOD

A. Requirements for individual items of equipment are included in Divisions 2 through 16 of these Specifications.

B. Prepare the equipment so it will operate properly and safely and be ready to demonstrate functional integrity.

C. The Contractor shall ensure that the Owner's Field Project Representative or the Engineer is present to witness the start-up of each piece of equipment. Coordination of start-up activities is the Contractor's responsibility.

D. Repairs for any damages, before or after start-up due to negligence, shall be borne by the Contractor.

E. Perform equipment start-up to extent possible without introducing product flow, or with limited use of product flow, or clean water (if acceptable).

F. Perform tests, checks, and activities required to make the equipment ready for Demonstration Period. Correct deficiencies as needed.

G. Start-up procedures to be completed to obtain approval of the PCS include, but are not necessarily limited to the following:
   1. Proper connection of the electrical wiring to motors.
   2. Power, control, and monitoring circuits continuity checks prior to connection to power source.
   3. Voltage check of all circuits. Verify the source voltage between pairs of legs to make sure that there is not an unbalance greater than 5%.
   4. Phase sequence check.
   5. Amperage check on each phase of a three phase motor while running at specified duty points. Calculate the amperage imbalance on each leg and if the average is greater than 2%, roll the lead positions, and re-test.
   6. Alignment of connected machinery.
   7. Valve orientation and position status.
   8. Instrumentation and control signal generation, transmission, reception, and response as required by Section 13302 – Process Control System Testing.
   9. Instrument calibration.
   10. Proper upper and lower frequency limits are programmed on the VFD (if provided.) Operate the equipment across the full useable frequency range to determine unstable frequencies. Let the equipment operate at each whole hertz frequency for one minute to reach steady-state conditions. Shut down the equipment immediately if excessive vibration occurs. A frequency shall be considered unstable if the vibration on any axis is greater than the limits shown in Table 2.1 below or in the specification for the equipment. Program the VFD to skip all unstable frequencies. Document all settings and useable frequencies on the Start-up sheet.
   11. Verify temperatures, including bearing temperatures, do not exceed manufacturer's recommendations and Engineer's recommendations.

12. Vibration readings while running at Duty Point One and Two for pumps and at the normal operating point for all other equipment if called for in the specification. See the equipment specifications for vibration limits that may supersede those shown below.
    a. Peak Vibration in any Plane

Type of Equipment	RPM	Velocity (in/sec)	Displacement (mils)
Vertical Pump (Short Set VT)	1,800	0.20	2.1

    b. Unfiltered vibration readings shall be in the vertical, horizontal, and axial plains, and taken at both the inboard and outboard bearing housings. Vibration analysis in the field shall be performed during typical operating conditions. Correct any vibrations in excess of the levels listed above by methods acceptable by the Engineer. Provide a written report of vibration levels and the location of each point measured.
13. For pumps:
    a. The flow rate must be measured by the permanent flow meter (after calibration) or a temporary flowmeter (if field calibrated). Provide documentation of the calibration to the FPR before starting the pumps.
    b. Measure the discharge pressure at each duty point and suction pressure if a suction gage is available.
    c. Note any noise or vibration generated.
    d. For clean water pumps, using a Rossum Sand Tester or clear jar, verify there are no brass shavings present in the water. The presence of brass must be remedied by the Contractor prior to acceptance.
14. After completion of equipment start-up / testing activities, drain, clean, and if applicable disinfect, process equipment as necessary to achieve sanitary conditions. Perform cleaning to meet the requirements of Section 01710 – Cleaning and Adjusting.
15. Obtain certifications, without restrictions or qualifications, and deliver to Engineer.
    a. Manufacturer's representative start-up report
    b. Reports from other specialists (e.g. Vibration reports, laboratory analytical results, etc.)

H. Personnel Training:
1. See individual equipment specification sections.
2. Conduct all personnel training after completion of start-up for the equipment for which training is being conducted.
    a. Personnel training on individual equipment or systems will not be considered completed unless:
        i. All pre-training deliverables are received and approved before commencement of training on the individual equipment or system.
        ii. No system malfunctions occur during training.
        iii. All provisions of field and classroom training specifications are met.
    b. Training not in compliance with the above will be performed again in its entirety by the manufacturer at no additional cost to Owner.
3. Field and classroom training requirements:
    a. Hold classroom training on-site.
    b. Notify each manufacturer specified for on-site training that the Owner reserves the right to video record any or all training sessions. Organize each training session in a format compatible with video recording.
    c. Training instructor: Factory trained and familiar with giving both classroom and "hands-on" instructions.
    d. Training instructors: Be at classes on time. Session beginning and ending times to be coordinated with the Owner and indicated on the master schedule. Normal time lengths for class periods can vary, but brief rest breaks should be scheduled and taken.

e. Organize training sessions into maintenance verses operation topics and identify on schedule.
f. Plan for minimum class attendance of 5 people at each session and provide sufficient classroom materials, samples, and handouts for those in attendance.
g. Instructors to have a typed agenda and well prepared instructional material. The use of visual aids, e.g., films, pictures, and slides is recommended for use during the classroom training programs. Deliver agendas to the Engineer a minimum of 7 days prior to the classroom training. Provide equipment required for presentation of films, slides, and other visual aids.
h. In the on-site training sessions, cover the information required in the Operation and Maintenance manuals submitted according to Section 01340 and the following areas as applicable to PCS's.
    i. Operation of equipment.
    ii. Lubrication of equipment.
    iii. Maintenance and repair of equipment.
    iv. Troubleshooting of equipment.
    v. Preventive maintenance procedures.
    vi. Adjustments to equipment.
    vii. Inventory of spare parts.
    viii. Optimizing equipment performance.
    ix. Capabilities.
    x. Operational safety.
    xi. Emergency situation response.
    xii. Takedown procedures (disassembly and assembly).
i. Address above Paragraphs i., ii., viii., ix., x., and xi. in the operation sessions. Address above Paragraphs iii., iv., v., vi., vii., and xii. in the maintenance sessions.
j. Maintain a log of classroom training provided including: Instructors, topics, dates, time, and attendance.
k. Deliver an electronic version of all training materials, videos, to the Owner on a portable electronic storage device.

3.4 DEMONSTRATION PERIOD

A. General:
1. Demonstrate the functional integrity of the mechanical, electrical, and instrumentation and control interfaces of the respective equipment and components comprising the facility.
2. Duration of Demonstration Periods: **14 calendar days per Demonstration Period.**
    a. Demonstration period of newly constructed, rehabilitated, or expanded treatment facilities begins on the first day treated effluent is discharged to the receiving water body via the newly constructed, rehabilitated, or expanded treatment facilities.
    b. Demonstration period of sludge holding tanks begin on the first day process fluid is introduced to the facilities.
3. If, during the Demonstration Period, the aggregate amount of time used for repair, alteration, or unscheduled adjustments to any equipment or systems that renders the affected equipment or system inoperative exceed 10% of the Demonstration Period, the demonstration of functional integrity will be deemed to have failed. In the event of failure, a new Demonstration Period will recommence after correction of the cause of failure. The new Demonstration Period shall have the same requirements and duration as the Demonstration Period previously conducted.
4. Conduct the demonstration of functional integrity under full operational conditions, and in automatic mode (if applicable) of Project Classified Systems.
5. Conduct the Functional Demonstration Test of control systems and furnish the Certificate of Installation from the Process Control System Supplier (PCSS) for each control system.

6. Owner will provide personnel to provide operational process decisions affecting plant performance. Owner's assistance will be available only for process decisions. Contractor, with the assistance of its subcontractors, equipment manufacturers, or contract personnel, will perform all other functions including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period.
7. Owner reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, etc., to verify the functional integrity of automatic and manual backup systems and alternate operating modes.
8. Time of beginning and ending any Demonstration Period shall be agreed upon by Contractor, Owner, and Engineer in advance of initiating Demonstration Period.
9. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's questions, provide final field instruction on select systems and to respond to any system problems or failures which may occur.
10. Provide all labor, supervision, utilities, chemicals, maintenance, equipment, vehicles or any other item necessary to operate and demonstrate all systems being demonstrated.

B. Instances of inoperative or defective equipment may be noted by the Owner, Engineer, or Contractor’s staff. Notification to the Contractor will be in writing.

C. The Contractor shall document each instance of inoperative or defective equipment, including time item was noted and by whom, time the Contractor was notified, time that the Contractor responded, responsible party, corrective action taken, and time that the item was resolved. This log shall be submitted to the Engineer for review and approval.

D. The Demonstration Period shall not be considered successful until the Engineer provides formal approval in writing.

END OF SECTION

SECTION 01652
BYPASS PLAN

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for furnishing turnkey bypass pumping systems at the locations shown on the construction drawings. The bypass plans shown on the construction drawings are not all inclusive, the Contractor shall submit a complete bypass plan prior to commencing work.

B. Each complete bypass pumping system including pumps, engine, controls, plugs, system monitoring/control instruments, piping, valves, and all else required for a complete and working system, shall be provided, installed, and removed by an approved bypass system supplier as listed herein.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples.

B. Bypass System Data
1. Equipment performance characteristics.
2. Equipment dimensions and weights.
3. Bypass system layouts and calculations.
4. Descriptive literature, bulletins and/or catalogs of the equipment.
5. Catalog data sheets for major components (e.g. drives, motors, etc.)
6. Materials of construction.
7. Electrical power requirements, wiring diagrams and controls schematics.
8. Certified shop and installation drawings showing details of construction, dimensions and other critical information. Provide any outside information needed to confirm proper function of the proposed equipment (e.g. clearances, pipe connections, valves, set-points, power, etc.)
9. Emergency contact list

C. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.4 QUALITY ASSURANCE

A. Provide all specified equipment of the latest, most modern design and guaranteed by the Manufacturer to meet the performance requirements as specified herein.

B. Provide a qualified technical representative of the Manufacturer to inspect the completed equipment installation, make all the adjustments necessary to place the equipment in trouble-free operation and instruct operating personnel in the proper care and operation of the equipment furnished.

1.5 GUARANTEE

A. For the duration of the temporary bypass equipment and/or facilities, the contractor or supplier shall repair or replace any piece of bypass equipment that malfunctions and maintain the affected property for the entire width and length of the area on which the proposed temporary bypass equipment is placed, by means of mowing and weed eating. Should a piece of bypass equipment fail, the Contractor will be responsible for any damages incurred due to the bypass equipment failure.

1.6 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work in this section. Include all costs in the associated lump sum bid price.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store equipment as per manufacturer's recommendations.

B. All equipment shall be stored in a secure location where it is protected from the public. All equipment shall be stored in a dry location that is protected from flooding.

C. Accept units on site. Inspect for damage upon delivery.

D. Do not remove shipping blocks, plugs or caps installed to protect the equipment during shipment until the equipment is installed and connections are made.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide complete bypass pumping systems including pumps, engine, plugs, controls, system monitoring, control instruments, piping, valves, fittings, supports, fencing, consumables, and all else required for a complete and working system, including installation and removal, for the duration required to complete the work. The Contractor and bypass supplier shall install bypass pumping systems and piping at the location shown on the plans. If a location is not shown or if the Contractor desires to change the location, the new location shall be shown in the submittal.

B. The Contractor shall route all bypass to designated tie-in location and all suction and discharge piping for the temporary system as shown on the construction drawings. <u>All piping shall be placed on pipe chocks on site pavement.</u>

C. Each bypass pump shall have a diesel engine and controls contained within a single trailer–mounted, sound attenuated enclosure. The bypass system shall be sound attenuated to no more than 80 dba at 15 ft.

D. The bypass pumps for the Lift Station Submersible System at Manhole No. 2 and at Clarifier Effluent Basins No. 1 and No. 2 shall be submersible pumps with diesel power packs.

2.2 PERFORMANCE REQUIREMENTS

A. Performance Table

Design Conditions	**Units**						
Location	-	Lift Station System No. 1	Lift Station System No. 2	Lift Station Submersible System	Filter Influent Channel System	Chlorine Contact Basin Skid No.'s 1 & 2	Chlorine Contact Basin Skid No.'s 3 & 4
Bypass System Total Design Flow	gpm	804	586	130	695	348	695
Total Dynamic Head	ft	53	42	36	12	8	14
Static Suction Lift	ft	30	20	-	-	5	5
Number of Duty Pumps	-	1	1	1	2	2	1
Number of Spare Pumps	-	1	1	-	-	-	1
Net Positive Suction Head Required (Max)	ft	1	11	16	27	26	23
Temporary Fence and Gate?	Y/N	N	Y	N	N	N	N

2.3 ACCEPTABLE MANUFACTURERS

A. Provide bypass systems from one of the following:
1. BPR
2. Capital Pump & Equipment
3. Global Pump (Mersino)

B. Listing as an acceptable supplier will not relieve the supplier from conforming to these specifications.

2.4 ADDITIONAL REQUIREMENTS

A. Provide adequately sized road ramps for bypass piping protection for all bypass piping crossing existing driveways, roadways, or any surface considered to provide drivable access.

B. The Contractor shall provide plugs at the bypass location and at the lift station wet well. The plugs shall be installed as to not allow any liquid into the lift station during construction or any build up at liquid downstream of the bypass location. The Contractor shall utilize the existing manhole to bypass the lift station and connect the bypass pumping system to the existing manholes. The Contractor shall be responsible for monitoring, maintaining and repairing plugs as needed to ensure no leakage for the duration of the bypass. Any damages, claims, or fines incurred by the Owner as a result of the Contractor failing to monitor, maintain and/or repair the plugs will be borne by the Contractor. This includes any emergency repairs performed by the Operator in an attempt to prevent an overflow.

PART 3 – EXECUTION

A. The Contractor shall submit a Bypass Plan to Engineer for approval at least 14 calendar days prior to starting any work. The Contractor shall coordinate with the Operator on any bypass or plant shut downs that must be done. The Contractor shall notify the Operator and Engineer 48-hours prior to doing any bypassing. All bypass set-ups are to be inspected by the FPR.

B. The Contractor shall be responsible for any leaks and cleanup related to the bypass system, immediately alerting the Owner and Engineer of any leaks or spills, at no additional cost to the Owner.

C. The bypass systems shall be in place for the duration necessary to complete all work specified and shown on the construction drawings.

END OF SECTION

SECTION 01710
CLEANING AND ADJUSTING

PART 1 – GENERAL

1.1 RESPONSIBILITY

A. The Contractor is responsible for cleaning and adjusting the work. If the Contractor fails to clean and adjust the work, the Owner may do so and charge the resulting costs to the Contractor.

B. Detailed cleaning and adjusting requirements for specific trades or work are specified in sections pertaining to that trade or work.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

A. Fire Protection. Store volatile waste in covered metal containers and remove from premises daily.

B. Pollution Control. Conduct cleaning and disposal operations in compliance with local ordinances and antipollution laws.

1. Remove waste materials, rubbish, and debris from the site and legally dispose at public or private dumping areas off the project site.
2. Disposal of volatile fluid wastes and other chemical wastes in storm or sanitary sewer systems or into streams or waterways is not permitted.

C. Safety Standards. Maintain the project in accordance with safety and insurance standards.

PART 2 – PRODUCTS

Use only cleaning materials recommended by the manufacturer of the surface to be cleaned. Employ cleaning materials as recommended by the cleaning material manufacturer.

PART 3 – EXECUTION

3.1 DURING CONSTRUCTION

A. Oversee cleaning and insure that the premises are maintained free from accumulations of waste material and rubbish. Do not allow waste materials, rubbish, and debris to accumulate and become unsightly or create a hazard. Provide containers and locate on site for collection of waste material, rubbish and debris.

B. At reasonable intervals during progress of the work, collect and dispose of waste material, rubbish, and debris. Handle waste in a controlled manner. Do not drop or throw materials from heights.

3.2 FINAL CLEANING AND ADJUSTING

A. Use experienced workmen or professional cleaners for final cleaning.

B. Remove grease, dust, dirt, stains, paint, oil, labels, fingerprints, and other foreign materials from interior and exterior surfaces. Repair, patch, and touch-up marred surfaces to match adjacent finishes.

C. Broom clean paved surfaces; rake clean other surfaces of grounds.

D. If installed features of the work fail to operate or operate improperly, make the necessary adjustments to permit and insure proper operation. Remove and repair or replace maladjusted items if necessary for proper adjustment.

E. Remove all waste material and rubbish from the project area, as well as all tools, construction equipment, machinery, surplus materials, and temporary facilities.

F. Immediately prior to acceptance or occupancy, conduct a final inspection of exposed interior and exterior surfaces to verify that the work is properly cleaned. Maintain cleaning until the premises are occupied by the Owner.

G. Clean and service all air filters and pipe strainers. Replace disposable air filters if dirty.

3.3 ADJACENT AREAS

To the Owner's satisfaction, clean or repair adjacent areas affected by the construction. Remove dust and debris in the adjacent area. Repair, patch, and touch-up marred surfaces to match adjacent finishes.

END OF SECTION

SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

Prepare and maintain record documents for the project to accurately reflect the construction as built. Documents must be submitted at work completion as a condition of final acceptance.

PART 2 – MAINTENANCE OF RECORD DOCUMENTS

A. Maintain at the job site, one (1) copy of:
   1. Contract drawings
   2. Complete set of specifications
   3. Addenda
   4. Reviewed shop drawings
   5. Change orders and field orders
   6. Other contract modifications
   7. Field test records
   8. Correspondence

B. Store record documents in an approved location apart from documents used for construction. Do not use record documents for construction purposes. Provide files and racks for orderly storage. Maintain documents in clean, dry, legible condition. Make documents available at all times for inspection by the Engineer.

PART 3 – MARKING DEVICES

Mark all changes with red pencil.

PART 4 – RECORDING

A. Keep record documents current. Do not permanently conceal any work until required information has been recorded.

B. Label each document "PROJECT RECORD" in two-inch (2") high printed letters. Legibly mark contract drawings to record actual construction:
   1. Depths of various elements of foundation in relation to survey data.
   2. Horizontal and vertical location of underground and underslab utilities and appurtenances referenced to permanent surface improvements.
   3. Location of internal utility and appurtenances referenced to permanent surface improvements.
   4. Field changes of dimension and detail.
   5. Changes made by change order or field order.
   6. Details not on original contract drawings.

C. Legibly mark specifications and addenda to record:
   1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
   2. Changes made by change order or field order.
   3. Other matters not originally specified.

D. Legibly annotate the following shop drawings to record changes made after review:
   1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
   2. Changes made by change order or field order.
   3. Other matters not originally specified.

PART 5 – SUBMITTAL

A. At project completion, deliver record documents to the Engineer. Place all letter-sized material in a three (3) ring binder, neatly indexed. Bind contract drawings and shop drawings in rolls of convenient size for ease of handling.

B. Accompany the submittal with a transmittal letter in duplicate, containing:
   1. Date
   2. Project title and number
   3. Contractor's name and address
   4. Title number of each record document
   5. Certification that each document as submitted is complete and accurate.
   6. Signature of Contractor

END OF SECTION

SECTION 02110
DEMOLITION

PART 1 – GENERAL

1.1 DESCRIPTION

A. The work includes demolition of materials and equipment as indicated on the construction drawings.

1.2 PAYMENT

A. No separate payment will be made. Include the cost of this work in contract unit prices. If the designated items are damaged during demolition, handling or storage, the items must be restored satisfactorily at no expense to the Owner. Materials and equipment not designated for reuse or salvage become the Contractor's property.

PART 2 – PRODUCTS

A. Obtain approval for equipment and materials before beginning demolition.

PART 3 – EXECUTION

3.1 PROTECTION OF PERSONS AND PROPERTY

A. Provide protection of persons and property, including safe working conditions throughout work progress.

B. Minimize the spread of dust and flying particles. Execute demolition in a manner to prevent damage from falling debris or other sources to Owner's property or adjacent property.

C. Do not interfere with use of adjacent buildings; maintain free and safe access at all times. Guard against movement or settlement of adjacent buildings. The Contractor is responsible for safety and integrity of adjacent structures and, consequently, is liable for any movement or settlement and any resulting injuries or damage. Provide proper bracing and shoring necessary for support. If safety of adjacent buildings appears to be endangered, cease operations. Do not resume demolition until proper protective measures have been taken.

3.2 BLASTING

A. Blasting is not permitted on this project.

3.3 FIRES

A. Fires are not permitted on this project.

3.4 UTILITY SERVICES

A. Interruption. When temporary interruption of utility service to an occupied building is required by the work, properly coordinate the outage to prevent untimely or damaging interruptions.

3.5 GENERAL WORK ITEMS

A. Operational procedures are at the Contractor's option but must not interfere with the execution of other work. Materials or equipment designated for reuse or salvage will be carefully removed, transported and stored in approved storage areas.

B. Structures. Remove structures as indicated on construction drawings.

END OF SECTION

SECTION 02212
EMBANKMENT

PART 1 – GENERAL

1.1 DESCRIPTION

A. Embankment work consists of placing and compacting approved materials to required lines, grades and cross sections.

1.2 PAYMENT

A. No separate payment will be made for work performed under this section. Include the cost of such work in contract prices for the items listed in the bid form and specified in other sections of this work.

PART 2 – PRODUCTS

A. Specific products are not required. Use equipment and materials necessary to properly complete embankment work.

PART 3 – EXECUTION

3.1 EXCAVATED MATERIALS

A. Suitable materials from excavation operations may be used for embankment. Suitable materials are those free of vegetation, humus or debris.

3.2 BORROW

A. If excavated material is not available in sufficient quantities for embankment work, obtain additional material from designated or approved sources. Such borrow material shall have a plasticity index of 10 or less. Not more than 40 percent (40%) of the material shall pass a No. 200 sieve.

3.3 PREPARATION

A. To prepare for embankment work, strip the area of vegetation, humus or other debris. Dispose of strippings with other waste materials.

3.4 CONSTRUCTION

A. Construct embankments in successive horizontal layers, uniform as to material, moisture and density. Where pneumatic rolling equipment is used, layer thickness must not exceed six-inches (6") before compaction. For tamped rolling equipment, layer thickness must not exceed eight-inches (8"). A layer thickness greater than twelve-inches (12") prior to compaction is not permitted, regardless of compaction methods or requirements.

3.5 COMPACTION

A. Compact to the required density by blading, rolling and sprinkling. Use mechanical tamps to obtain the required density in areas inaccessible to other equipment. Unless otherwise specified or noted in the Geotechnical Engineering Report, place embankment at -3% to +5% of optimum moisture content. Compact to a minimum density of 95 percent (95%) using ASTM D 698.

END OF SECTION

SPECIFICATION 02220
EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for excavation, trenching and backfilling for storm sewers, sanitary sewers, water distribution mains, and other utility systems and appurtenances.

1.2 RELATED WORK

A. All sections of the contract documents, technical specifications, and Geotechnical Report are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this section. Include the cost of such work in contract prices for the items listed in the bid form and specified in other sections of this work.

B. No separate payment will be made for performing Critical Location exploratory excavation. Include cost in unit price for installed underground piping, sewer, conduit, or duct work.

PART 2 – PRODUCTS

2.1 CEMENT-SAND BACKFILL

A. Prepare cement-sand backfill as specified in the section on Cement-Sand Backfill, Division 2, Site Work.

2.2 BANK SAND

A. Obtain bank sand from an approved source. Use sand that is free from clay lumps, organic and other deleterious material, and having a plasticity index (PI) of four (4) or less.

PART 3 – EXECUTION

3.1 EXCAVATION

A. Procedure. Excavate to indicated or specified depths.
   1. During excavation, pile material suitable for backfilling in an orderly manner far enough from the bank of the trench to avoid overloading, slides or cave-ins.
   2. Remove any waste as indicated or directed including all excavated materials not required or suitable for backfill.

3. Grade as necessary to prevent surface water from flowing into trenches or other excavations. Remove any water accumulating in trenches or other excavations, using pumping or other approved means.
4. Excavate by open cut with trenching machine or backhoe. Where machines other than ladder or wheel type trenching machines are used, do not use excavated material composed of large chunks or clods for back-fill, but dispose of such material and provide other suitable material for backfill without additional expense.

B. Trench Excavation.
1. Dig the trench the proper width for laying pipe, as shown. Trench width in the pipe zone shall not exceed pipe O.D. plus 24 inches. Cut banks of pipe trench as nearly vertical as practical. Remove stones as necessary to avoid point-bearing. Over excavate wet or unstable soil from the trench bottom to permit construction of a more stable bed for pipe.
2. Backfill the trench to the proper grade with granular material.
3. Be careful not to over excavate. Accurately grade the trench bottom to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except where necessary to excavate for bell holes and for proper sealing of pipe joints. Dig bell holes and depressions for joints after the trench bottom has been graded. Make bell holes and depressions for joints no deeper, longer or wider than needed to make the joint properly.

C. Sheeting and Bracing. Install in trenches and other excavations with vertical sides, sheeting and bracing necessary to support the sides. Sheeting may be pulled after excavation has been backfilled, but not without approval.

D. Pipe Bedding.
1. Class AA Bedding. 36-inch (36") diameter pipe and smaller. Accurately grade the bottom of the trench four-inches (4") below the bottom of the pipe. Place cement stabilized sand seven-inches (7") deep and shape to conform to the bottom of the pipe. The minimum cement sand thickness under the pipe shall be four-inches (4"). After the pipe has been installed, backfill with thoroughly rodded cement stabilized sand, to a level of six-inches (6") above the top of the pipe.
2. Class C Bedding. Accurately grade the bottom of the trench six-inches (6") below the elevation of the normal pipe installation and to the width shown. Place and compact six-inches (6") of bank sand in the trench before the pipe is laid. After the pipe is laid, place a minimum compacted depth of 12-inches (12") over the top of the pipe to provide a compacted encasement surrounding the pipe.

3.2 UTILITY INSTALLATION

A. Storm and Sanitary Sewers. Limit clear space on either side of the pipe to twelve inches (12") at and below the top of the pipe. Above the pipe, cut as wide as necessary to sheet and brace and properly perform the work. Provide bedding as per the Geotechnical Engineering Report and Construction Details located in the Construction Plans.

B. Water Distribution Lines. Grade trenches to avoid high points requiring vacuum and relief valves in waterlines. Provide a minimum cover over the top of the pipe of four feet (4'), or as shown on drawings, from the existing ground surface or the adjacent top of curb, whichever is lower. Avoid interference of waterlines with other utilities. Provide bedding per the Geotechnical Engineering Report and Construction Details located in the Construction Plans.

C. Electrical System. Banks of trenches for electrical cables and duct lines need not be kept vertical but may be sloped or widened to such general limits as may be set, provided there is not interference with other utilities.

1. Over-excavating and backfilling with suitable selected material where rock is encountered will not be required except for a gradual cushioning toward points of abrupt drop off of the rock to levels considerably below the grade of the duct.

D. Excavation of Appurtenances. Excavate sufficiently for manholes and similar structures to leave at least two-feet (2') clear between the outer surfaces and the embankment or timber that may be used to hold and protect the banks. Any over-depth excavation below such appurtenances not directed will be considered unauthorized and will be refilled with sand, gravel or concrete, as directed, at no additional cost.

3.3 PROTECTION OR REMOVAL OF UTILITY LINES

A. Existing utility lines shown on drawings or known to the Contractor prior to excavation and that are to be retained, as well as utility lines constructed during excavation operations must be carefully protected and satisfactorily repaired if damaged. Any damage to lines not shown should be reported immediately. When utility lines that are to be removed are encountered, notify the Engineer so that measures can be taken to avoid interruption of services.

3.4 BACKFILLING

A. Criteria. Do not backfill trenches until the utility systems that are installed to conform to specified requirements of the appropriate sections. Backfill trenches to ground surface with selected material as specified for embankments under applicable sections in Division 2, Site Work. Reopen trenches improperly back-filled to depth required for proper compaction. Refill and recompact as specified, or otherwise correct the condition in an approved manner. Compaction shall be by mechanical means. Water tamping is not allowed.

B. Open Areas.

1. In the pipe zone, deposit backfill material in layers no thicker than eight-inches (8"). Compact to 95 percent (95%) ASTM D 698 at minus four percent (-4%) to plus four percent (+4%) of optimum moisture content in accordance with the PI noted in the Geotechnical Engineering Report, until there is a cover of not less than one-foot (1') over utility lines. Backfill material shall meet the required moisture content and compaction noted in the Geotechnical Engineering Report. Take special care not to damage pipe wrapping or coating.
2. Above the pipe zone, deposit backfill in 8-inch (8") layers. Compact each layer to 95 percent (95%) ASTM D 698 at minus four percent (-4%) to plus four percent (+4%) of optimum moisture content.

C. Pavement Sections.

1. In the pipe zone, deposit backfill in layers eight inches (8") or thinner. Compact each layer to 95 percent (95%) of ASTM D 698, at minus three percent (-3%) to plus three percent (+3%) of optimum moisture content in accordance with the PI noted in the Geotechnical Engineering Report.
2. Above the pipe zone, deposit backfill in 8-inch (8") layers and compact to 95 percent (95%) ASTM D 698 at minus three percent (-3%) to plus three percent (+3%) of optimum moisture content. Place compacted fill in accordance with the Geotechnical Report to within one-foot (1') of proposed subgrade.

3.5 CRITICAL LOCATION INVESTIGATION

A. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to waterlines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. At Critical Locations shown on Drawings, perform vacuum excavation to field verify horizontal and vertical locations of such lines within zone of 2 feet vertically and 4 feet horizontally of proposed work.

1. Minimum of 7 days prior to manufacturing pipe and prior to beginning pipeline excavation or excavation for auger pit or tunnel shaft, Contractor shall properly locate and identify all existing utilities in proximity to the proposed utility construction. Contractor shall confirm existing utility locations. Use extreme caution and care when uncovering utilities designated by the indication of a Critical Location.
2. Notify Owner's Representative in writing immediately upon identification of obstruction or any unidentified obstruction. In event of failure to identify obstruction in minimum of 7 days, Contractor will not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until 7 days has passed from time the Owner's Representative is notified of obstruction.

3.6 TEST FOR DISPLACEMENT OF SEWERS

A. After the trench has been backfilled to two-feet (2') above the pipe and tamped as specified, check the alignment as follows. Flash a light through the sewer between manholes. Use a flashlight or reflect sunlight with a mirror. If the illuminated interior of the pipeline shows poor alignment, pipe displacement, or other defects, remedy them satisfactorily.

3.7 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess or unsuitable material from the excavation off the job site.

B. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide Owner's Representative with 48 hours notice prior to field excavation or related work.

C. Survey vertical and horizontal locations of obstructions relative to project baseline and datum. Submit to Owner's Representative for approval, horizontal and vertical alignment dimensions for connections to existing lines, tied into project baseline, signed and sealed by R.P.L.S.

END OF SECTION

SECTION 02221
CEMENT-SAND BACKFILL

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for the use of cement-sand as bedding material under sewer and plant process pipes; for backfilling material around sewer and plant process pipes, manholes, inlets and drainage structures as required, and for backfill of utilities in pavement sections.

1.2 RELATED SECTIONS

A. All sections of the contract documents, technical specifications, and Geotechnical Report are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 PAYMENT

A. No separate payment will be made for work or materials performed under this section.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Sand. Use clean durable sand containing not more than the following:

1. Deleterious materials.
   a. Clay lumps, ASTM C-142; less than 0.5 percent (0.5%)
   b. Lightweight pieces, ASTM C-123; less than five percent (5.0%)
   c. Organic impurities, ASTM C-40; shall not show a color darker than the standard color
   d. Other deleterious materials such as coal, shale, coated grains of soft flakey particles; less than two percent (2.0%)
2. Plasticity index shall be four (4) or less when tested in accordance with ASTM D-43 and ASTM D-424.
3. Gradation Requirements.

	% Retained
3/8-inch sieve	0%
¼-inch sieve	0% - 5%
10-mesh sieve	5% - 35%
20-mesh sieve	15% - 55%
40-mesh sieve	35% - 85%
60-mesh sieve	60% - 95%
100-mesh sieve	80% - 97.5%
200-mesh sieve	95% - 100%
270-mesh sieve	100%

4. Color test ASTM C40-73. Color not darker than standard color.

B. Portland Cement. Furnish Portland cement to conform with ASTM C-150, Type I.

C. Water. Water shall be reasonably clean and free from injurious amounts of oil, acid, alkalies, salt, organic matter, or other deleterious material.

2.2 PROPORTIONING AND MIXING

A. Add not less than 1½ sacks of Portland cement to stabilize one (1) cubic yard of sand mixture. Add required amount of water and mix thoroughly in an approved pug-mill type mixer. Stamp batch ticket with the time of loading. Material not in place within three (3) hours after loading will be rejected.

2.3 TESTING

A. Upon request of the Engineer, the Contractor or his supplier will furnish samples of the sand and cement for testing before and/or during project construction. Samples shall be submitted two (2) days prior to stabilized sand being delivered to the project site. If the material source is changed during project construction, new samples shall be submitted.

PART 3 – EXECUTION

3.1 BEDDING PROCEDURES

A. Place cement-sand in a trench or excavation prepared for sewer pipe to the depth shown on the drawings.

B. After bedding material is in place, set pipes in position to grade.

C. Add additional cement-sand material around pipe, filling to at least six-inches (6") above pipe crown. Place cement-sand material at optimum moisture content, and in layers not to exceed six-inches (6") measured loose.

D. Compact with mechanical hand tamps to at least 95 percent (95%) of AASHTO Density, Test Method T-99.

3.2 FOUNDATIONS

A. Use cement-sand for stabilizing below the foundation for pre-cast manholes, inlets or concrete structures. Backfill outside the manhole to a minimum of six-inches (6") above the largest pipe crown. With "AA" bedding, continue cement-sand backfill to within one-foot (1') of the finished pavement surface.

3.3 BACKFILL PROCEDURES

A. Place cement-sand in sewer trenches as backfill for sewer lines under existing or future pavement. Backfill to within one-foot (1') of the subgrade with the cement-sand. Use cement-sand material as backfill material around manholes if the structure lies within two-feet (2') of the pavement.

B. Place cement-sand material at optimum moisture content in layers not to exceed 12-inches (12"), measured loose.

C. Compact with mechanical hand tamps to at least 95 percent (95%) of prescribed ASTM D 558.

3.4 PERFORMANCE

A. The sand-cement mixture shall produce a minimum unconfined compressive strength of 100 pounds per square inch (100 psi) in 48 hours when compacted to 95 percent (95%) of ASTM D-698 without additional moisture control, cured (ASTM C-31, Item 9), and tested in accordance with ASTM C-31.

END OF SECTION

SECTION 02222
STRUCTURAL EXCAVATION AND BACKFILL

PART 1 – GENERAL

p

1.1 DESCRIPTION

A. This section describes the excavation for all structures except pipe sewers, the backfilling around completed structures and the disposal of all excess excavated material. All operations required for the proper completion of the excavation work, including sheeting, shoring, bracing, dewatering of excavations, and compaction of backfill are included under this section.

B. All structural backfill shall be select fill in accordance with the Geotechnical Engineering Report. Reutilization of excavated on-site soils to backfill around foundations and structural walls shall not be permitted.

C. All spoils shall be removed and disposed of by the Contractor off-site.

1.2 RELATED SECTIONS

A. All sections of the contract documents, technical specifications, and Geotechnical Report are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCE STANDARDS

A. Perform all work in this section in accordance with applicable sections of the following standards, except as modified in this specification.
   1. American Society of Testing and Materials (ASTM).
   2. American Association of State Highway and Transportation Officials (AASHTO).

1.4 PAYMENT

A. No separate payment will be made. Include cost of work in other related bid prices.

1.5 PROTECTION

A. Before the start of earthwork operations, adequately protect existing structures, utilities, trees and shrubs and other permanent objects. Costs resulting from damage to permanent facilities due to negligence or lack of adequate protection will be charged to the Contractor. The Contractor will also be charged for damage to facilities scheduled for later removal or demolition if the damage sufficiently impairs proper operation to the extent that temporary replacement or repair is required.

PART 2 – PRODUCTS

2.1 BACKFILL

A. Refer to Geotechnical Engineering Report for backfill types, respective fill placement and respective compaction requirements.

2.2 SAND BACKFILL

A. Where sand backfill is specified, use reasonably clean bank sand from an approved source. The sand must be free from large lumps of clay, rubbish, organic matter or other deleterious substance. Not more than 12 percent (12%) by weight shall pass the 200 mesh sieve and the plasticity index shall not exceed 4.0.

2.3 CEMENT-STABILIZED SAND BACKFILL

A. Prepare a mixture of sand, cement and water.

B. Use washed river sand free from large clay lumps or appreciable amounts of other foreign materials. The sand must not be darker than the standard color when subjected to a color test in accordance with ASTM C-40.

C. Required gradation of sand:

Screen Size	Percent Retained
⅜-inch screen	0 Percent
¼-inch screen	0 Percent - 5 Percent
20 mesh screen	15 Percent - 50 Percent
100 mesh screen	80 Percent - 100 Percent

D. Use Type I cement conforming to ASTM C-150.

E. Mix in a pug mill using not less than 1½ sacks of cement per cubic yard of mixture with sufficient water to hydrate the cement.

PART 3 – EXECUTION

3.1 EXCAVATION

Excavation work shall be unclassified and includes removal of all types of materials encountered without exception. Make excavations to lines and grades indicated on drawings. Complete excavations within the tolerances specified. Perform all work in conformity with the rules and regulations of the Federal Occupational Safety and Health Act.

A. Shoring, Bracing and Dewatering. Provide shoring, bracing and dewatering of excavations required to properly and safely complete the work as shown. Construct shoring and bracing to prevent the excavation from extending beyond specified or indicated limits and to protect workmen. Keep excavations dewatered by drainage, pumps or well points as necessary while work is in progress. Dewatering methods are subject to approval. Remove shoring, bracing and sheathing as excavations are backfilled in a manner to prevent injurious caving.

B. Pipe Trenches. Excavate by open cut methods. Make and maintain the sides of the trench as nearly vertical as practical. Provide shoring to maintain the sides of the trench in a vertical position and to protect workmen. Complete and shape the trench to provide free working space and to permit thorough tamping of backfill around the pipe. Grade trench bottoms accurately to provide uniform bearing on firm soil along the entire length of each pipe section. Remove rubbish, rock or debris encountered at grade to at least six-inches (6") below the bottom of the pipe. Reshape and compact the trench bottom. Working space measured from the outside of the pipe to the side of the trench must be at least six-inches (6") but not more than 24-inches (24"). Provide bell holes where required for making proper connections at joints.

C. Structures Other Than Pipes.

1.
   a. Cut all excavations a sufficient distance from walls, shafts or similar elements of structures to allow for placing and removing forms and for inspection.
   b. Make no excavation beyond a vertical plane three-feet (3') outside of footing lines or wall lines except as shown or specifically authorized.
2. Carry all excavations to the elevations shown and to deeper levels as directed when suitable foundation soils are not encountered at plan depth. Remove all pockets of soft or otherwise unstable soils and replace with concrete or with suitable well compacted soil as directed.
3. Fill all unauthorized excessive excavation with concrete at no change in the contract sum.

4. Protect all open excavations from rainfall or excessive drying. Provide pumps and other equipment as required to keep excavations reasonably free of water at all times and completely free of water during placement of concrete.
5. Do not remove the last four-inch (4") depth of excavation for slabs or footing until reinforcing steel and concrete are ready to be placed.
6. For footings founded on rock, hard shale or similar material, remove all loose material. Clean and cut to a firm surface either level, stepped or serrated as directed. Clean out seams and fill with concrete at the time footing concrete is placed.

3.2 BACKFILL

Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable soils from the excavation as backfill material. Do not use peat or other organic matter, silt, muck, debris or similar materials. Deposit backfill in uniform layers and compact each layer as specified.

A. Backfill at Structures. Place backfill as promptly as practicable after completion of each structure or portion of a structure. Do not however, place backfill against concrete walls or similar structures until concrete has been cured at least seven (7) days. Remove concrete forms before starting backfill and remove shoring and bracing as the work progresses. Take care to prevent any wedging action of backfill against the structure. Step cut or serrate the slopes bounding the excavation as required to prevent wedging.

B. Backfilling of Pipe Trenches.
1. Do not start backfilling until all pipe joints have been inspected and approved. Remove shoring and bracing before backfilling or as backfilling progresses. When specifically approved, shoring and bracing may be cut off 18 inches below the ground line and left in place.
2. Place initial backfill in equal layers along both sides of the pipe and carefully tamp to form a uniform bedding. Continue in this manner until the pipe is covered.

C. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to approximately optimum moisture content. Compact with power-driven hand tampers to the prescribed density.
1. Backfill. Place in eight-inch (8") maximum layers, loose measure. Compact to not less than 95 percent (95%) of maximum dry density as determined by ASTM D 698.
2. Sand Backfill and Filter Material Backfill. Place in six-inch (6") maximum layers, loose measure. Compact to not less than 95 percent (95%) of maximum dry density as determined by AASHTO Standard Method T-99.
3. Cement Stabilized Sand Backfill. Place in eight-inch (8") maximum layers. Compact to not less that 95% of maximum dry density as determined by ASTM D 558.

3.3 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess or unsuitable material from the excavation off the job site.

END OF SECTION

SECTION 02226
TRENCH SAFETY SYSTEM

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for the installation and maintenance of a trench safety system that meets the minimum requirements of OSHA Safety and Health Regulations, Part 1926, subpart P.

1.2 RELATED WORK

A. Division 2, Site Work
   1. Sanitary Sewers
   2. Cement-Sand Backfill
   3. Storm Sewers
   4. Manholes
   5. Water Distribution Mains
   6. Concrete Construction for Structures

1.3 MEASUREMENT AND PAYMENT

A. All work performed under this section will be paid for at contract unit prices for trench safety system based on the size of pipe and depth of trench. Unit prices shall include all required materials, installation, maintenance, and removal of the trench safety system.

B. The trench safety system shall be measured along the centerline of the excavated trench for the length of system installed. The depth shall be measured from natural ground to the bottom of the excavated trench.

1.4 QUALITY ASSURANCE

A. Trench safety system shall meet the current standards established by the Occupational Safety and Health Administration (OSHA) Safety & Health Regulations, Part 1926, Subpart P - Excavations, Trenching and Shoring.

B. The Engineer's Field Representative will inform the Contractor, the Owner and/or OSHA should the Representative observe actions not in accordance with OSHA regulations. Any construction not in accordance with OSHA regulations may not be eligible for payment, and any delays in construction to bring the project within OSHA regulations will not be the responsibility of the Owner or the Engineer.

1.5 RESPONSIBILITY

A. Contractor has the sole and exclusive responsibility for the sufficiency of the trench excavation safety systems utilized. The Contractor shall specifically agree that neither the Owner nor the Engineer has such responsibility, and Contractor will not rely on the Owner or the Engineer or any of their representatives for inspection, design, supervision, construction or any other aspect of trench excavation safety protection.

END OF SECTION

SECTION 02227
WASTE MATERIAL DISPOSAL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Waste material disposal consists of disposal of trees, stumps, logs, brush, roots, grass, vegetation, humus, rubbish and other objectionable matter from operations such as clearing and grubbing, excavation and grading. Unless otherwise specified, the Contractor is responsible for removal and disposal of waste material.

B. All unusable spoils shall be removed and disposed of by the Contractor. Contractor shall note that on site soils cannot be used for backfilling structures.

1.2 PAYMENT

A. No separate payment will be made. Include cost of work in contract bid prices.

PART 2 – PRODUCTS

A. Specific products are not required. Use equipment and materials necessary to properly complete disposal of waste materials.

B. Obtain approval for equipment and materials before beginning disposal of waste materials.

PART 3 – EXECUTION

A. All waste material becomes the property of the Contractor and is to be removed from the worksite and legally disposed of in a manner not to damage the Owner. All rules of the Texas Commission on Environmental Quality, Texas Air Control Board, and U.S. Environmental Protection Agency shall be followed in the disposal of waste material.

B. If regulations require, provide "cradle-to-grave" documentation of the disposal including manifests.

END OF SECTION

SECTION 02230
GRADING AND COMPACTION OF SUBGRADE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Grading and compaction of subgrade consists of grading and compacting the road embankment to desired grades and cross section and to desired compaction.

1.2 PAYMENT

A. No separate payment will be made for work performed under this section. Include the cost of such work in contract prices for the items listed in the bid form and specified in other sections of this work.

PART 2 – PRODUCTS

A. Specific products are not required. Use equipment and materials necessary to properly complete the required work.

PART 3 – EXECUTION

3.1 EXCAVATED MATERIALS

A. Suitable materials from excavation of road ditches may be used for road embankment. Suitable materials are those free of vegetation, humus or debris.

3.2 BORROW

A. If excavated material is not available in sufficient quantities for road embankment work, obtain additional material from designated or approved sources. Such borrow material shall have a plasticity index of 20 or less. Not more than 40 percent (40%) of the material shall pass a No. 200 sieve.

3.3 GRADING

A. The road embankment is to be graded to proper grades and cross section. Construct embankment in successive horizontal layers, uniform as to material, moisture and density. Where pneumatic rolling equipment is used, layer thickness must not exceed six-inches (6") before compaction. For tamped rolling equipment, layer thickness must not exceed eight-inches (8"). A layer thickness greater than twelve-inches (12") prior to compaction is not permitted, regardless of compaction methods or requirements.

3.4 COMPACTION

A. Compact to the required density by blading, rolling and sprinkling. Use mechanical tamps to obtain the required density in areas inaccessible to other equipment. Unless otherwise specified, place embankment at minus four percent (-4%) to plus four percent (+4%) of optimum moisture. Compact to a minimum density of 95 percent (95%) using ASTM D 698.

END OF SECTION

SECTION 02515
CONCRETE CONSTRUCTION FOR STRUCTURES

PART 1 – GENERAL

1.1 SCOPE

A. This section covers the work to be performed in the construction of storm sewer inlets, manholes and miscellaneous concrete items.

1.2 RELATED WORK

A. All Sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cement.
   1. Type. ASTM C-150, Type I unless authorized to be Type III.
   2. Requirements. ASTM Specifications for weight variations and length of storage. Use no caked cement. Deliver in bags for site-mixed concrete. Use only one (1) brand of cement in any one (1) structure.

B. Water. Clean and free from injurious amount of oils, acids, alkalies, or other deleterious substances.

C. Coarse Aggregate. ASTM C-33. Unless otherwise specified, use standard size form No. 4 to 1½-inch (1½") and modify only in accordance with the following requirements. Not larger than $^{1}/_{5}$ of narrowest dimension between sides of forms, nor larger than ¾ of the minimum clear spacing between reinforcing bars.

D. Fine Aggregate. ASTM C-33.

E. Air-Entraining Admixtures. ASTM C-260.

F. Reinforcing Steel.
   1. Bars. All bars except No. 3 bars shall meet ASTM A-615-72, new billet steel, grade 60, manufactured by the open hearth process, unless otherwise shown or specified. When placed in work, bars shall be free from dirt, scale, rust, paint, oil or other injurious materials. No. 3 bars shall be grade 40 steel.
   2. Bars to be Field Bent. Bars to be bent in the field must be grade 40.

3. Welded Wire Fabric. Wire fabric, when shown shall be ASTM A-82-62T, of gauge and spacing shown with longitudinal and transverse wires electrically welded together at points of intersection and welds of sufficient strength that they will not be broken during handling or placing. Welding and fabrication of fabric sheets shall be in accordance with ASTM A-185-64. Welded wire fabric must be provided in sheets. Rolls are not allowed.
4. Furnish manufacturer's certificates giving properties of steel and specimens, free of cost, for testing when required.

G. Curing. Liquid membrane forming compounds for curing concrete shall be Type 2 white pigmented conforming to ASTM Designation C-309.

2.2 STORAGE OF MATERIALS

A. Cement. Store off ground in a well ventilated weatherproof building.

B. Aggregate. Prevent admixture of foreign materials and aggregate, and preserve gradation.

C. Reinforcing Steel. Store in such manner that it is protected from mechanical injury and surface deterioration caused by exposure to conditions producing rust.

2.3 CONCRETE

Use either ready-mixed concrete (ASTM C-94) or site-mixed concrete.

2.4 MEASUREMENT OF MATERIALS

A. Measure materials by weight.

B. Water may be measured by volume.

C. Cement may be measured by bag. One (1) bag weighs 94 pounds.

2.5 CLASSIFICATION AND PROPORTIONING

A. Proportioning. Concrete materials will be proportioned on basis of maximum water-cement ratio and minimum strength allowable with limits set on minimum cement content. Cement content shall be increased above minimum, without additional cost to Owner, if at any time the type, gradation, or size of aggregate being supplied requires that extra cement be added to meet strength and workability requirements.

B. Classification.

Class	Type	Minimum Compressive Strength (Pounds Per Square Inch) 7-Day	28-Day	Maximum Water Content Per Bag of Cement (Gal.)	Minimum Cement (Cubic Yard)	Consistency Range in Slump (Bags Per Inch)
A	Normal Weight	2000	3000	6.25	5.0	2 to 5
B	Pipe Blocking Fill	….	1500	8.00	4.0	3 to 5
C	Structural	….	4000	….	6.0	3 to 5

1. Include a maximum water, free water in aggregate minus absorption of aggregate based on a 30 minute absorption period.
2. Use minimum of 6.5 bags of cement per cubic yard of concrete if concrete is to be placed under water.

C. Consistency. Use concrete with consistency that can be worked readily into corners and around reinforcing steel without segregation of materials or having free water collect on surface. Proportions will be changed if satisfactory mix is not being obtained.

D. Air Content. Approximately three percent (3%) is required, unless otherwise specified. Determine in accordance with approved ASTM standard method.

E. Changes in Mixes. Engineer will make changes in proportions or materials, or both, necessary to secure desired concrete properties, subject to above limitations. Should Contractor desire to make changes in materials, gradation, or proportions of mixture, or use special concrete additives, obtain prior approval.

2.6 QUALITY OF CONCRETE

A. Field Tests. Test cylinders or beams will be made in numbers required to maintain check on strength of concrete. Provide and maintain curing facilities as required in ASTM C-31. Moisture tests of aggregate will be made at sufficient intervals for accurate batching and proportioning.

B. Applicable Standards. ASTM Standards for sampling and testing.

C. Tests on High-Early Strength Cement. Normal Portland cement seven-day (7) and 28-day tests and minimum strengths required at three (3) to seven (7) days.

D. Failure to Meet Specifications. Should seven-day (7) or three-day (3) test strengths, as applicable for type of cement being used, fail to meet established strength standards, Owner may require extended curing or resumed curing on these portions of structure represented by test specimens. Should additional curing fail to give required strength, Owner may require, at Contractor's expense, strengthening or replacement of portions of structure which fail to develop required strength. Use ASTM C-42 for test cores.

PART 3 – EXECUTION

3.1 MIXING CONDITIONS

A. General. Mix concrete in quantities required for immediate use, and place concrete within one (1) hour after start of mixing, except as otherwise authorized. Clock-stamp delivery ticket of all batches with time of mixing, at ready-mix plant. When adverse weather conditions affect quality of concrete, work shall be postponed.

B. Cold Weather. Unless prior approval is obtained, do not mix concrete when air temperature is at or below 40°F (taken in shade away from artificial heat) and falling. Concrete may be mixed when temperature is 35°F and rising. If authorized for placement during cold weather, place concrete in accordance with PCA "Design and Control of Concrete Mixtures." Protect concrete from temperatures below 32°F until it has cured for minimum of three days (3) at 70°F or five days (5) at 50°F. Remove and replace unsatisfactory concrete.

3.2 MIXING AND MIXING EQUIPMENT

A. Mixer. Use approved type and size, and do not load beyond manufacturer's rated capacity.

B. Mixing Time. Minimum of l½ minutes after materials are placed in mixer. Increasing mixing time 15 seconds for each ½ yard increase in mixer capacity over one (1) cubic yard size.

C. Batch Material Control. Maintain positive batch control, accurate to within one percent (1%).

D. Operation and Maintenance of Equipment. Clean, maintain, and operate equipment such that it is at all times capable of thoroughly mixing materials as required.

E. Hand Mixing. Only when approved by Engineer.

3.3 FORMS

A. General. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate clean-out openings and before placing concrete, remove extraneous matter from within forms.

B. Design Loads for Forms and Falsework. Use fluid pressure of 150 pounds per cubic foot and live load of 50 pounds per square foot on horizontal surfaces with maximum unit stresses of 125 percent (125%) of allowable stresses used for design of structures.

C. Material.

1. General Form Lumber. Use seasoned lumber of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect its strength or impair finished surface of concrete. Use S4S lumber for facing or sheathing. Use nominal two-inch (2") lumber as minimum thickness for forms for bottoms of caps, or ¾-inch (¾") form plywood backed adequately to prevent misalignment. Provide lumber of nominal one-inch (1") thickness or form plywood of approved thickness for general use and back by sufficient number of studs and wales.
2. Lining - Rub-Finish Surfaces. Provide form surfaces or form lining surfaces free of irregularities for exposed concrete faces which are to be given rubbed finish. Use plywood for form lining made with waterproof adhesive of ¼-inch (¼") minimum thickness, preferably oiled at mill, and then re-oiled or lacquered on job before using. Facing may be constructed of ¾-inch (¾") plywood made with waterproof adhesive backed by adequate studs and wales, and in which case, form lining will not be required. Provide rubbed finishes where indicated on drawings.
3. Special Form Lumber. Make molding for chamfer strips, or other uses, of redwood, cypress, or pine of quality that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces. Unless otherwise provided, fillet forms at sharp corners and edges with triangular chamfer strips, ¾-inch (¾") measured on sides.

D. Form Ties. Use metal form ties of approved type to hold forms in place. Do not use wire ties or snap ties. Remove form ties to depth of at least ¾-inch (¾") from surface of concrete. Form tie holes shall be not larger than $^{7}/_{8}$ -inch ($^{7}/_{8}$ ") diameter. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.

E. Wetting and Oiling Forms. Treat facing of forms with approved form oil before concrete is placed. When so directed, treat both sides of face forms with oil. Apply oil before reinforcement is placed. In general, wet surfaces for forms which will come in contact with concrete immediately before concrete is placed.

F. Metal Forms. Applicable provisions of foregoing specifications for "Forms" apply equally to metal forms. Countersink bolt and rivet heads on facing sides. Use only metal forms which present smooth surface and line up properly. Keep metal free from rust, grease or other foreign material that will tend to disfigure or discolor concrete. Metal pan forms shall be clean and in good condition, free from dents and rust. Gage and condition of pans shall be such that they will support without significant distortion, concrete and construction loads.

3.4 FALSEWORK

A. General. Provide rigid false work having no excessive settlement or deformation.

B. Design Loads. Use 150 pounds per cubic foot for concrete, and live load of 50 pounds per square foot of horizontal surface of form work with maximum unit stresses of 125 percent (125%) of allowable stresses used for design of structures.

C. Materials. Use sound timber in false work centering. Use hardwood timber for wedges.

3.5 PLACING REINFORCEMENT

A. Placing. The reinforcing steel shall be accurately placed and adequately secured in position in the forms. Maintain in place by approved chairs and spacers. No bar tie "pigtail" shall extend more than $^{3}/_{8}$ -inches past the outside face of the bar. All reinforcing steel shall be inspected and approved by the Engineer before placing of concrete.

B. Bar Spacing and Cover. Minimum spacing center to center of parallel bars shall be 2½ times nominal diameter of bar but in no case shall clear distance between bars be less than l½ times maximum size of coarse aggregate. Where not otherwise shown on drawings, minimum cover measured from surface of concrete to face of reinforcing bar shall be three-inches (3").

C. Bending. Field bend steel only with prior approval of the Engineer. Bend reinforcing steel at required shapes while steel is cold. Excessive irregularities in bending will be cause for rejection. Detail bars in accordance with ACI-315-87. Bars to be field bent, must be Grade 40.

D. Splices. Splicing of bars except where shown will not be permitted without written approval. Approved bar bending schedules or placing drawings constitute written approval. Splice bars with lap of at least 36 times diameter of reinforcement. Stagger splices or else locate at points of low tensile stress.

3.6 CONSTRUCTION JOINTS

A. General. Contact surface between plastic concrete and concrete that has attained initial set is a "construction joint." "Monolithic" means manner of concrete placing which prevents construction joints. Joints other than those indicated, are not permitted without written authorization. Where authorized, make additional construction joints with details equivalent to those for joints in similar locations.

B. Construction. Make surface of concrete previous placed rough with some aggregate particles exposed. Remove loose materials, wash and scrub clean with stiff brooms, and keep wet several hours prior to placing of plastic concrete. Immediately prior to placing of concrete on horizontal surfaces, slush surface with coating of mortar. Where possible, apply mortar on previously placed vertical surfaces by brushing and work mortar into irregularities of surface. Form keyways so as to permit easy removal of forms without damaging concrete.

3.7 PLACING CONCRETE

A. General. Give advance notice to permit inspection of forms, reinforcing steel, preparations for placing of concrete. Place no concrete prior to approval. Regulate concrete placing so as to permit completion of finishing operations in daylight hours. However, if necessary to continue after daylight hours, light site as directed. If rainfall occurs after placing operations are started, provide covering to protect work.

B. Handling and Transporting. Arrange and use metal or metal lined chutes, troughs and pipes in placing concrete so that ingredients of concrete will not be separated. Use concrete having maximum slump of three-inches (3") if deposited by chutes and/or troughs. Discharge troughs and chutes either vertically down inside of forms or into pocket outside of forms from which it can flow through holes left in forms. Keep chutes, troughs and pipe clean and free from coatings of hardened concrete. Use of chutes in excess of 35-foot (35') total length, by specific authorization only.

C. Depositing. Limit free fall of concrete to four-feet (4'). Use tremies for placing concrete in walls, and similar placement. Do not deposit large quantities of concrete at one point in forms such that it requires running or working it along forms. Do not jar forms after concrete has taken initial set, or place any strain on projecting reinforcement or anchor bolts. Make tremies in sections, or provide in several lengths, so that outlet may be adjusted to proper heights during placing operations. Place concrete in continuous horizontal layers approximately 12-inch (12") thickness. Place each layer while layer below is still soft, and unless otherwise specified, let not more than one (1) hour elapse between placing of successive layers in continuous placement.

D. Consolidation. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type. Use vibrators of type which operates by attachment to forms only when immersion type vibrators cannot be used. Apply vibrators to concrete immediately after depositing, and move through layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set, and do not use vibrators to aid flow of concrete laterally.

3.8 CURING

A. General. Curing shall be accomplished by preventing loss of moisture, rapid temperature change and mechanical injury for a period of seven (7) curing days when normal Portland cement has been used and for three (3) curing days when high-early-strength Portland cement has been used. Curing shall be started as soon as free water has disappeared from the surface of the concrete after placing and finishing.

B. Form-Finish. Formed surfaces not requiring rub-finished surfaces shall be cured by leaving forms in place for the full curing period.

C. Rub-Finish. Formed surfaces requiring rub-finished surfaces shall be cured by leaving forms in place for a minimum number of curing days as follows: Vertical surfaces - two (2) full curing days. Underside of sidewalk - four (4) full curing days. After rub-finish operations are complete, formed surfaces shall be cured by using moist cotton mats until normal curing period is complete.

D. Unformed Surfaces. Cure by membrane curing compound method.

1. After concrete has received final finish and surplus water sheen has disappeared, seal surface with a single uniform coating of approved curing compound applied at rate of coverage recommended by manufacturer and as directed by Engineer, but not less than one (1) gallon per 180 square feet of area. Provide satisfactory means and facilities to properly control and check rate of application of compound.
2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers, equipped with satisfactory atomizing nozzles, except that for application on small miscellaneous items, hand powered spray equipment may be used. For all spraying equipment, prevent loss of compound between nozzle and concrete surface during spraying operations.
3. Do not apply compound to a dry surface. If surface of concrete has become dry, thoroughly moisten immediately previous to application. At locations where coating shows discontinuities, pin holes or other defects, or if rain falls on newly coated surface before film has dried sufficiently to resist damage, apply an additional coat of compound immediately, at same rate of coverage specified herein.

3.9 REMOVAL OF FORMS AND FALSEWORK

A. Forms may be removed after 24 hours or when the concrete has sufficiently set-up, whichever is greater. The Contractor shall insure that no deformation of the proposed structural shapes occurs because of early removal of forms. This may be accomplished by use of temporary bracing during the curing time. A "Curing Day" is any calendar day on which temperature is above 50°F for at least 19 hours. Colder days may be counted if air temperature adjacent to concrete is maintained above 50°F. In continued cold weather, when artificial heat is not provided, removal of forms and false work may be permitted at end of period of calendar days equal to twice the number of curing days stated as above.

3.10 DEFECTIVE WORK

A. Immediately repair any defective work discovered after forms have been removed. If surface of concrete is bulged, uneven, or shows excess honeycombing or form marks, which cannot be repaired satisfactorily, remove and replace entire section.

3.11 FINISHING

A. General. Immediately repair any defective work discovered after forms have been removed. If surface of concrete is bulged, uneven, or shows excess honeycombing or form marks, which cannot be repaired satisfactorily, remove and replace entire section.

B. Patching. Patch slight honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one (1) part cement to two (2) parts fine aggregate, unless otherwise directed. Repair by cutting out unsatisfactory material and replacing it with new concrete, securely keyed and bonded to old concrete and finish so as to make joints as inconspicuous as possible. Use stiff mixture and thoroughly tamp into place. After patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with surface.

C. Rub-Finish.

1. Rub-Finish all exposed surfaces of formed concrete structures except as noted below. After pointing has set sufficiently, wet surface with brush and give first surface rubbing with No. l6 carborundum stone or equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce smooth, dense surface. Add no cement to form surface paste. Spread or brush materials, which has been ground to paste, uniformly over surface and allow to take reset. In general, do not rub chamfered corners in first surface rubbing. In preparation for final acceptance, clean surfaces and give final finish rubbing with No. 30 carborundum stone or equal. After rubbing, strip surface with brush and allow mortar on surface to take reset; then wash surface with clean water. Leave structure with clean, neat and uniform appearing finish.

D. Float-Finish. Concrete slabs shall receive a wood float finish.

END OF SECTION

SECTION 02530
DEWATERING AND DRAINAGE OF EXCAVATION

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for furnishing all labor, materials, equipment, power and incidentals, and for performing all operations necessary to dewater, drain and maintain excavations and foundation beds as described herein and as necessary for construction of structures and appurtenances. Included are construction, maintenance and removal of cofferdams; removal of standing water, surface drainage and seepage from excavation or other work, and protecting work against rising waters and floods, and repair of any resulting damage.

1.2 CONTRACTOR'S RESPONSIBILITY

A. Assume sole responsibility for dewatering systems and for all loss or damage resulting from partial or complete failure of protective measures. Owner will require that Contractor Foreman be responsible for preventing any flooding due to construction in ditch or bayou. The Foreman must be on-site during all construction hours and available for immediate action using any equipment necessary during the evening hours.

1.3 PLANS AND OTHER DATA TO BE SUBMITTED

A. Submit plans for review of proposed methods of dewatering, foundation drainage and diversion, in accordance with sound engineering practice. Do not start dewatering without written approval from the Engineer.

1.4 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.5 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work or materials associated with this section.

PART 2 – PRODUCTS

A. Contractor may use equipment and material desired.

PART 3 – EXECUTION

3.1 DEWATERING EXCAVATIONS

A. Furnish, install, operate and maintain all necessary pumping for dewatering the various parts of the work and for maintaining free of water the foundations and such other parts of the work as required for construction operations. Provide manpower and all equipment necessary to prevent any flooding that could occur due to rainfall (day or night) that cannot drain due to construction. Also, as required for inspections and safety, or for any reason determined by the Engineer to be desirable.

END OF SECTION

SECTION 02600
WELL POINT SYSTEM

PART 1 – GENERAL

1.1 SCOPE

A. This section shall consist of supplying all labor, materials, and plant and performing all work necessary to lower and control the groundwater levels and hydrostatic pressures to permit all excavation and construction specified under this contract to be performed under dry conditions.

B. The work under this section shall include all costs of mobilization, supply, installation, operation, maintenance, supervision, and final dismantling and removal from the site of the dewatering equipment.

1.2 EXAMINATION OF THE SITE

A. The Contractor shall take all the steps that he considers necessary to familiarize himself with the site conditions, the ground conditions and the groundwater conditions. Copies of the logs of the borings, information on the groundwater conditions, have been included in these specifications. The data described above is furnished for information only, and it is expressly understood that the Owner and/or the Engineer will not be held responsible for any interpretation or conclusions drawn there from by the Contractor.

PART 2 – EXECUTION

2.1 SUBMITTALS

A. The Contractor shall submit complete plans and description of the overall dewatering system he proposes to use for the work under this section for approval by the Engineer, showing the details of the dewatering system prior to initiation of any excavation within three-feet (3') of the prevailing groundwater levels.

B. Approval by the Engineer of the dewatering system proposed by the Contractor will only be with respect to the basic principles of the methods the Contractor intends to employ. Approval by the Engineer of the dewatering system will be based on the demonstrated performance of the system to satisfy the requirements for dewatering as specified herein.

2.2 DEWATERING REQUIREMENTS

A. It is the intent of these specifications that an adequate dewatering system be installed to lower and control the groundwater in order to permit excavation, construction of the facilities and the placement of the fill materials, all to be performed under dry conditions. The dewatering system shall be adequate to predrain the water-bearing strata above and below the bottom of the structure foundations, the drains, the sewers and all other excavations. In addition, the system to be used shall reduce the hydrostatic head in the water-bearing strata below the structure foundations, the drains, sewers, and all other excavations, to the extent that the water level and piezometric water levels in the construction area are substantially a minimum of three-feet (3') below the prevailing excavation surface at all times.

B. Prior to any excavation below the groundwater level, the dewatering system shall be placed into operation to lower the water levels as required and then shall be operated continuously 24 hours per day, seven (7) days per week until all drains, sewers and structures have been satisfactorily constructed (including placement of backfill materials) and no longer require dewatering. An adequate weight of backfill material should be in place to prevent buoyancy prior to discontinuing operation of the dewatering system.

C. The Contractor shall obtain approval from the Engineer before discontinuing the operation of the dewatering system.

D. The Contractor shall be solely responsible for the arrangement, location and depths of the dewatering system necessary to accomplish the work described under this section of the specifications. The dewatering shall be accomplished in a manner that will reduce the hydrostatic head below any excavation to the extent that the water level and piezometric water levels in the construction area are substantially a minimum of three-feet (3') below the prevailing excavation surface. The dewatering will prevent the loss of fines, seepage, boils, quick conditions or softening of the foundation strata, will maintain stability of the sides and bottom of the excavation, and will result in all construction operations being performed under dry conditions.

E. The Contractor shall dispose of all water from the excavation in such a manner as will not endanger public health, property, any portion of the work under construction or completed either by him or any other contractor, and shall be performed in such a manner as will cause no inconvenience whatsoever to the Owners, Engineer or to others engaged on work about the site.

F. The Contractor shall provide complete standby equipment, installed and available, for immediate operation as may be required, to adequately maintain the dewatering on a continuous basis in the event that all or any part of the dewatering system may become inadequate or fail.

G. If the dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system, then loosening of the foundation strata, or instability of the slopes, or damage to the foundations or structures may occur. The supply of all labor, materials, and plant, and the performance of all work necessary to carry out additional work for reinstatement of the structures or foundation soil resulting from such inadequacy or failure shall be undertaken by the Contractor to the approval of the Engineer, and at no additional expense to the Owner.

2.3 OBSERVATION WELLS (PIEZOMETERS)

A. The Contractor shall supply, install, take measurements and maintain at least one (1) observation well (piezometer) per 400 linear feet of utility excavation and such additional observation wells as may at any time be ordered by the Engineer.

B. The observation well shall be of a suitable design proposed by the Contractor and as approved by the Engineer.

C. The Contractor shall be responsible for installing and maintaining all observation wells and observing and recording the elevation of the groundwater and piezometric water levels in all the observation wells daily. A record of the information obtained shall be given to the Field Project Representative each day. The Contractor shall also permit the Engineer to make his own observations. Any observation wells that become inactive, damaged or destroyed shall be replaced within 24 hours by the Contractor at no additional expense to the Owner. If an observation well

become inactive, damaged or destroyed, and if in the opinion of the Engineer, the observations from that observation well are critical, further excavation shall be suspended at the discretion of the Engineer at no additional expense to the Owner and excavation shall not commence until that observation well is repaired or replaced to the satisfaction of the Engineer and reliable observations can be obtained from that well or its replacement well.

D. The Contractor shall, by adding or removing water from all observation well risers, demonstrate that the observation wells are functioning properly.

E. All observation wells shall be satisfactorily installed and proven to be functioning properly prior to commencement of dewatering in any section.

2.4 CONTROL OF GROUNDWATER LEVELS

A. The observation wells and test pits, or holes, shall be used as a primary basis of determining compliance with the requirements of the dewatering specification.

2.5 DEWATERING SUBCONTRACTOR

A. The Contractor may employ a dewatering Subcontractor who has experience in the field of dewatering including installation, operation, and removal of the necessary dewatering facilities to perform the dewatering of the construction area.

B. Employment of a dewatering Subcontractor does not relieve the Contractor of the performance requirements of this specification.

C. The Contractor shall name the dewatering Subcontractor he intends to use when submitting his bid. Qualification of the dewatering Subcontractor shall be a basis of considering the qualification of the Contractor.

PART 3 – MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made under this section of work for structures, but should be incidental to such items of work indicated on the construction drawings.

END OF SECTION

SECTION 02613
CEMENT STABILIZED SUBBASE

PART 1 – GENERAL

1.1 SCOPE

A. This item consists of furnishing compacted mixture of soil, Portland cement and water, placed, finished and cured to lines, grades, thickness and typical sections shown. Soil-cement subbase is generally required under the proposed asphaltic concrete pavement.

1.2 MEASUREMENT AND PAYMENT

A. Measurement. Compacted cement stabilized subbase will be measured by the square yard of completed and accepted subbase of the thickness required, within the limits shown on the drawings.

B. Payment. Shall be made at the contract unit price per square yard for "Cement Stabilized Subbase," of the thickness required. This price shall be full compensation for furnishing all materials, including Portland cement, and for all preparation, delivering, placing, mixing and compaction of these materials; and for all labor, equipment, tools and incidentals necessary to complete the item.

PART 2 – PRODUCTS

2.1 SOILS

A. The soil shall consist of approved select borrow fill from approved sources. PI must be less than or equal to 40.

2.2 PORTLAND CEMENT

A. Cement shall be Type "I," standard brand conforming to ASTM Designation C-150. One sack shall weigh 94 pounds and one barrel shall weigh 376 pounds. Bulk cement may be used provided weighing and handling is approved.

2.3 WATER

A. Sprinkling or mixing water shall be clean, clear, and free from injurious amount of sewage, oil, acid, strong alkalizes, or other deleterious matter.

PART 3 – EXECUTION

3.1 PROPORTIONING

A. Prior to base course construction the top six-inches (6") of subgrade shall be constructed to line and grade.

B. 35 pounds of cement per square yard shall be added and mixed with the top six-inches (6") of subgrade.

C. Moisture by weight after field mixing and/or compaction, shall be at optimum to plus two percent (2%) as determined by AASHTO moisture density Test Method T-180.

3.2 MIXING

A. After the cement has been applied uniformly on the soil, it shall be dry mixed first with the soil. Mixing shall continue until the cement has been sufficiently blended with the soil to prevent the formation of cement balls when water is applied.

B. Immediately after the soil and cement have been mixed, water shall be incorporated into the mixture. Excessive concentrations of water on or near the surface shall be avoided. A water supply and pressure distributing equipment shall be provided that will assure the application within three (3) hours of all mixing water on the section being processed. After all mixing water has been applied, mixing shall continue until a uniform and intimate mixture of soil, cement, and water has been obtained.

C. The soil for the subbase shall be so pulverized that at the completion of moist-mixing, 100 percent (100%) by dry weight passes a one-inch (1") sieve and a minimum of 90 percent (90%) passes a No. 4 sieve.

3.3 PLACING

A. Prior approval of prepared subgrade shall be required before placing of subbase. Mixing and placing shall be discontinued when temperature is less than 40□ F. At the end of each day's run, a transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true transverse vertical face.

B. The protection provided for construction joints shall permit the placing, spreading, and compacting of base material without injury to the work previously laid. Where it is necessary to operate or turn any equipment on the completed base course, sufficient protection and cover shall be provided to prevent damage to the finished surface. A supply of mats or wooden planks shall be maintained and used as approved and directed by the Engineer.

C. Care shall be exercised to insure thorough compaction of the base material immediately adjacent to all construction joints. When spreading or compacting base material adjacent to a previously constructed lane, care shall be taken to prevent injury to the work already constructed.

3.4 COMPACTION

A. The loose mixture may be rolled with tamping rollers in addition to power rollers, rubber-tired rollers, or vibratory rollers. In all places not accessible to the rollers, the mixture shall be compacted with mechanical hand tampers. Compaction shall begin not later than 30 minutes after the water has been added to the cement-treated mixture. The rate of operation and the number of rollers shall be sufficient to uniformly compact the section being processed to the required density with four (4) hours. The compacted density of cement stabilized subbase shall be 95 percent (95%) of maximum density as determined in the laboratory in accordance with AASHTO Standard T-180. Complete the cement stabilized subbase ready for curing before initial setting of mixture and reduce four (4) hour limit if necessary to assure this.

B. The final surface compaction and finishing shall produce a smooth, dense, closely-knit surface, free of cracks, ridges or loose material, and conforming to the elevations, grade and lines shown.

3.5 CURING

A. After the subbase course has been placed as specified herein, it shall be kept moist for a period of three (3) days before placing base material.

B. Finished portions of soil-cement that are used by equipment in constructing an adjoining section shall be protected to prevent equipment from marring or damaging the completed work.

3.6 LIMITATIONS

A. When any of the operations after the application of cement are interrupted for more than 30 minutes or when the uncompacted soil-cement mixture is wetted by rain so that the moisture content is exceeded by a small amount, the decision to reconstruct the portion affected shall rest with the Engineer. In the event the uncompacted, rain-wetted mixture exceeds the specified moisture content tolerance, the contractor shall reconstruct at his expense the portion affected. All material along the longitudinal or transverse construction joints not properly compacted shall be removed and replaced, at the Contractor's expense, with properly moistened and mixed soil-cement compacted to specified density.

B. The finished surface shall not vary more than $^{3}/_{8}$-inch ($^{3}/_{8}$") when tested with a 16-foot (16") straightedge applied parallel with, or at right angles to, the longitudinal axis of the pavement. Any variations in excess of this tolerance shall be corrected by the Contractor, at his own expense, and in a manner satisfactory to the Engineer.

C. The thickness of the soil-cement base course shall be determined from measurements of cores drilled from the finished base or from thickness measurements at holes drilled in the base at intervals so that each test shall represent no more than 300 square yards. The average thickness of the base constructed during one day shall be within ½-inch (½") of the thickness shown on the plans, except that the thickness of any one point may be within ¾-inch (¾") of that shown on the plans. Where the average thickness shown be the measurements made in one (1) day's construction is not within the tolerance given, the Engineer shall evaluate the area and determine if, in his opinion, it shall be reconstructed at the Contractor's expense or the deficiency deducted from the total material in place.

END OF SECTION

SECTION 02614
PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 – GENERAL

1.1 SCOPE

A. This section specifies the furnishing and placing of Portland cement concrete pavement on prepared subgrades. Construct pavement of designated thickness and to line, grade and typical cross section, as shown.

1.2 RELATED WORK

A. All Sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work in this section. Include all costs in the associated lump sum bid price.

1.4 HANDLING AND STORAGE

A. Do not mix different classes of aggregate without written permission of the Engineer.

B. The class of aggregate being used can be changed before or during the job with proper notice. The new class must meet specifications.

C. Segregated aggregate will be rejected. Before using aggregate whose particles are separated by size, mix them uniformly to grading requirements.

D. Aggregates mixed with dirt, weeds or foreign matter will be rejected.

E. Do not dump or store aggregate in the roadbed.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Portland Cement.
   1. Sample and test cement to verify compliance with standards of ASTM C-150, Type I or ASTM C-175, Type III.
   2. Bulk cement which meets referenced standards may be used if the method of handling is approved by the Engineer. When using bulk cement, provide satisfactory weighing devices.

B. Water. Furnish clean, drinkable water free from injurious amount of oils, alkalis or other deleterious substances.

C. Coarse Aggregate. Provide crushed stone or gravel which is clean, hard, durable, and well graded within specified limits. When tested by standard laboratory methods, coarse aggregate must conform to the following requirements:

1. The maximum percentage by weight of deleterious substances must not exceed the following values:

Constituents	Percent by Weight
Removed by decantation	4.00
Shale	0.25
Clay Lumps	0.25

Constituents	Percent by Weight
Soft fragments	3.00
Other local deleterious substances, such as friable pieces	3.00
The sum of the percentages of above constituents shall not exceed	5.00

2. Furnish coarse aggregate worn no more than 45 percent (45%) when tested according to AASTHO T-96.
3. Conform to the following grading requirements for aggregate tested on a standard square-opening sieve.

Sieve	Percent Retained
2½-inches	0
1¾-inches	0 to 20
$\frac{3}{8}$-inch	25 to 65
No. 4	95 to 100

D. Fine Aggregate. Provide washed sand having clean, hard, durable grains, well graded from coarse to fine. The sand must be free from soft or flaky particles or other injurious matter. When tested by standard laboratory methods, fine aggregate must conform to the following requirements:

1. Conform to the following grading requirements for aggregates tested on standard sieve.

Screen or Sieve	Percent Retained by Weight
3/8-inch screen	0
¼-inch screen	0 to 5
20 mesh sieve	15 to 50
100 mesh sieve	85 to 100

2. Weight removed by elutriation test must not be more than two percent (2%).
3. When subjected to color test for organic impurities, fine aggregate must not show color darker than standard color.

E. Mineral Filler. The addition of stone dust, sand, or crushed (oyster) shell dust of acceptable quality and cleanliness may be required as mineral filler to improve workability or plasticity of concrete mixture. When mineral filler is used, it must be batched and weighed separately. Filler may be used in amounts not to exceed 15 percent (15%) of weight of fine aggregate. When tested with standard laboratory sieves, mineral filler must meet the following requirements:

Passing 30 mesh sieve	95 to 100 percent
Passing 200 mesh sieve	50 to 100 percent

F. Reinforcing Steel.
1. Provide new billet steel manufactured by the open hearth process and conforming to ASTM A-615, Grade 60. Store steel to protect it from mechanical injury and rust. At the time of placement, steel should be free from dirt, scale, rust, paint, oil or other injurious materials.
2. Cold bend reinforcing steel to shapes shown. If rebending is required, the reinforcing steel must be Grade 40. Grade 60 reinforcing steel may not be rebent.
3. Wire fabric must be of gage and facing shown and must meet ASTM A-82. Use fabric in which longitudinal and transverse wires have been electrically welded at points of intersection. Welds must have sufficient strength not to be broken during handling or placing. Welding and fabrication of fabric sheets must conform to standards ASTM A-185.
4. Furnish the manufacturers certificate giving property of steel. Provide specimens for testing, when required.

G. Air Entraining Agent. Furnish an air entraining agent which meets standards of ASTM C-260. Use MB-VR by Master Builders Company, Air-in By Hot Process Corporation-Southern, or an approved equal.

H. Retardant. As retardant provide Pozzolith No. 8 by Master Builders Company, HPS-R by Hunt Process Corporation-Southern, or an approved equal.

I. Expansion Joint Material. Furnish filler board of selected stock. Use wood of density and type as follows:
   1. Clear, all heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.
   2. Clear, all heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

J. Joint Sealing Compound. Furnish hot-poured elastomeric polymer exceeding Federal Specifications SS-S-164.

K. Load Transmission Devices. Provide smooth steel bar dowel, as shown. Steel bars must conform to standards of ASTM A-615, Grade 60.

L. Metal Supports for Reinforced Steel and Joint Assembly. Employ metal of approved shape and size. Space supports as directed.

M. Liquid Membrane Forming Compound for Curing Concrete. Provide Type II white pigmented compound conforming to standards of ASTM C-309.

2.2 PROPORTIONING

A. Responsibility. Proportioning of the concrete mix is the responsibility of the Contractor. Design the concrete mixture and furnish a statement giving the proportion of materials in the mix. Submit commercial laboratory report showing that proportions and materials selected will produce laboratory mixed concrete of the specified quality, having strength 10 percent (10%) higher than that specified. Testing of design mixes is the Contractor's responsibility.

B. Concrete Mix. Provide a concrete mix that is uniform and workable. Design the mix to produce concrete which will have a compressive strength of 3,500 psi at 28 days. Flexural strength shall be 500 psi for six-inch (6") and 500 psi for seven-inch (7") concrete at seven (7) days and 600 psi at 28 days. Settlement of concrete must be at least 1½-inches, but no more than 4½-inches, when gauged by a standard slump test.

   1. Concrete pavement must contain at least five (5) sacks of cement per cubic yard. The concrete mixture shall contain no more than 8.0 gallons of water, net, per sack of cement. Addition of mineral filler may be required to improve workability or plasticity of concrete.
   2. The net amount of water is the amount added at the mixer, plus prewater in the aggregate, minus absorption the aggregate displays in 30 minutes. No water allowance will be made for evaporation after batching.
   3. Coarse dry aggregate will not exceed 85 percent (85%) of the loose volume of concrete.
   4. Add the air entraining agent to the concrete to produce the effect that could be obtained by use of Air-Entraining Portland cement, as specified in ASTM C-175. Use the amount needed to entrain three percent (3%) to five percent (5%) of air by volume of concrete. Add the agent to the batch in a solution of the mixing water. Batch this solution by means of a mechanical batcher capable of accurate measurement. Insure a uniform distribution throughout the batch during the specified mixing period.
   5. Retardant is required when the ambient temperature exceeds 85° F. Proportion as recommended by the manufacturer. Use the same brand as used for the air entraining agent. Add and batch the material using the same methods as used for the air entraining agent.

2.3 MIXING EQUIPMENT

A. Condition. Mixing equipment must be in first class working condition and must be inspected and approved by the Engineer before paving operations will be permitted.

B. Scales.

1. Weigh materials separately and accurately using standard scales attached to a standard batching plant approved by the Engineer. Consider a sack of cement weighing 94 pounds to be one (1) cubic foot.
2. Employ beam type or springless dial type scales. Equip the beam type with a springless dial indicator showing at least 100 pounds over or under the required weight. Use graduated scales or dial indicator showing increments of five (5) pounds or less.
3. Use scales accurate within four (4) pounds per 1,000 pounds net load in the hopper.

C. Mixer.

1. A capacity of not less than 14-S mixer, as rated by Mixer Manufacturers Bureau of Associated General Contractors, is required. Provide a speed regulator to hold a mixer to the normal speed of revolution. Equip the mixer with an automatic timer and lock for the discharging device to prevent discharge until all materials have been mixed together for the minimum time required. The time and lock must operate independently of the drum. Also provide a bell to indicate completion of a mixing time. The bell must be plainly audible to a distance of 50-feet (50') from the mixer.
2. Equip the mixer with an accurate device to measure water within one percent (1%) of the total amount required. Construct the measuring drum with an opening to atmospheric pressure when the measured amount of water is inside. Place and construct the drum so that a single batch of water can be discharged into a calibrated tank or a weighing device attached to the mixer, without seriously delaying paving operations. Check the operation of this water measuring device daily.

D. Batch Truck. Batch trucks, for the transportation of measured materials from the batching plant to the mixer, must be covered tight to prevent excessive evaporation or any loss of materials.

2.4 MIXING

A. Central batching and transit mixing will be permitted. A central mixing plant will be allowed upon approval of mixing and handling methods.

B. Mix concrete in a batch-mixer as specified only in such quantities as are required for immediate use. Thoroughly mix aggregate and cement for a period of not less than 50 seconds, computed from the time the last aggregate disappears into the drum until the concrete begins to appear in the discharge chute. Lock the mixer discharge with an automatic timing device until the specified time has elapsed. Introduce water into the drum during the first 15 seconds of mixing. Discharge the entire contents of the drum before the materials are placed for a succeeding batch. Retempering or remixing will not be permitted.

C. For transit mixed concrete use a water-type truck mixer. Mix each batch for 100 revolutions at the mixer manufacturer's mixing speed. Perform additional mixing or agitation at the speed specified for agitation.

D. Stamp the time of loading the transit-mix truck on the delivery ticket before the truck leaves the plant. Equip truck mixers with water tank and measuring devices which permit positive measurement of mixing water. When aggregate contains more than six percent (6%) water, place the concrete within ½ hour after the introduction of water. When aggregate contains from three percent (3%) to six percent (6%) water, place concrete within ½ hour after the introduction of cement. Transitmix concrete must conform to other applicable requirements of this section.

PART 3 – EXECUTION

3.1 WEATHER CONDITIONS

A. Place concrete only when the air temperature is above 40°F and rising. Place no concrete if the temperature is below 50°F and falling. Maintain the temperature of the air surrounding the concrete at 50°F for not less than five (5) days. The Contractor is responsible for the quality and strength of concrete placed under any weather conditions.

3.2 EQUIPMENT

A. Equipment necessary for preparing the subgrade, placing, consolidating, and finishing the concrete pavement, in accordance with these specifications and in accordance with the construction drawings, must be in good working order. It must have the capacity to perform the work with an adequate factor of safety. Equipment proposed for use under this specification is subject to approval by the Engineer.

3.3 SUBGRADE

A. Properly prepare, shape and compact each section of subgrade before placing forms, steel or concrete. After forms have been set to proper grade and alignment, use a subgrade planer to shape the subgrade to its final cross section. Check the contour of the subgrade with the template.

3.4 FORMS

A. Side Forms. Use metal or wood forms of approved shape and section. A form as deep as the pavement edge thickness is preferred. Forms with depth up to one-inch (1") greater or less than pavement thickness may be used. Forms with less depth than pavement thickness will be brought to required depth by securely attaching wooden planks of approved section and size to the bottom of the form. Use a form section at least 10-feet (10') in length, and staked in position with at least three (3) pins. Forms must have adequate strength to withstand machine loads without visible springing or settlement. Use forms free from warps, bends and kinks and sufficiently true to provide a straight edge on the concrete. Test the top of each form section with a straight edge and verify that it conforms with requirements for the surface of complete pavement. Use flexible or curbed forms of wood or metal to set the proper radius on curves of 100-feet (100') radius or less.

B. Form Setting.

1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Remove subgrade that will not support the loaded form. Replace and compact subgrade to required density. Accurately set forms to required grade and alignment and, during the entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and alignment more than ⅛-inch (⅛") to 10-feet (10') in ⅛length. Do not remove forms for at least 24-hours after the completion of finishing operations. Provide a supply of forms that will be adequate to comply with this requirement and for orderly and continuous placing of concrete. Set the forms and check the grade for at least 130-feet (130') ahead of the mixer.
2. Adjacent slabs may be used instead of the forms, provided that the concrete is well protected from possible damage by finishing equipment. These adjacent slabs must not be used for forms until the concrete has aged at least seven (7) days. For short radius curves, forms less than 10-feet (10') in length or curved forms may be used. For curb returns at street intersections and driveways, wood forms of good grade and quality may be used. Do not use any material which, in the opinion of the Engineer, is unsuitable for forms.

3.5 REINFORCING STEEL AND JOINT ASSEMBLIES

A. Accurately place reinforcing steel and joint assemblies and position them securely in accord with details shown. Wire reinforcing bars securely together at intersections and splices. Bars and coatings must be free of rust, dirt or other foreign matter when the concrete is installed.

B. Place pavement joint assemblies at required locations and elevations, and rigidly secure all parts in required positions. Install dowel bars accurately in joint assemblies as shown, each parallel to the pavement surface and to the center line of the pavement and rigidly secure in the required position to prevent displacement during placing and finishing of concrete. Accurately cut header boards, joint filler and other material used for forming joints to receive each dowel bar.

C. Place all reinforcing steel and secure to chairs.

3.6 PLACING

A. Maximum Time to Placement

The maximum time interval between the addition of cement to the batch, and the placing of concrete in the forms shall not exceed the following:

Concrete Temp (at point of placement)	Max Time (No Retarding Agent) Minutes	Max Time (With Retarding Agent) Minutes
	Non-Agitated Concrete	
All Temperatures	30	45
	Agitated Concrete	
90° F to 95° F	45	75
Above 75° F thru 90° F	60	90
75° F and Below	90	120

The use of an approved retarding agent in the concrete will permit the extension of each of the above temperature-time maximums by 30 minutes for bridge decks, top slabs of direct traffic culverts and cased drilled shafts, and one hour for all other concrete except that the maximum time shall not exceed 30 minutes for non-agitated concrete.

Fine aggregate containing more than six percent (6%) moisture and coarse aggregate containing more than three percent (3%) moisture will likewise be rejected.

B. Deposit concrete rapidly and continuously on subgrade or subbase in successive batches. Distribute concrete to the required depth and for entire width of the pour by shoveling or by other approved methods. Do not use rakes in handling concrete. At the end of the day or in case of unavoidable interruption of more than 30 minutes, place a transverse construction joint at the point of stopping work, provided that the section on which work has been suspended is not less than 10-feet from the preceding joint. Sections less than 10-feet along must be removed and replaced.

C. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in the edge of the finished pavement will be cause for rejection.

D. **Concrete will be rejected if the temperature of the concrete exceeds 95° F prior to placement.**

3.7 COMPACTING

A. Consolidate the concrete using an approved mechanical vibratory unit designed to vibrate concrete internally. Extend a vibratory unit across the pavement, not quite touching the side forms. Equip the unit with synchronized vibrators. Space individual vibrators at close enough intervals to vibrate and consolidate the entire width of the pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints.

B. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

3.8 FINISHING

A. Finish concrete pavement by power-driven transverse finishing machines or by hand finishing methods.
   1. Use the transverse finishing machine to make at least two (2) trips over each area. Make the last trip over a given area a continuous run of not less than 40-feet (40') . After transverse screeding, use a hand operated longitudinal float to test and level the surface to the required grade.
   2. Hand finish with a mechanical strike and tamping template as wide as the pavement to be finished. Shape the template to the pavement section. Move the strike template forward in the direction of the work, maintaining a slight excess of material in front of the cutting edge. Make at least two (2) trips over each area. Screed the pavement surface to the required section. Work the screed with a combined transverse and longitudinal motion in the direction work is progressing. Maintain the screed in contact with the forms. Use a longitudinal float to level the surface.

B. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike-off concrete with a strike-off screed. Move the strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining the screed in contact with the forms, and maintaining a slight excess of materials in front of the cutting edge. Tamp the concrete with a tamping template. Use a longitudinal float to level the surface.

C. After completion of the straight edge operation, make the first pass of a burlap drag as soon as construction operations permit and before the water sheen has disappeared from the surface. Follow this by as many passes as required to produce the desired texture depth. Permit no unnecessary delays between passes. Keep the drag wet, clean and free from encrusted mortar during use.

3.9 SURFACE TESTS

A. Test the entire surface before the initial set and correct irregularities or undulations. Bring surface within requirements of the following test and then finish. Place an approved 10-foot (10') straight edge parallel to the center of the roadway to bridge any depressions and touch all high spots. Do not permit ordinates measured from the face of the straight edge to the surface of the pavement to exceed $\frac{1}{16}$-inch ($\frac{1}{16}$") per foot from the nearest point of contact. In no case permit the maximum ordinate to a 10-foot (10') straight edge to exceed $\frac{1}{8}$-inch ($\frac{1}{8}$").

3.10 JOINTS

A. Placement. Place joints of the types shown on drawings at required locations and at spacings shown.

B. Construction Joints. Place a transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes where required. Work the concrete well against the bulkhead. The key-way on the longitudinal construction joint may be omitted when a traveling form paver is used, and when No. 5 deformed tie bars, 30 inches long and space inches on centers, are used.

C. Expansion Joints. Place expansion joints at radius points of curb returns for cross street intersections, or as shown. Use no boards shorter than six-feet (6'**)**. When pavement is 24-feet or narrower, use not more than two (2) lengths of board. Secure pieces to form a straight joint. Shape board filler accurately to the cross section of the concrete slab. Use premolded joint filler, accurately shaped, in curb section. Use load transmission devices of the type and size shown. Use a joint sealing compound as required.

D. Contraction Joints. Make contraction joints straight and place them at spacings shown. Place smoothed, painted and oiled dowels accurately and normal to the joint. Tool the edges of the groove and seal the groove with joint sealing compound.

E. Longitudinal Weakened Plane Joints. Make a longitudinal weakened plane joint with a deformed metal strip. Adequately stake the metal strip in place to prevent lateral movement of the metal strip while the concrete is being placed.

3.11 MEMBRANE CURING

A. After the concrete surface has been finally finished and the surplus water sheen has disappeared, seal the surface with single uniform coating of an approved curing compound. Apply the compound at the rate of coverage recommended by the manufacturer and as directed by Engineer, but not less than one 1. gallon per 180 square feet of surface area. Control and check the rate of application.

B. Thoroughly agitate the compound during use and apply by means of approved mechanical power pressure sprayers, equipped with satisfactory atomizing nozzles. For application on small miscellaneous items, hand powered spray equipment may be used. For all spraying equipment, provide means to prevent loss of compound between the nozzle and the concrete surface while spraying.

C. Thoroughly moisten the surface just before applying the curing compound. Where discontinuities, pin holes or other defects show, or where rain has fallen, immediately apply an additional coat of compound to the newly coated surface before the film has dried sufficiently to resist damage. Apply the added coat at the same rate of coverage as specified.

3.12 JOINT SEALING

A. Seal joints only when surface and joints are dry, ambient temperature is above 50□ F, and weather is not foggy or rainy.

B. Before work is started, the joint sealing equipment must be in first class working condition, and be approved by the Engineer. Use a concrete grooving machine or a power operated wire brush and other equipment such as plows, brooms, brushes and blowers as required to produce satisfactory joints.

C. Clean joints of loose scale, dirt, dust and curing compound. When required, remove the joint filler to the depth shown. The term joint includes wide joint spaces, expansions joints, dummy groove joints or cracks, either performed or natural. Remove loose material from concrete surfaces adjacent to joints.

D. Fill joints neatly with joint sealer to the depth shown. Pour sufficient joint sealer into the joints so that, upon completion, the surface of the sealer within the joints will be ¼-inch (¼") below the level of the adjacent surface or at an elevation as directed.

3.13 PROTECTION AND OPENING PAVEMENT TO TRAFFIC

A. Barricade a pavement section from use for at least 72 hours during the curing period. Do not open pavement to traffic until concrete is at least 10 days old. On those sections of pavement open to traffic, seal the joints, clean the pavement and place earth against the pavement edges before permitting use by traffic. Such opening of pavement to traffic in no way relieves the contractor from his responsibility for the work.

3.14 TESTING

A. Laboratory Services. The Owner will appoint a commercial laboratory and payment for laboratory services rendered will be as outlined in Division 1, Testing Laboratory Services.

B. Duties. Arrange for the laboratory to inspect and test materials entering the concrete and check the design of concrete mixes to meet specified strengths, uses and finishes. The lab will analyze aggregate for quality durability, grading and free water content. The lab will take representative specimens of ingredients and mixes; make test cylinders and measure their compressive strength. The lab will check the moisture content of aggregates and control their mix subject to approval.

C. Test Procedures. The laboratory will make tests in conformance with current standard test procedures of ASTM and AASTHO.

D. Test Reports. The laboratory will promptly furnish written reports covering results of test and inspections to the Engineer and the Contractor.

E. Test Beams. Four (4) test beams for flexural strength and two (2) cylinders for compressive strength will be made for each 750 square yards or less of pavement placed in one (1) day or one (1) per street. Beams and cylinders will be made, cured, and tested using applicable ASTM Standards for sampling and testing.

Two (2) beams will be tested at seven (7) days. Two (2) beams and two (2) cylinders will be tested at twenty-eight (28) days. The minimum flexural strength shall be 500 psi at seven (7) days and 600 psi at twenty-eight (28) days, unless otherwise required by the Engineer.

F. Core Samples. After the pavement has been in place a minimum of fourteen (14) calendar days, drill core samples of concrete pavement at locations designated to measure thickness. One (1) core shall be taken for each 1,000 square yards of pavement, except that not less than one (1) core for each street. Cores shall be taken in alternate one-half (½) sections of the roadway. At age of 28 days, each core may be tested for compressive strength. The compressive strength of each core tested must be at least 3,000 psi.

END OF SECTION

SECTION 02800
HYDRO-MULCH SEEDING

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for the covering of channel bottom, side slopes, berms, and berm ditches with healthy permanent and rooted grass system for erosion prevention. The work covered by this section consists of furnishing all plant, labor, materials, equipment, supplies, supervision, and tools, and performing all work necessary for topsoiling, smoothing, seeding, fertilizing, watering, maintenance, and clean-up of the top and side slopes of the rectified channel sections, all in accordance with the drawings and specifications.

B. The hydro-mulch seeding operations, together with all other necessary related work, shall conform to the requirements specified in this section. The area to be hydro-mulch seeded is the entire unpaved disturbed areas within the right-of-way. Areas within the right-of-way that are not disturbed and which have a well established turf will not require hydro-mulch seeding.

1.2 PAYMENT

A. No separate payment will be made. Include the cost of work in the contract bid price.

PART 2 – PRODUCTS

2.1 EQUIPMENT

A. The Contractor may use equipment necessary for a complete installation.

2.2 MATERIALS

A. Seed. All seed must meet the requirements of U.S. Department of Agriculture Rules and Regulations as set forth in Federal Seed Act and Texas Seed Law. Type of seed, purity and germination requirements, rate of application and planting dates are as follows:

	Type	Application Rate Pounds Per Acre	Planting Date
1.	Cereal Rye Grain	34	Sep. 15 to Mar. 1
	Oats	4	
	Western Wheatgrass	5.6	
2.	Hulled Bermuda (Min. PLS = 0.83)	45	Mar. 1 to Sep. 15

B. Fertilizer. Fertilizer shall be water soluble with analysis of 15 percent (15%) nitrogen, 15 percent (15%) phosphoric acid and 15 percent (15%) potash. Rate of application shall be 750 pounds per acre except during the period of April 15 thru September 1, when the rate shall be reduced to 600 pounds per acre.

C. Mulch. Mulch shall be virgin wood cellulose fiber made from whole wood chips. Within the fiber mulch material at least 20 percent (20%) of the fibers will be 10.7 mm in length and 0.27 mm in diameter. Rate of application shall be 2,000 pounds per acre. Soil stabilizers such as Terra Type III, (or approved equal) shall be applied at a rate of 40 pounds per acre on the side slopes and "Terra Tack I" (or approved equal) shall be applied at a rate of 40 pounds per acre in the flatter upper portions of the channel areas.

PART 3 – EXECUTION

3.1 HYDROMULCHING

Apply a mulch mixture to the channel area at the rates specified:

A. Prepare the area to be seeded as required.

B. Apply the mulch mixture to the area at the specified rates.

C. Fertilize, water and cultivate the application to insure a good product.

D. Reapply a mulch mixture if necessary to get a stable growth.

PART 4 – GUARANTEE

A. The hydro-mulch seeding shall be adequately watered until established. Any areas damaged by erosion or areas that do not have an acceptable turfing shall be redone to the satisfaction of the Engineer.

B. Contractor will guarantee a permanent covering grass after sufficient time for germination.

END OF SECTION

SECTION 03100
CONCRETE FORMWORK

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section defines requirements and limitations for design, construction, erection, and removal of concrete formwork for this project.

1.2 REFERENCE STANDARD

A. American Concrete Institute; ACI 347, "Recommended Practice for Concrete Formwork."

PART 2 – PRODUCTS

2.1 MATERIALS

A. Forms for As-Cast Finish
   1. Rough Form Finish. Dressed or undressed lumber free of knots, splits, or other defects; plywood; metal; other approved material.
   2. Smooth Form Finish. Plywood, tempered, concrete-form hardboard; dressed lumber faced with plywood; metal; plastic; other approved material. Do not use material with raised grain, torn surface, work edges, patches, dents, or other defects.

B. Form Accessories
   1. Use commercially manufactured ties, hangers, and other accessories for embedding in concrete. Use of wire which is not commercially fabricated as form accessories is not permitted.
   2. Install form ties so that ends or end fasteners can be removed without causing spalling of concrete faces.
   3. After ends or end fasteners of form ties have been removed, the embedded portion must be no less than 1-inch (1”) from the plane of the exposed concrete surface. Tie cones shall be no greater than 1-inch (1”) in diameter.
   4. Burning off ties is not permitted.
   5. Removable or taper ties are not permitted.

C. Form Coating. Use commercial formulation of form oil or form-release agent having proven satisfactory performance. Coating must not bond with, stain, or adversely effect concrete surfaces. It must not impair subsequent treatment of concrete surfaces, including bonding agents and curing compounds.

D. Chamfer Strips. Provide in corners of forms to produce beveled edges on permanently exposed surfaces. Size of chamfer is ¾-inch (¾") unless shown otherwise. Interior corners and edges of formed joints do not require beveling unless otherwise shown.

2.2 DESIGN OF FORMWORK

A. Design formwork for loads, lateral pressure, and allowable stresses as described in the reference standard (ACI 347). Allow for design consideration, wind loads, allowable stresses, and other applicable requirements of controlling local building codes.

A. Tolerances.
   1. For concrete surfaces exposed to view, the maximum allowable deflection is 1/240 of the span between structural members.
   2. When necessary to maintain specified tolerances, chamfer formwork to compensate for anticipated deflection during concrete hardening.
   3. Design forms sufficiently tight to prevent loss of mortar.

B. Earth Cuts For Forms. For beams under slabs on grade, use earth cuts for forms where beams are shown to have sloping sides and are integral with slab. Earth cuts may be used for sides of footings if sides of excavation are in stable condition to prevent caving or sloughing.

C. Slip Forming. Not permitted.

PART 3 – EXECUTION

3.1 NOTIFICATION

A. At least 24 hours prior to scheduled concrete placement, notify the Engineer that formwork may be inspected. Do not place concrete until forms have been inspected and approved.

3.2 PREPARATION

A. Anchor, brace, and tie formwork to shores, members, or other supporting surfaces to prevent upward or lateral movement to any part of formwork system during concrete placement. Tighten forms to close joints and insure conformance to specified lines and shapes. Remove and rebuild forms that cannot be tightened properly.

B. Arrange facing material in an orderly and symmetrical fashion. Keep the number of seams to a practical minimum. Support facing material adequately to prevent deflection in excess of specified tolerances.

C. For flush surfaces exposed to view, overlap previously placed, hardened concrete with form sheeting by approximately one-inch (1"). Hold forms against hardened concrete to maintain true surfaces, preventing offsets or loss of mortar.

D. Provide temporary openings at the base of column and wall forms and at other points required. The openings facilitate observation and cleaning immediately before concrete is placed.

E. If runways are required for moving equipment, provide for support of runways with struts or legs resting directly on the formwork or structural member. Do not allow runways or supports to rest on reinforcing steel.

3.3 ADJUSTMENTS

A. Use wedges or jacks to provide positive adjustment of shores and struts. Wedges used for final adjustment of forms should be fastened in position after final inspection and before concrete placement.

B. Securely brace forms against lateral deflections. Prepare to compensate for settling during concrete placement.

C. For wall openings, construct wood forms that facilitate any necessary loosening to counteract swelling of forms.

3.4 TOLERANCES

A. Construct formwork so that concrete surfaces will conform to tolerance limits as listed in the appropriate table at the end of this section.

B. Establish sufficient control points and bench marks as references for tolerance checks. Maintain these references in undisturbed condition until final completion and acceptance of the project.

3.5 PREPARATION OF FORM SURFACES

A. Before placing concrete, clean surfaces of forms and embedded materials. Remove accumulated mortar, grout, rust and other foreign matter.

B. Coat forms for exposed or painted concrete surfaces with form oil or form-release agent before placing reinforcement. Cover form surfaces with coating material used in strict accordance with the manufacturer's printed instructions. Do not allow excess coating material to accumulate in forms or to contact hardened concrete against which fresh concrete will be placed. Remove coating material from reinforcement before placing concrete.

C. Other than retained-in-place metal forms, forms for unexposed surfaces may be wet with water immediately before concrete placement in lieu of coating. One exception is that when a possibility of freezing temperatures exists, use of a coating is mandatory.

3.6 REMOVAL OF FORMS

A. On vertical surfaces when repair of surfaces defects or finishing is required before concrete is aged, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations.

B. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed after 12 hours provided that concrete has hardened sufficiently to resist damage from removal operations. When shores and other vertical supports are arranged so that nonload-carrying, form-facing material may be removed without loosening or disturbing shores and supports, facing material may be removed at an earlier age.

C. Keep in place all forms and shoring used to support weight of concrete until concrete has reached the minimum strength specified for removal of forms and shoring. In no case shall forms be removed in less than four (4) days.

3.7 REMOVAL STRENGTH

A. Control Tests. Suitable strength control tests will be used as evidence that concrete has attained specified strength for removal of formwork or shoring supporting weight of concrete in beams, slabs, and other structural members.
   1. Field Test. When field cured test cylinders reach the specified removal strength, formwork or shoring may be removed from the respective concrete placements.
   2. Laboratory Test. When concrete has been cured as specified for cast-in-place concrete for the same time period required by laboratory cured cylinders to reach specified strength, the formwork or shoring may be removed from respective concrete placements. Determine the length of time that the concrete placement has been cured by totaling the number of days or fraction of days, not necessarily consecutive, during which the air temperature surrounding the concrete is above 50□F and the concrete has been damp or thoroughly sealed against evaporation and loss of moisture.

B. Compressive Strengths. The minimum concrete compressive strengths for removal of all formwork not specifically covered under the previous paragraph on Removal of Forms shall be 75 percent (75%) of the specified minimum 28-day strength of the class of concrete involved.

3.8 SHORING

A. When reshoring is permitted or required, plan operations in advance and secure approval of such operations. While reshoring is under way, keep live load off the new construction. Do not permit concrete in beam, slab, column or other structural member to be subjected to combined dead and construction loads in excess of loads permitted for developed concrete strength at the time of reshoring.

B. Place reshores as soon as practicable after stripping operations are complete but in no case later than the end of the working day on which stripping occurs. Tighten reshores to carry the required loads without overstressing construction. Leave reshores in place until tests representative of concrete being supported have reached specified strength or strength specified for removal of reshores.

C. Leave original supporting shores in place or reshore those floors supporting shoring under newly placed concrete. Reshoring system capacity must be sufficient to resist anticipated loads and in all cases have a capacity equal to at least ½ of the capacity of the shoring system above. Locate reshores directly under shore positions above unless other locations are permitted.

D. Extend reshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms and construction live loads in such a manner that design superimposed loads of floors supporting shores are not exceeded.

3.9 FORM REUSE

A. Approval is required before reusing any forms. Do not reuse forms that are worn or damaged beyond repair. Thoroughly clean and recoat forms before reuse. For wood and plywood forms to be used for exposed smooth finish, sand or otherwise dress concrete contact surface to original condition or provide form liner facing material. For metal forms, straighten, remove dents and clean to return to original condition.

TABLE 3A

TOLERANCES FOR FORMED SURFACES

CONCRETE IN BUILDINGS

Variation Form	Variation in	For Any 10 Foot Length	For Any 20 Foot Length or Any Bay	Maximum For Entire Dimension
Plumb or Specified Batter	Lines and surfaces of columns, piers, walls, and arrises	¼"	--	1"
	Exposed corner columns, control joint grooves, and other conspicuous lines	¼"	¼"	½"
Level or Specified Grade	Slab soffits, ceilings, beam soffits, and in arrises (measured before removal of shores)	¼"	_"	¾"
	exposed lintels, sills, parapets horizontal grooves and other conspicuous lines	--	¼"	½"
Drawing Dimensions	Position of linear building lines, columns, walls, and partitions	--	½"	1"
	Size and location of sleeves, floor openings and wall openings	--	--	±¼"
	Cross section of columns, beams, slabs, and walls	--	--	+½" -¼"
	Footings* in plan	--	--	+2" -½"
	Footing misplacement or eccentricity of direction error (the less of)	--	--	2% of width or 2"
	Footing thickness decrease	--	--	5%
	Footing thickness increase	--	--	no limit
	Step rise in flight of stairs	--	--	±_"
	Step tread in flight of stairs	--	--	±¼"
	Consecutive step rise	--	--	$\pm 1/16$"
	Consecutive step tread	--	--	±_"

* Footing tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items.

TABLE 3B

TOLERANCES FOR FORMED SURFACES

CONCRETE IN BRIDGES, WHARVES AND SIMILAR STRUCTURES

Variation Form	**Variation In**	**Maximum**
Plumb or Specified Batter	Surfaces of Columns, Piers, and Walls	½" in 10_
Level or Specified Grade	Top Surfaces of Slabs, Curbs, & Railings	$^{3}/_{16}$" in 10_
Drawings Dimensions	Cross Section of Columns, Caps, Beams and Similar Members	+½" -¼"
	Thickness of Deck Slabs	+¼" -_"
	Footing	*

* Same as footings for buildings - See Table 3A.

END OF SECTION

SECTION 03150
CONCRETE JOINTS AND EMBEDDED ITEMS

PART 1 – GENERAL

1.1 SCOPE

A. This section specifies requirements for construction joints, contraction joints, expansion joints and embedded items for concrete work. Coordinate work of this section with related work of other sections to obtain a proper installation. Review drawings and specifications for additional requirements for joints and embedded items.

1.2 REFERENCE STANDARDS

A. The latest editions of reference standards listed below form a part of this specification and are applicable to this project.

B. American Society for Testing and Materials (ASTM).
1. ASTM A-120, "Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses."
2. ASTM A-306, "Carbon Steel Bars Subject to Mechanical Property Requirements."
3. ASTM D-994, "Preformed Expansion Joint Filler for Concrete (Bituminous Type)."
4. ASTM D-1751, "Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextending and Resilient Bituminous Types)."
5. ASTM D-1752, "Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction."

1.3 SUBMITTALS

A. Shop Drawings. Submit shop drawings as specified in Division 1 - General Requirements. Shop drawings shall show expansion joints, construction joints and sequences for concrete placement.

B. Substitute Materials. Acceptable brands of materials are specified herein. If substitutions are desired, submit brochures and samples of requested substitutions for approval before delivery to the project.

PART 2 – PRODUCTS

A. Expansion Joint Filler, Nonbituminous. Preformed cork filler conforming to ASTM D-1752 or plain fillerboard conforming to ASTM D-1751. Use ¾-inch (¾") thickness unless otherwise shown on the drawings.

B. Expansion Joint Sealer. Polysulfide compound conforming to ANSI 116.1. Acceptable products include:
1. Cork filler such as Sonneborn's "Sonoflex Cork" or Grace's "Standard Cork" Code 4323.
2. Grace's "Verti-seal" (Thiokol two-component Polysulfide Sealant) #2382 or Sonneborn's "Sonolastic" (Two Part) (Code CS 311).
3. Or approved equal.

C. Bonding Agent. A. C. Horn Products, "Thiopoxy 62"; Sika Corporation, "Sikadur 32 Hi-Mod"; or Permagile Corporation, "Uniweld"; or approved equal.

D. Bond Breaker. 30-pound asphalt saturated felt.

E. Expansion Joint Dowels. Plain steel bars conforming to ASTM A-306, grade 70. Cut dowels to length at shop or mill before delivery to the site. Dowels must be straight and clean, free of loose flaky rust and loose scale. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04-inches from the end.

F. Sleeves. ASTM A-120, standard weight galvanized pipe.

G. Waterstops. Use polyvinylchloride waterstops as manufactured by Tiger Indus-tries; W. R. Meadows, Inc.; W. R. Grace & Company; or approved equal. Unless otherwise shown, use stops of six-inch (6") minimum width and $^{3}/_{16}$-inch ($^{3}/_{16}$") minimum thickness, similar in construction to "Tiger-Flex," Type SB, standard ribbed with bulb.

PART 3 – EXECUTION

3.1 PLACEMENT OF EMBEDDED ITEMS

A. Place embedded items to least impair strength of the structure. Obtain approval of locations for embedded items before placement of concrete. Should locations of embedded items conflict with reinforcement or be detrimental to strength of structure, relocate items as directed.

B. Do not cut or reposition reinforcing steel to facilitate installation of inserts, conduit, sleeves, anchor bolts, mechanical openings and similar items without prior approval.

3.2 CONSTRUCTION JOINTS

A. Make construction joints only at locations shown on reviewed shop drawings or as directed. Comply with the following procedures unless exceptions are shown on the drawings or deviations are specifically directed by the Engineer.

B. Joints not shown on drawings must be approved. Locate joints to least impair strength of the structure. In general, locate joints near the middle of spans of slabs, beams and girders. However, if a beam intersects a girder at the joint, offset joints in girders a distance equal to twice the width of the beam. Locate joints in walls and columns at the underside of floors, slabs, beams and girders and at tops of footings or floor slabs. Place beams, girders, brackets, column capitals, haunches and drop panels monolithic with slabs.

C. Place all joints perpendicular to main reinforcement. Continue all reinforcing steel and mesh across construction joints. Provide keys as directed. Provide longitudinal keys at least 1½-inch (1½") deep by 1/2 of the wall thickness, centered in the wall, in all joints in walls.

D. Prepare joints by roughening the concrete surface in an approved manner which will expose aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at surface.

E. Filler must be full depth of concrete section with top held down ¾-inch (¾") to provide recess for sealant. Polysulfide sealer shall be used on all interior expansion joints and paving.

F. In lieu of the above method for securing bond between new and set concrete, the following optional method may be used. Use a bonding agent applied to roughened and cleaned surfaces of set concrete in strict accordance with manufacturer's recommendations with respect to preparation of surfaces and applications of bond agent.

3.3 WATERSTOPS

A. Install in locations shown.

B. Each piece of premolded water stop must be of maximum practicable length for a minimum number of end joints.

C. Make joints at intersections and at ends of pieces in a manner most appropriate to the material being used and in accordance with manufacturer's recommendations. Joints must develop effective watertightness fully equal to that of continuous waterstop material, must permanently develop not less than 50 percent (50%) of mechanical strength of parent section, and must permanently retain flexibility.

D. Accurately position and support waterstops against displacement during concrete placement.

3.4 OTHER EMBEDDED ITEMS

A. It is the Contractor's responsibility to check shop drawings for number and location of embedded items and that work is coordinated so that embedded items are properly placed.

B. Accurately position and support embedded items against displacement during concrete placement.

C. Metal items, except reinforcing, must be galvanized unless specific exception is obtained.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 – GENERAL

1.1 SCOPE

A. This section gives requirements for concrete reinforcement. Coordinate the requirements of this section with all other sections of Division 3 - Concrete.

1.2 REFERENCE STANDARDS

A. The latest editions of reference standards listed below form a part of this specification and are applicable to this project.

1. American Society for Testing and Materials.

   ASTM A-615, "Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"

   ASTM A-185, "Specification for Welded Steel Wire Fabric for Concrete Reinforcement"

   ASTM A-306, "Specification for Carbon Steel Bars Subject to Mechanical Property Requirements"

2. American Concrete Institute.

   ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures"

   ACI 318, "Building Code Requirements for Reinforced Concrete"

3. Concrete Reinforcing Steel Institute.

   CRSI 163, "Recommended Practice for Placing Reinforcing Bars"

   CRSI 165, "Recommended Practice for Placing Bar Supports, Specifications and Nomenclature"

1.3 SUBMITTALS

A. Certificates. Submit the manufacturer's certificates giving the properties of steel proposed for use. List the manufacturer's test number and heat number, chemical analysis, yield point, tensile strength and percent elongation. Also identify on the certificates the proposed location of the steel in the work.

B. Bill of Materials. Submit bills of materials to be reviewed with shop drawings.

C. Shop Drawings.

1. Submit shop drawings according to Division 1, General Requirements. Show reinforcement fabrication, bar placement location, splices, spacing, and bar designation, bar type, length, size, bending, number of bars, location of bars to accommodate post-tensioning tendons and other pertinent information, including dimensions. Information must correspond directly to data listed on the bill of material.

2. Provide sufficient detail to permit placement of reinforcement without use of design drawings. Reproduction of design drawings for use as shop drawings will not be allowed. Begin fabrication of reinforcing steel after shop drawings have been reviewed by the Engineer.
3. Refer to ACI reference standards for detailing, location, placing, splicing, etc. of reinforcing steel to be shown on shop drawings.

1.4 SCHEDULING

A. Schedule materials for delivery to the site so that items may be installed immediately upon delivery. Plan the schedule to accommodate other work, especially post-tensioning. Place items in the proper sequence so that removal and replacement to accommodate other work is avoided.

1.5 HANDLING AND STORAGE

A. Store steel reinforcement above the ground on platforms, skids or other supports. Protect reinforcing, as far as practicable, from mechanical injury, surface deterioration and rusting caused by exposure to the weather.

1.6 INSPECTION

A. Make storage and fabrication facilities of the supplier and fabricator available for inspection by the Engineer prior to and during fabrication.

PART 2 – PRODUCTS

2.1 REINFORCEMENT

A. Deformed Bars. Use deformed bars conforming to ASTM A-615, grade as specified on drawings, for all bars except column spirals and those shown on drawings to be smooth bars. Where grade is not specified on drawings, use Grade 60.

B. Smooth Bars. Use bars conforming to ASTM A-306, Grade 70, for all smooth bars including column spirals.

C. Marking. Clearly mark all bars with waterproof tags showing the number of bars, size, mark, length and yield strength. Mark steel with the same designation as the member in which it occurs. Key marks to the concrete placement number as designated in the concrete placement sequence shown on the drawings.

D. Welded Wire Fabric. ASTM A-185, electrically-welded wire fabric of cold-drawn wire. Provide gauge and mesh size as shown.

2.2 MECHANICAL BAR SPLICES

A. G-Loc Splices. As manufactured by Gateway Building Products, 3233 W. Grand Avenue, Chicago, Illinois, or approved equal.

B. Cadweld Splices. As manufactured by Erico Products, Inc., 2070 E. 61st Place, Cleveland, Ohio, or approved equal.

2.3 TIE WIRE

A. Use 18-gage annealed steel for tie wire.

2.4 ACCESSORIES

A. Provide chairs, riser bars, ties and other accessories made of plastic or metal, except as otherwise specified. Where concrete surfaces are exposed to the weather in finished work, provide plastic or plastic-coated accessories only. Use of galvanized accessories is not permitted in these locations. Use plastic accessories manufactured by W.H.C. Products, Inc., Houston, Texas or approved equal.

PART 3 – EXECUTION

3.1 NOTIFICATION

A. Notify the Engineer at least 24-hours before concrete placement so that reinforcement may be inspected and errors corrected without delaying the work.

3.2 FABRICATION

A. Cold-Form Bent Bars. Fabricate cold-form bent bars to the shapes shown on the drawings. Do not straighten or rebend bars without specific approval. On the job, cut bars by shearing or sawing.

B. Splices. Use a minimum number of splices. Lap splices in strict accord with ACI 318 or as shown. Where it is necessary to splice reinforcement other than as shown, the Engineer will determine the character of the splice. Do not make splices at points of maximum stress. Stagger splices in adjacent bars.

C. Fabrication Tolerances. Bars used for concrete reinforcement must conform to the following fabrication tolerances.

Measurement	Tolerance in Inches
Sheared length	± 1
Depth of truss bars to 8-inch depth	± 0, - ¼
Depth of truss bars over 8-inch depth	+ 0, - ½
Stirrups, ties and spirals	± ¼
All other bends	± 1

3.3 PLACING

A. Condition of Reinforcement. Reinforcement must be free of injurious seams, flaws, cracks, scale, loose or flaky rust or other foreign material, including oil, mud or coating that will reduce the bond to concrete.

B. Placement Tolerances. Place reinforcement within the following tolerances.

Placement	Tolerance in Inches
Concrete cover to formed surfaces	± ¼
Minimum spacing between bars	± ¼
Top bars in slabs and beams to 8-inch depth	± ¼
Top bars in slabs and beams between 8 and 24-inch depth	± ½
Top bars in slabs and beams more than 24 inches in depth	± 1

Crosswise of members spaced evenly within	± 2
Lengthwise of members	± 2

C. Concrete Cover. Except as otherwise shown, provide a clear cover measured from reinforcement to the face of the concrete as listed.

Surfaces	Measurement in Inches
Interior not exposed to weather	
Slabs, joists, and walls	¾
Beams, girders, and columns	1½
Exterior not in contact with earth or water	
Slabs and walls, No. 6 and smaller bars	1
Slabs and walls, No. 7 and larger bars	1½
Beams, girders, and columns	2
Exterior in contact with earth or fresh water	
Slabs and walls, No. 6 and smaller bars	1½
Slabs and walls, No. 7 and larger bars	2
Beams, girders, and columns	2½
Exposed to salt water or salt spray	
Slabs and walls	2
Beams, girders, and columns	3
Footings	
Top and sides	2
Bottom	3
Increase measurements under these conditions:	
Cover of top bars for slabs without wearing surface designed to carry vehicular traffic	½
When using No. 14 or No. 18 bars	½

3.4 ASSEMBLY

A. Reinforcing Bars in Forms Use spacers, chairs, wire ties and other accessory items necessary to properly assemble, space and support reinforcing. Provide accessories of sufficient number, size and strength to adequately prevent deflection or displacement of reinforcement due to construction loads or concrete placement. Accessories recommended by CRSI will be used if not otherwise specified or shown. Accessories shall be of a size to provide concrete cover as previously specified. Use appropriate accessories to position and support bolts, anchors and other embedded items. Tie reinforcing bars at each intersection and to accessories. Blocking reinforcement upon concrete or masonry is prohibited.

B. Reinforcement for Concrete on Ground. Support reinforcement on plastic chairs spaced about three-feet (3") on center each way. Use a minimum of one (1) chair for each nine (9) square feet. Fasten chairs to the reinforcement as recommended by the manufacturer of the chairs.

C. Vertical Reinforcement in Columns. Offset vertical bars by at least one (1) bar diameter at splices. Provide accurate templates for column dowels to insure proper placement.

D. Mechanical Bar Splices. Use only where indicated.

E. Welded Wire Fabric.

1. For welded wire fabric designated as load carrying reinforcement, make lapped splices so that the overlap measured between the outer-most cross wires of each fabric sheet is not less than the spacing of cross wires plus two-inches (2"). Support as required for reinforcing bars.
2. For welded wire fabric not specifically designated as load carrying reinforcement, make lapped splices so that the overlap measured between the outermost cross wires of each fabric sheet is not less than two-inches (2"). Extend the fabric across supporting beams and walls to within four-inches (4") of concrete edges. Also extend the fabric through contraction joints and construction joints, other than keyed joints in slabs on the ground.

F. Construction Joints. Provide continuous reinforcing through joints. As a general rule, place unscheduled joints at midspan. Obtain specific approval for jointing and bar splicing that is not indicated on the drawings. Splices shown on reviewed shop drawings are acceptable.

G. Interferences. If reinforcing interferes with the location of other reinforcing steel, conduits or embedded items, request instructions from the Engineer. The Engineer need not be notified if bars are moved to avoid such interferences unless the bars are moved more than one (1) bar diameter or enough to exceed specified tolerances. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without approval.

H. Field Bending. Shape reinforcing bent during construction operations to conform to the drawings. Closely inspect the reinforcing for breaks. If reinforcing is damaged, replace, cadweld, or otherwise repair as directed. Do not bend reinforcement after it is embedded in concrete.

I. Welding. Unless directed by the Engineer, do not weld reinforcing bars.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 SCOPE

A. This section gives requirements for normal weight structural concrete.

B. Coordinate the requirements of this section with all other sections of Division 3, Concrete. All requirements of this section apply to those except as may be otherwise specified in such sections.

1.2 REFERENCE STANDARD

A. The current issue of ACI-318, "Specifications for Structural Concrete for Buildings" is a part of this specification and is applicable to this project.

1.3 SUBMITTALS

A. Mill Certificates. Required for all bulk cement and reinforcing steel.

B. Admixtures. Submit brochures on admixtures proposed for use if different from those specified.
1. A submittal is required from the manufacturer of the approved air-entraining admixture. Give requirements to control percent of air content under all conditions including temperature variations. Provide three (3) copies.
2. A submittal is required from the manufacturer of the approved water-reducing retarder. Give requirements for quantities and types to be used under various temperatures and job conditions to produce a uniform, workable concrete mix.

C. Design Mixes. Submit historical test data on proposed design mixes for each type of concrete in the project. Historical test data must comply with the requirements of ACI 318-11 chapter 5.

D. Curing Method. Submit the proposed curing method for all concrete. If the use of a white pigmented membrane-forming compound is recommended, submit evidence that the compound is satisfactory for the intended application. A written guarantee will be required.

E. Sample Ticket: Provide sample delivery ticket. Delivery ticket shall include, at a minimum, the following items:
1. Delivery ticker number
2. Supplier
3. Mix ID
4. Batch Plant ID
5. Truck Number
6. Load Number
7. Batch Date and Time
8. Material Target vs. Actual (water, cement, aggregate, admixtures, etc.)
9. Target Slump

1.4 STORAGE OF MATERIALS

A. Cement. Store cement in weather tight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set.

B. Aggregate. Arrange and use aggregate stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding three-feet (3') in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregates.

C. Sand. Before using, allow sand to drain until uniform moisture content is reached.

D. Admixtures. Store admixtures to avoid contamination, evaporation or damage. For those used in the form of suspensions or nonsoluable solutions, provide suitable agitating equipment to assure uniform distribution of ingredients. Protect liquid admixtures from freezing and other temperature changes which would adversely affect their characteristics.

1.5 TESTING LABORATORY SERVICES

A. The tests required in this section will be performed by a commercial testing laboratory as specified in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Portland Cement. Use cement conforming to ASTM C-150, Type "I." Type III may be used when specifically authorized. Use the same brand of cement upon which the selection of concrete was based. Only one (1) brand of each type will be permitted in any one structure, unless otherwise specified.

B. Admixtures. Use the following admixtures as required or permitted. The use of calcium chloride will not be permitted. The products must conform to the referenced standards.
1. Air-entraining Admixtures. Conform to ASTM C-260, such as Sika's "AER," Sonneborn's "Aerolith" or approved equal.
2. Chemical Admixtures. Conform to ASTM C-494, "Tentative Specifications for Chemical Admixtures for Concrete."
3. Water-reducing Retarder. Use of an admixture containing chloride is not permitted. The product must be nonstaining. Use Master Builder's "MBHC," Sika's "Plastiment" or approved equal.

C. Mixing Water. Fresh, clean and drinkable.

D. Aggregates. Use coarse aggregate from only one (1) source and fine aggregate from only one (1) source for exposed concrete in a single structure.
1. Coarse aggregate for normal weight concrete shall conform to ASTM C-33. Grading limits for precast, prestressed members and for all members six- inches (6") or less in least dimension, one-inch (1") to No. 4. Grading for all other normal weight concrete, 1½-inches (1½") to No. 4.
2. Use natural sand complying with ASTM C-33 for fine aggregate in normal weight concrete.

E. Membrane-forming Curing Compound. ASTM C-309, white pigmented commercial curing compound which will not permanently discolor concrete.

F. Sheet Material for Curing Concrete. ASTM C-171, waterproof paper, polyethylene film or white burlap-polyethylene sheeting.

G. Non-shrink Grout. Unless otherwise specified, use Master Builders' "Embeco 153," or approved equal, consisting of specially prepared catalyzed metallic aggregate, Portland cement that is not air-entrained, and specially size-graded sand.

H. Reinforcing Steel. Use ASTM A-615, Grade 60 reinforcing steel, unless otherwise specified or noted on the drawings. Use deformed bars except where smooth bars are specified.

I. Expansion Joints. Use ASTM D-994 expansion joint filler, ¾-inches (¾") thick, unless otherwise show, from full depth to one-inch (1") above the slab. Use ASTM-1190 joint sealer to fill the joint. Provide joint filler and sealer at locations shown.

2.2 PROPORTIONING

A. Objective. Select proportion of ingredients to produce concrete having proper placability, durability, strength, appearance, and other required properties. Proportion ingredients to produce a homogeneous mixture which will work readily into corners and angles of forms and around reinforcement by methods of placing and consolidation employed on the work, but without permitting materials to segregate or allowing excessive free water to collect on the surface.

B. Strength. Provide ultimate strength concrete in all portions of the work. Strength must conform to values for the class of concrete specified for each portion of the structure. Requirements are based on 28-day compressive strength. If high early-strength concrete is specified, requirements are based on seven (7) day compressive strength.

C. Entrained Air. Air-entrain all concrete, unless otherwise specified. Provide for not less than three-percent (3%) nor more than five-percent (5%) by volume of total entrapped and entrained air for normal weight concrete.

D. Slump. The maximum permissible slump for concrete is five-inches (5"); the minimum is three-inches (3"). Determine slump by methods given in ASTM C-143.

E. Admixtures. Proportion admixtures according to the manufacturer's recommendations. Use of an approved accelerator is permitted when the air temperature is less than 40° F. Use of an approved retarder is required when the temperature of placed concrete exceeds 85° F.

F. Classification and Use.

1. Classification:

Class	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Contents Sacks per Cubic Yard*
Normal Weight		
A	3000	5
Sidewalks		
B	2500	4½
Structural		
C	4000	6

* If the required strength is not secured with the minimum cement content as specified, add cement or provide other aggregates as necessary.

2. Use the specified classes of concrete in the following locations:
   a. Class A – Miscellaneous Concrete
   b. Class B – Sidewalks
   c. Class C – Foundations and structures, equipment slabs, pipe supports, underground thrust blocks.

G. Water-Cement Ratio for Normal Weight Concrete. If the relationship between strength and the water-cement ratio has been determined previously for materials specified for normal weight concrete, the ratio may be used. Otherwise, determine the proper water-cement ratio by using the following procedures.

1. Make concrete trial mixtures having suitable proportions and consistency. Use at least three (3) different water-cement ratios which will produce a range of strengths encompassing those required. Design trial mixes to produce the maximum allowable slump.
2. Determine proportions of ingredients and conduct tests in accordance with basic relationships and procedures outlined in ACI 613, "Recommended Practice for Selecting Proportions for Concrete."
3. Make and cure specimens according to ASTM C-192, "Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory." For each water-cement ratio, prepare at least three (3) specimens for each age test. Test for strength at seven (7) days and 28 days, or other age as required. Conduct tests according to ASTM C-39, "Method of Test for Compressive Strength of Molded Concrete Cylinders."
4. From results of these tests plot a curve showing the relationship between water-cement ratio and compressive strength.

H. Alternate Determination of Proportions. In lieu of proportioning as specified for normal and lightweight concrete, a mix design employing the same ingredients proposed for use, and used successfully on previous projects under similar conditions may be used. To obtain the necessary approval, submit the following:

1. Concrete mix design.
2. Reports for at least 20 consecutive sets of 7-day and 28-day concrete strength tests made during the last six (6) months.
3. Reports of compliance tests of fine and coarse aggregates made during last six (6) months.

2.3 MIXING NORMAL WEIGHT CONCRETE

A. Ready-Mixed Concrete. Mix and transport ready-mixed concrete according to ASTM C-94, "Specifications for Ready-Mixed Concrete." In addition, the batch plant shall provide for the following items:

1. Arrangement. Provide separate bins or compartments for different sized aggregates and for bulk cement. Compartments of ample size constructed so that materials will be kept separate under all working conditions are required.
2. Weighing of Materials. Aggregates may be weighed in separate weigh batchers with individual scales. Weigh bulk cement on a separate scale in a separate weigh batcher. Observe the following limits of accuracy when weighing or measuring materials.

Materials	Percent Accuracy
Cement	1
Water	1
Aggregates	2
Admixture	3

3. Water Meter or Batcher. Provide a suitable measuring device capable of measuring mixing water within the specified accuracy for each batch. Note the number of gallons of water as batched on printed batching tickets.
4. Moisture Control. Provide a moisture meter to measure the amount of free water in fine aggregates within 0.3 of a percent. Compensate for varying moisture contents of fine aggregates and change batch weights of materials if necessary before batching.
5. Scales. Provide adequate facilities for accurate measurement and control of each material entering each batch of concrete. Accuracy of weighing equipment must conform to applicable requirements of ASTM and NRMCA for such equipment.

6. Recorders or Printers. Provide recorders/printers to produce tickets. Each ticket will provide a printed record of weights for cement as batched and for separate aggregates as batched individually. Use the type of indicator that returns for zero punch or to zero after a batch is discharged. Clearly indicate by stamped letters or numbers the difference between aggregates and cement as batched. Show the time of day stamped or printed at intervals of not more than six (6) minutes. Deliver recorded ticket copies with concrete. The testing agency will keep one (1) copy.
7. Protection. Protect weighing, indicating, recording or printing, and control equipment against exposure to dust and weather.

B. Transit Mix Truck Requirements.
1. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant.
2. Keep the water tank valve on each transit truck locked at all times that the truck is in use. Any addition of water must be directed by the Engineer. Added water must be incorporated by additional mixing of at least 35 revolutions or two (2) minutes.
3. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.

C. Batch Mixing at Site.
1. Mix concrete in a batch mixer conforming to requirements of the Mixer Manufacturers' Bureau of the Associated General Contractors of America. Use a mixer equipped with a suitable charging hopper, water storage tank and water measuring devices. It must be capable of thoroughly mixing aggregates, cement and water into a uniform mass within the specified mixing time, and of discharging the mix without segregation. Operate the mixer according to the rated capacity and recommended revolutions per minute printed on the manufacturer's rating plate.
2. Charge the batch into the mixer so that some water will enter in advance of cement and aggregates. Keep water running until ¼ of specified mixing time has elapsed. Provide controls to prevent discharging until the required mixing time has elapsed. When concrete of normal weight is specified, provide controls to prevent the addition of water during mixing. Discharge the entire batch before the mixer is recharged.
3. Mix each batch of two (2) cubic yards or less for not less than one (1) minute and 30 seconds. Increase mixing time 15 seconds for each additional cubic yard or fraction of a yard.
4. Keep the mixer clean. Replace pick-up and throw-over blades in the drum when they have lost 10 percent (10%) of original depth.

D. Admixtures.
1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device. Measure admixture to an accuracy within ±3 percent (3%). Do not use admixtures in powdered form.
2. Two (2) or more admixtures may be used in the same concrete, provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other. Inject the admixtures separately during the batching sequence.
3. Add retarding admixtures as soon as practicable after the addition of cement.

E. Temperature Control.
1. When the mean temperature falls below 40° F, keep the admixed temperature above 55° F to maintain concrete above the minimum placing temperature.
2. If water or aggregates have been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to the mixtures of water and aggregate when the temperature of the mixture is greater than 95° F.
3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature. If necessary, substitute well-crushed ice for all or part of the mixing water.

PART 3 – EXECUTION

3.1 JOINT PREPARATION

A. Thoroughly roughen the top surface of concrete placement terminating at the construction joints as soon as practical after initial set is attained.

B. Clean hardened concrete surfaces of all loose material, laitance, dirt, and foreign matter, and saturate it with water. **Pressure washing is not acceptable**. Remove all free water and moisten the surface before concrete or bonding grout is placed against it.

C. Coat the joint surface with bonding mortar, grout, epoxy or other material as indicated in the plans. Provide Type V epoxy for bonding fresh concrete to hardened concrete:

1. Eucopoxy LPL MV
2. Sikadur Hi-Mod
3. Or approved equal.

D. Place bonding agents in accordance with the manufacturer's recommendations.

3.2 CONCRETE PREPARATION

A. Coordination. Mix concrete only in quantities for immediate use. Discard concrete which has set. Retempering of set concrete is not permitted. Completely discharge concrete at the site within one (1) hour and 30 minutes after adding cement to aggregate. In hot weather reduce this time to one (1) hour or less to prevent stiffening of concrete before it is placed.

B. Protection from Adverse Weather. Unless adequate protection is provided or approval is obtained, do not place concrete during rain, sleet, snow or freezing weather. Do not permit rainwater to increase mixing water or to damage the surface finish. If rainfall occurs after placing operations begin, provide adequate covering to protect the work.

C. Placing Temperature.

1. Cold Weather. Unless special provisions are made for heating the concrete mix and concrete in forms, do not place any concrete when the air temperature is below 40° F or is predicted to be below 40° F within the next 48 hours after placement. Provide and use protective material and heating equipment as required to maintain the temperature of the concrete surface at not less than 35° F for a period of at least 36 hours after placement.
2. Hot Weather. When the air temperature is above 85° F, use of an approved retarding agent is required in all concrete. Concrete temperature prior to placement shall not exceed 95° F.

D. Adjusting Slump. If concrete arrives at the project with slump below that specified, water may be added. Indiscriminate addition of water to increase slump is prohibited. Do not exceed either the maximum permissible water-cement ratio or maximum slump. Any addition of water above the maximum water-cement ratio must be accompanied by a corresponding quantity of cement. Mix adjustments to obtain specified slump must be approved and directed by the Engineer.

3.3 CONVEYING

A. Objectives. Handle concrete from mixer to placement as quickly as practicable while providing concrete to required quality in the placement area. Use methods which prevent loss of ingredients and segregation.

B. Equipment. Obtain approval of the conveying equipment. Select equipment of size and design to insure continuous flow of concrete at the delivery end. Conform to the following equipment and operations requirements.

1. Provide truck mixers, agitators, nonagitating units and manner of operation conforming to requirements of ASTM C-94, "Specifications for Ready-Mixed Concrete."
2. Use belt conveyors configured horizontally or at a slope which causes no segregation or loss. Use an approved arrangement at the discharge end to prevent separation. Discharge long runs without separation into a hopper.
3. Provide metal or metal-lined chutes. Arrange for slopes not exceeding one (1) vertical to two (2) horizontal and not less than one (1) vertical to three (3) 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.
4. Pumping of concrete will be permitted only after written approval. Use a batch design and aggregate sizes suitable for pumping.

C. Maximum Time to Placement

1. The maximum time interval between the addition of cement to the batch, and the placing of concrete in the forms shall not exceed the following:

Air or Concrete Temperature (Whichever is Higher)	Maximum Time (Addition of Water or Cement to Placing in Forms)
Non-Agitated Concrete	
Over 80°F	15 Minutes
35°F to 79°F	30 Minutes
Agitated Concrete	
90°F or Above	45 Minutes
75°F to 89°F	60 minutes
35°F to 74°F	90 Minutes

2. The use of an approved retarding agent in the concrete will permit the extension of each of the above temperature-time maximums by 30 minutes for bridge decks, top slabs of direct traffic culverts and cased drilled shafts, and one hour for all other concrete except that the maximum time shall not exceed 30 minutes for non-agitated concrete.

3.4 PLACING

A. Preparation. In addition to the previous requirements, confirm that formwork has been completed. Remove ice, excess water, dirt and other foreign materials from forms. Confirm that reinforcement is securely in place and expansion joint material, anchors and other embedded items are properly positioned. Have a competent workman at the pour location who can assure that reinforcement and embedded items remain in design locations while concrete is being placed. Sprinkle semi porous subgrades to eliminate suction. Seal extremely porous subgrades in an approved manner.

B. Procedure.

1. Deposit concrete continuously, or in layers of such thickness that no concrete will be deposited 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.
2. Proceed with placement at a rate such that concrete which is being integrated with fresh concrete is still plastic. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
3. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only if made of galvanized metal or concrete, and if prior approval has been obtained.
4. Do not start placing of concrete in supported elements until concrete previously placed in columns and walls is no longer plastic.
5. Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to a procedure which will cause segregation.
6. Where surface mortar is to be the basis of a finish, especially those designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of mortar against the form. Prevent formation of excessive surface voids.
7. Consolidate concrete by vibration, spading, rodding or forking so that concrete is thoroughly worked around reinforcement, around embedded items and into corners of forms. Eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness. A minimum frequency of 7000 revolutions per minute is required for mechanical vibrators. Do not use vibrators to transport concrete within forms. Insert vibrators and withdraw at points from 18 to 30 inches apart. At each insertion vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not over-vibrate causing segregation. Keep a spare vibrator on the site during concrete placing operations.

C. Concreting Under Water. When required or permitted, deposit concrete under water by an approved method. Obtain advanced approval of the method from the Engineer. Deposit concrete in such a way that fresh concrete enters the mass of previously placed concrete from within, causing water to be displaced with a minimum disturbance at the surface of the concrete.

3.5 REPAIRING SURFACE DEFECTS

A. Defective Areas. Repair defective areas immediately after the removal of forms.

1. Remove honeycombed and other defective concrete down to sound concrete. To prevent absorption of water from patching mortar, dampen the defective area and a strip six-inches (6") wide surrounding the area to be patched. Prepare bonding grout by mixing approximately one (1) part cement to one (1) part fine sand passing a No. 30 mesh sieve. Mix to a consistency of thick cream, and brush thoroughly into the surface.

2. Make patching mortar of the same materials and of approximately the same proportions as concrete, except omit coarse aggregate. Prepare mortar with not more than one (1) part cement to 2½ parts sand by damp loose volume. Substitute white Portland cement for part of the gray Portland cement on exposed concrete in order to produce a color matching the color of surrounding concrete. Determine color by making a trial patch.
3. Use no more mixing water than necessary for handling and placing. Mix patching mortar in advance and allow to stand. Mix frequently with a trowel until it has reached the stiffest consistency that will permit placing. Do not add water.
4. After surface water has evaporated from the area to be patched, thoroughly brush a coat of bond grout into surface. When bond grout begins to lose its water sheen, apply the premixed patching mortar. Thoroughly consolidate the mortar into place and strike off to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave undisturbed for at least one (1) hour before final finishing. Keep the patched area damp for seven (7) days. Do not use metal tools in finishing patches in a formed wall which will be exposed.

B. Tie Holes. Patch tie holes immediately after removal of forms. After cleaning and thoroughly dampening the tie hole, fill solid with patching mortar.

C. Proprietary Materials. If permitted or required, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Use such compounds according to the manufacturer's recommendations.

3.6 FINISHING OF FORMED SURFACES

A. Surfaces Requiring No Finish. A finish is not required on surfaces concealed from view by earth, water, ceiling, etc. in the completed structure.

B. Smooth Form Finish.
1. Use plywood or fiberboard linings or forms in as large sheets as practicable and with smooth, even edges and close joints.
2. Patch tie holes and defects. Rub fins and joint marks with carborundum blocks to leave a smooth, unmarred finished surface.
3. Rubbed Finishes. In basins that contain liquids with normal water levels, the rubbed finish need only extend 3 feet below the normal level. Where fill dirt is placed against an exterior surface, extend the finish 3 feet below the finished grade. All other visible surfaces shall receive a finish. Produce one of the following finishes on concrete specified to have a smooth form finish:
    a. Grout-cleaned finish – Begin cleaning operations after contiguous surfaces to be cleaned are completed and accessible. Do not clean surfaces as work progresses. Wet the surface and apply grout consisting of one part portland cement and one and one-half parts fine sand with enough water to produce the consistency of thick paint. Add white cement as needed to match color of surrounding concrete. Scrub grout into voids and remove excess grout. When grout whitens, rub the surface and keep the surface damp for 36 hours afterward.

3.7 FINISHING SLABS AND SIMILAR FLAT SURFACES

A. Shaping to Contour. Use strike-off templates or approved compacting-type screeds riding on screed strips and edge forms to bring concrete surface to the proper contour. See the section on Concrete Formwork for edge forms and screeds.

B. Consolidation. Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Obtain consolidation of slabs and floors with vibrating bridge screeds, roller pipe screeds, or other approved means. Concrete to be consolidated must be as dry as practicable. Do not permit manipulation of surfaces prior to finishing operations.

C. Tolerances for Finished Surfaces. Tolerances are checked by placing a straightedge of specified length anywhere on the slab. The gap between slab and straightedge must not exceed the tolerance listed for the specified class.

Class	Straightedge Length In Feet	Tolerance In Inches
A	10	_
B	10	¼
C	10	⅛

D. Floated Finish.
1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when the mix has stiffened sufficiently to permit proper operation of a power-driven float. Consolidate the surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to a power-driven machine and on small, isolated slabs.
2. Recheck tolerance of the surface after initial floating with a 10-foot (10') straightedge applied at not less than two (2) different angles. Cut down high spots and fill low spots to Class "B" tolerance. Immediately refloat slab to uniform, smooth, granular texture.

E. Troweled Finish.
1. To obtain a troweled finish, a floated finish as previously specified must be applied. After power floating, use a power trowel to produce a smooth surface which is relatively free of defects but which may still contain some trowel marks. Do additional trowelings by hand after the surface has hardened sufficiently. Do final troweling when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate the surface by hand troweling operations.
2. Produce a finished surface free of trowel marks, uniform in texture and appearance and conforming to Class "A" tolerance. On surfaces intended to support floor coverings, remove defects which might show through covering by grinding.

3.8 CURING PROCEDURES

A. Objective. Protect freshly deposited concrete from premature drying and excessively hot or cold temperatures. Maintain a minimal moisture loss and a relatively constant temperature during the time necessary for hydration of cement and proper hardening of concrete.

B. Initial Curing. Immediately after the finishing operation, begin initial curing. Keep concrete continuously moist at least overnight. Use one of the following materials and methods for initial curing:
1. Ponding or continuous sprinkling.
2. Absorptive mat or fabric kept continuously wet.
3. Sand or other covering kept continuously wet.
4. Continuous steam bath (not exceeding 150° F at the surface of concrete).
5. Vapor mist bath.
6. Membrane-forming curing compound applied according to the manufacturer's recommendations.

C. Final Curing. Immediately following the initial curing and before concrete has dried, provide additional curing by one (1) of following materials or methods:
   1. Continuing the method used in initial curing.
   2. Waterproof paper, polyethylene film or white burlap-polyethylene sheeting.
   3. Other moisture-retaining coverings as approved.

D. Duration of Curing. Continue final curing until the cumulative number of days or fractions of days during which the ambient temperature is above 50° F has totaled seven (7). If high-early-strength concrete has been used, combine final curing for a total of three (3) days. Prevent rapid drying at the end of the curing period.

E. Curing Day. A curing day is defined as a calendar day when the temperature, taken in the shade away from artificial heat, is above 50° F for at least 19 hours, (or colder days if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 40° F for the entire 24 hours). The required curing period shall begin when all concrete has attained its initial set.

F. Formed Surfaces. Steel forms heated by the sun and wood forms in contact with concrete during final curing period shall be kept wet. If forms are to be removed during the curing period, employ one (1) of the above curing materials or methods immediately. Continue such curing for the remainder of the curing period.

G. Temperature.
   1. Cold Weather. Place concrete only when the temperature is above 40° F and rising. Place no concrete if the temperature is below 50° F and falling. Maintain the ambient temperature of the air surrounding the concrete above 50° F for the required curing period. When necessary, make arrangements for heating, covering, insulating or housing concrete work in advance of placement to maintain the required temperature and moisture conditions. Prevent injury due to concentration of heat.
   2. Hot Weather. When necessary, make arrangements for installation of windbreaks, shading, fog spraying, sprinkling, ponding or wet covering of light color in advance of placement. Take such protective measures, as quickly as concrete hardening and finishing operations will allow.
   3. Temperature Changes. Control changes in temperature of concrete at a rate as uniform as possible. Do not permit a temperature change to exceed 5° F in any one hour or 50° F in any 24-hour period.

H. Protection From Mechanical Injury. During the curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock and excessive vibration. Protect finished concrete surfaces from damage caused by construction equipment, materials, or methods and by rain or running water. Do not load self-supporting structures in any way that overstresses concrete.

I. Membrane Curing Requirements.
   1. After concrete has received final finish and surplus water sheen has disappeared, seal surface with a single uniform coating of approved curing compound applied at rate of coverage recommended by manufacturer and as directed by Engineer, but not less than one (1) gallon per 180 square feet of area. Provide satisfactory means and facilities to properly control and check rate of application of compound.
   2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers, equipped with satisfactory atomizing nozzles, except that for application on small miscellaneous items, hand powered spray equipment may be used. For all spraying equipment, prevent loss of compound between nozzle and concrete surface during spraying operations.

3. Do not apply compound to a dry surface. If surface of concrete has become dry, thoroughly moisten immediately previous to application. At locations where coating shows discontinuities, pin holes or other defects, or if rain falls on newly coated surface before film has dried sufficiently to resist damage, apply an additional coat of compound immediately, at same rate of coverage specified herein.
4. Use any of the following curing compounds for unformed surfaces:
   a. ShepCure City White
   b. W.R. Meadows 1600 White Series
   c. Day-Chem White Pigmented Cure (J-8)
   d. Or approved equal.
5. Use any of the following curing compounds for all formed surfaces to receive further surface treatment or additional concrete:
   a. Shep Cure 309 Rez All
   b. W.R. Meadows 1100 – Clear Resin Based
   c. Day – Chern Rez Cure (J-11-W)
   d. Or approved equal.

END OF SECTION

SECTION 03350
GROUTING

PART 1 – GENERAL

1.1 SCOPE

A. This section covers grouting of pump, motor, and equipment baseplates and column baseplates. Epoxy Grout and grout applied as concrete fill in structures or for use in concrete masonry are also covered under this section.

1.2 REFERENCES

A. CRD C 621 – Corps of Engineers Specification for Non-shrink Grout.

B. ASTM C 109 – Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm. cube specimens)

C. ASTM C 230 – Specification for Flow Table for use in Tests of Hydraulic Cement.

D. ASTM C 1107 – Standard Specification for Packaged Dry, Hydraulic Cement Grout (Non-shrink)

1.3 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

B. Quality Control:
   1. The Contractor shall submit manufacturer's literature certifying compliance with the specified properties for Class I and II grouts.
   2. The Contractor shall submit manufacturer's literature containing instruction and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

C. The Contractor shall submit manufacturer's written warranty as specified.

1.4 QUALITY ASSURANCE

A. Field Tests:
   1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.
   2. Compression tests and fabrication of specimens for non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.
   3. Grout already placed which fails to meet the requirements of these Specifications is subject to removal and replacement no additional cost to the Owner.
   4. The cost of laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Engineer in obtaining specimens for testing. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. The Contractor shall supply materials necessary for fabricating the test specimens.

B. Warranty:
   1. Provide one-year warranty for work provided under this Section.
   2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to only the purchase price of products or materials furnished.
   3. Manufacturer shall warrant participation with Contractor in replacing or repairing grout found to be defective due to faulty materials, as determined by industry standard test methods.

PART 2 – MATERIALS

A. Nonshrink Grout. Product and Manufacturer: Provide one of the following:

B. Set Grout, as manufactured by Master Builders, Inc.

C. NBEC Grout, as manufactured by Five Star Products, Inc.

D. NS Grout, as manufactured by the Euclid Chemical Company.

E. Sikagrout 212, as manufactured by Sika Corporation

F. Or approved equal according to Corps. of Engineers Specification CRD-C62l.

G. Epoxy Grout.

Adhesive	Sika "Sikadur Hi-Mod" or "Sikadur Hi-Mod Gel" or approved equal.
Aggregate	Suitable for application as recommended by the epoxy grout manufacturer.

H. Grout for Concrete Fill. Portland Type 1 Cement and Aggregate according to ASTM C-476.

I. Water. Clean and free from all deleterious substances.

2.1 NONSHRINKING GROUT

A. Application - The following is a listing of typical applications and the corresponding type of non-shrink grout which is to be used. Unless indicated otherwise, grouts shall be provided as listed below whether or not called for on the Drawings.

Application:	Type of Grout
Structural member base plates	Non-shrink Class II
Storage tanks and other equipment	Non-shrink Class I
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-shrink Class II (Class I where placement time exceeds 15 minutes)
Under precast concrete elements	Non-shrink Class I
Toppings and concrete fill less than 3 inches thick	Concrete Topping per Section 03310 and Section 03345
Toppings and concrete fill greater than 3 inches thick	Concrete Fill per Section 03310 and Section 03345
Any application not listed above, where grout is called for on the Drawings	Non-shrink Class I, unless noted otherwise

B. Prepackaged Grouts

1. Basic Requirements for Cementitious Non-Shrink Grout
   a. Provide prepackaged non-shrink grout that is inorganic, flowable, non-gas-liberating, non-metallic, and cement-based, requiring only the addition of water.
   b. Deliver grout in original packaging with manufacturer's instructions printed on each container.
   c. Select the specific formulation for each class of non-shrink grout specified to conform to that recommended by the manufacturer for the particular application.
   d. Compressive strength at 28 days: 7000 psi minimum.
   e. Do not use a grout for which the non-shrink property is based on a chemically generated gas or gypsum expansion.
2. Class I Non-Shrink Grout:
   a. Supply Class I Grout conforming to these specifications and to CRD C 621 and ASTM C 1107 Grade C and B (as modified below) when tested using the amount of water needed to achieve the following properties:
      i. Fluid consistency (20 to 30 seconds) per CRD C 611 at initial testing.
      ii. Fluid consistency (45 seconds) per CRD C 611 at 30 minutes after mixing.
      iii. At temperatures of 45, 73.4, and 95 degrees F.
   b. To satisfy non-shrink requirements, the length change from placement to time of final set shall not have a shrinkage greater than the amount of expansion measured after final set at 3 and 14 days. The expansion at 3 and 14 days shall not exceed the 28-day expansion.
   c. Fluid grout shall pass through the flow cone, with a continuous flow, 1 hour after mixing.
   d. Demonstrate in tests that grout maintains contact with the baseplate to provide an minimum effective bearing area of 95 percent of the gross contact area after final set.

e. The grout packaging shall list weight, maximum amount of mixing water to be used, maximum usable working time (pot life) at flowable consistency, and temperature restrictions for preparation and placement within which grout will meet specified requirements.

3. Class II Non-Shrink Grout:
   a. Supply Class II Grout confirming to ASTM C 1107 and the following requirements when tested using the amount of water needed to achieve the following properties:
      i. Flowable consistency: 140 percent flow on ASTM C 230, five drops in 30 seconds.
      ii. Fluid working time: 15 minutes, minimum.
      iii. Flowable duration: 30 minutes, minimum.
   b. When tested, the grout shall not bleed at maximum allowed water.

C. Curing Materials. Curing materials: As specified in Section 03370 - Concrete Curing and as recommended by the manufacturer of prepackaged grouts.

D. Consistency. Mix grouts to the consistency necessary to completely fill the space to be grouted. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

2.2 EPOXY GROUT

A. Epoxy grout shall be provided for all anchor bolts and reinforcing bars installed in hardened concrete.

B. Epoxy resin, 50% hardener and 50% resin by volume, shall be provided in equal parts containers. Contractor shall not exceed manufacturer's recommendation for pot life.

1. Preparation. Where indicated on the drawings, anchor bolts and reinforcing bars shall be epoxy grouted in holes drilled into hardened concrete. Diameters of holes shall be ¼-inch (¼") larger than the maximum dimension of the bolt head, and ½-inch (½") larger than the bar diameter. The embedment depth for epoxy grouted anchor bolts and reinforcing bars shall not be less than 10 bolt or bar diameters unless indicated otherwise on the drawings.

   Holes shall be prepared for grouting as recommended by the grout manufacturer.

2. Installation. Anchor bolts and reinforcing bars shall be clean, dry and free of grease and other foreign matter at time of installation. The bolts and bars shall be set and positioned and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Particular care shall be taken to ensure that all spaces and cavities are filled with epoxy grout, without voids.

2.3 GROUT FOR CONCRETE FILL

A. Grout for concrete fill in structures or for use in concrete masonry should comply with ASTM C-476. Fine or coarse grout may be used depending upon the horizontal dimension of the grout space. Fine grout shall be used when the minimal dimension is two-inches (2") and coarse grout shall be used when the minimal dimension is four-inches (4").

B. Grout Proportions by volume shall be supplied as follows:

(1) Fine Grout: 1 part Portland cement; 2¼ to 3 parts fine aggregate

(2) Coarse Grout: 1 part Portland cement; 2¼ to 3 parts fine aggregate; 1 to 2 parts coarse aggregate

C. All grout should be of fluid consistency; the desired slump is eight-inches (8").

D. Whenever possible, grout should be batched, mixed, and delivered in accordance with ASTM C-94, requirements for transit mixed concrete. When a batch mixer is used on the job site, all materials should be mixed thoroughly for at least five (5) minutes. Grout which has not been placed l½ hours after water is first added should be discarded.

PART 3 – EXECUTION

3.1 PREPARATION

A. Verify that base concrete or masonry has attained design strength before grout is placed.

B. When cementitious grouts are used on concrete surfaces, saturate the concrete surface with water for 24 hours prior to placement of cement-based grout. Upon completion of saturation period remove excess water prior to grouting.

3.2 GROUTING PROCEDURES

A. Prepackaged Grouts: Perform mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts according to the written instructions of the manufacturer. Use prepackaged materials in the quantities and proportions as directed by the manufacturer unless there is certified test data verifying that the specified properties are attained by modified mix.

3.3 CONSOLIDATION

A. Place grout in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

3.4. EDGE FINISHING.

A. The grout shall be finished smooth in all locations where the edge of the grout will be exposed to view after it has reached its initial set. Edges of grout shall be cut flush at the baseplate of structural member or piece of equipment unless drawings indicate otherwise.

END OF SECTION

SECTION 03931
CONCRETE REPAIR AND REHABILITATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Repair of cracks, holes and surface defects, and repair of deteriorated concrete surfaces.

B. Installation of embedded items into existing concrete.

1.2 UNIT PRICES

A. Measurement for repair materials is on a lump-sum basis for each structure as bid. Payment includes work performed on these structures in accordance with related sections included in the Contract Documents.

1.3 REFERENCES

A. ASTM C 109 - Compressive Strength of Hydraulic Cement Mortars.

B. ASTM C 881 - Epoxy-Resin-Base Bonding Systems for Concrete.

C. ASTM C 882 - Bond Strength of Epoxy-Resin Systems Used with Concrete.

1.4 SUBMITTALS

A. Under provisions of Section 01330 -Submittal Procedures, submit manufacturer's product information, installation instructions and recommendations, and certification of compliance with required properties for all repair materials.

1.5 REPAIR SCOPE

A. The Contractor shall provide and install all the plugs, blocks, restraints, pumps and discharge lines required for controlling and diverting all of the water flow into the new and existing structures necessary for the work. The Contractor will use the appropriate action or measures to lower the water flow below the surface to be coated. The Contractor shall comply with all local; state and OSHA confined space entry requirements.

B. Patch, fill holes in and otherwise repair damage to concrete and concrete surfaces resulting from removal of penetrating pipes and other embedded items, from installation of pipes or other items embedded in or passed through concrete, and from other construction activities.

C. Prior to doing any repair work, the Contractor shall remove all solids and grit from the floor from the basins.

D. Crack Repair: Repair the full length of cracks in concrete members in structures as they are encountered.

E. Exposed Piping. The contractor shall near-white blast clean in accordance with Steel Structures Painting Council Surface Preparation Specifications SSPC-SP-10, and apply an epoxy coating to all exposed piping in the lift station wet well only.

F. Deteriorated Concrete:
1. Repair all walls and ceilings as noted on the plans or as necessary to repair concrete damaged in the course of the work.
2. The level of deterioration of the concrete varies within the listed structure. For bidding purposes, average depth of deteriorated concrete walls (existing facilities) and undersides of top slabs is assumed to be 1" inch.

1.6 QUALITY ASSURANCE

A. Field Tests of Cement-based Grouts:
1. Compression test specimens will be prepared during construction by the Engineer, or Engineer's authorized representative, from the first placement of each type of mortar or grout, and at intervals thereafter as determined by the Engineer, to ensure continued compliance with these specifications.
2. Specimen preparation and compression testing for repair mortar and non-shrink grout will be performed as specified in ASTM C 109. A set of three specimens will be made for testing at 7 days, 28 days, and additional testing as appropriate.
3. Material failing to meet Contract requirements is subject to removal, and replacement with new material meeting requirements, at no additional cost to the Owner.
4. Cost of laboratory tests on mortar and grout will be borne by the Owner, except Contractor shall pay for tests failed, and additional testing and investigation work performed because of work not meeting Contract requirements.
5. Contractor shall supply all materials necessary for fabricating test specimens and assist the Engineer in obtaining specimens for testing.

B. Repair concrete shall be tested as required in Section 03300 – Cast-In-Place Concrete.

C. Epoxy grout shall be tested as required in Section 03350 - Grouting.

D. Chemical Grout:
1. Installer: A waterproofing contractor with a minimum of 3 years experience in the installation of chemical grout systems as specified herein, and shall be certified or approved by the manufacturer.
2. Waterproofing contractor shall submit a list of 5 previous jobs successfully completed by that firm that successfully utilized the specified chemical grout system.

E. Construction Tolerances: As specified in Section 03100 - Concrete Formwork, and Section 03300 –Cast-In-Place Concrete, except as otherwise indicated.

1.7 WARRANTY

A. Applicator shall warrant all work against defects in materials and workmanship for a period of one (1) year, unless otherwise noted, from the date of substantial completion of the project. Applicator shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said one (1) year period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to the Owner.

PART 2 – PRODUCTS

2.1 REPAIR MORTAR

A. Repair Mortar: Prepackaged polymer-modified cement-based product specifically formulated for repair of surface defects in concrete, having the following minimum properties:

Physical Property	Value	ASTM Standard
Compressive Strength	(minimum)	C 109
1 day		2000 psi
28 days		6000 psi
Bond Strength	(minimum)	C 882 (modified)
1 day		1200 psi
7 days		2000 psi

B. Manufacturer and Product:
Permacast CR-5000 by Permaform
Aluminaliner by Quadex a Vortex Company
Strong-Seal-MS-2C by The Strong Company
Reliner MSP by Standard Cement Materials
Permacast-MS-10,000 by Permaform
Emaco S88-CA/RE-066 by Master Builders
SikaRepair 224 by Sika Corporation
Pre-Approved Equal

Where the manufacturer offers products in formulations intended for specific application conditions such as overhead and shotcrete application, use the formulation recommended by the manufacturer for the condition required.

C. Minimum Repair Thickness: 1.0 inch.

2.2 NON-SHRINK GROUT

A. Non-shrink Grout: Comply with requirements of Section 03350 - Grouting.

2.3 CONCRETE MATERIALS

A. Cement: Type II Portland cement, unless indicated otherwise. Where repairs are made on wall surfaces exposed to view and above normal water surface elevation, blend white Portland cement with Type II cement as needed to match the color of adjacent existing concrete surface.

B. Repair Concrete: Class A (4000 psi) concrete with one-inch maximum coarse aggregate, complying with Section 03330 – Cast-in-Place Concrete; minimum repair thickness, 2 inches.

C. Cement Grout: Comply with Section 03350 - Grouting; minimum repair thickness, one inch.

D. Curing Materials, Bonding Agents, and Other Miscellaneous Materials: Comply with Section 03300 – Cast-In-Place Concrete.

2.4 AGGREGATE

A. Aggregate for Extending Repair Mortar and Non-shrink Grout Products: 3/8 inch clean, washed gravel or crushed stone complying with Section 03300 – Cast-In-Place Concrete.

2.5 CHEMICAL GROUT

A. Chemical Grout: Hydrophilic urethane or polyurethane material of low viscosity suitable for pumped injection into cracks, which reacts with water to form a closed-cell foam material that completely fills and seals all cracks against leakage. Cured material shall remain elastic and maintain an expansive pressure through repeated wet-dry cycles.

B. Manufacturer and Product: Scotch Seal 5600 by the Adhesives, Coatings, and Sealers Division of 3M Products; Flex LV by De Neef America, Inc.; SikaFix by Sika Corporation; or approved equal. Use different formulations in the same family of materials, accelerators, and other materials necessary for installation where recommended by the manufacturer for specific application conditions.

C. Reacted and cured chemical grout shall be resistant to organic solvents, mild acids, alkali and micro-organisms. Cured material shall be approved for use with potable water by the appropriate federal, state, or local government agency.

2.6 EPOXY PRODUCTS

A. Epoxy Grout: Comply with Section 03350 - Grouting, modified as specified herein.

B. Epoxy for Crack Injection: ASTM C 881, Type IV; low viscosity, moisture-insensitive material specifically formulated for that use; 2500 psi minimum bond strength when tested in accordance with ASTM C 882 at 14 days, moist cured.

2.7 SEALANT

A. Sealant: 2-part polyurethane.

2.8 FORMWORK

A. Formwork, Where Needed: Comply with Section 03100 - Concrete Formwork.

2.9 REINFORCEMENT

A. Reinforcement, Where Required: Comply with Section 03210 - Reinforcing Steel.

2.10 RESILIENT WATERSTOP

A. Resilient Waterstop to be six (6) inches wide with center bulb, ribs, and a minimum web thickness of 3/16”.

PART 3 – EXECUTION

3.1 PREPARATION AND CURING

A. Where repairs are made on wall surfaces exposed to view and above normal water surface elevation, installed repair material shall match adjacent concrete surface in color.

B. Surface Preparation:

1. Clean entire area to be repaired of laitance, foreign material and loose or deteriorated concrete by chipping, hydroblasting or abrasive-blasting; further roughen surfaces as specified herein. Where non-shrink grout or repair mortar is used, perform any additional surface preparation steps recommended by the manufacturer**. Hydroblasting shall be at a minimum pressure of 5,000 psi at 5 gpm**.
2. Where cementitious repair materials are used, maintain surfaces to be repaired in a saturated surface dry condition and prevent concrete from drying until repair operations are completed. Re-wet surfaces to be repaired by water spray on at least a daily basis. Remove standing water in areas to be repaired prior to placement of repair material. Provide means to remove excess water from the structure.
3. Where repair material manufacturer recommends use of an epoxy-bonding agent, follow recommendations of both the repair material and epoxy bonding agent manufacturers.

C. Fully consolidate repair material, completely filling all portions of areas to be filled.

D. Bring repair surfaces into alignment with adjacent existing surfaces to provide uniform, even surfaces. Unless indicated otherwise, repair surfaces shall match adjacent existing surfaces in texture and receive coatings or surface treatments provided for adjacent existing surfaces.

E. Curing:

1. Cure repair mortar and non-shrink grout according to manufacturer's recommendations, except that minimum cure period shall be 3 days.
2. Cure other materials in accordance with Section 03300 – Cast-In-Place Concrete.
3. If manufacturer recommends use of a curing compound, use no material that would interfere with the bond of any coating or adhesive required to be applied to the surface.

3.2 TREATMENT OF SURFACE DEFECTS

A. Definition - Surface Defects: Depressions in concrete surfaces not extending all the way through a member, caused by physical damage, unrepaired rock pockets created during original placement, spalling due to corroded reinforcing steel or other embeds, or removal of embedded items or intersecting concrete members.

B. Preparation:

1. Remove loose, damaged concrete by chipping to sound material.
2. Where existing reinforcing bars are exposed, remove concrete at least one inch deep all around the exposed bars. If the existing bars are cut through, cracked, or cross-sectional area is reduced by more than 25 percent, notify Engineer immediately.

C. Repair Material:

1. Use only repair mortar to repair surface defects in members normally in contact with water or soil, and defects in interior surfaces of structures that are intended to contain water.
2. Repair of other surface defects may be by application of repair mortar, repair concrete or cement grout, as appropriate.

3.3 PATCHING OF HOLES IN CONCRETE

A. General:

1. Definition - Holes: For the purposes of this section, holes are defined as penetrations completely through a concrete member, with interior surfaces approximately perpendicular to the surface of the existing member. Chip interior surface areas which are inclined and do not meet this criterion as necessary to meet this requirement.
2. Perimeter of holes at the surface shall form a regular shape composed of curved or straight-line segments. Provide at least the minimum placement depth specified for the material used at all locations. Score existing concrete by saw cutting and chip as needed to meet this requirement.
3. Roughen the interior surface of holes less than 12 inches in diameter to at least 0.125-inch amplitude. Roughen larger holes to at least 0.25-inch amplitude.
4. At holes not filled with repair mortar or non-shrink grout, and where otherwise recommended by the repair material manufacturer, coat existing surfaces to be repaired with epoxy bonding agent.
5. Where a surface of a member is exposed to view and the repair material cannot be adjusted to match the color of the existing concrete, hold back the repair material 2 inches from the surface. Fill the remaining 2 inches with color-adjusted cement grout. Roughen the surface of the repair material when placed to improve bond with the cement grout.

B. Patching Small Holes:

1. Fill holes less than 12 inches in least dimension and extending completely through concrete members with repair mortar or non-shrink grout.
2. Fill holes in members normally in contact with water or soil with Class I non-shrink grout in accordance with Section 03350 - Grouting.

C. Patching Large Holes:

1. Fill holes larger than 12 inches in least dimension with repair concrete, repair mortar or non-shrink grout.
2. Provide large holes normally in contact with water or soil and not filled with Class I non-shrink grout with resilient waterstop placed in a groove approximately 0.25 inch deep ground into the interior edge of the hole at the center of the wall providing a smooth surface in which to place the resilient waterstop. Alternatively, bond bentonite waterstop to the surface using an epoxy grout that completely fills all voids and irregularities beneath the waterstop material.
3. Provide reinforcing steel in layers matching existing reinforcement locations, except provide concrete cover required by the Contract Documents for the applicable service condition.
4. For holes smaller than 48 inches, reinforcement shall be at least #5 bars on 12 inch centers in each layer required. At all holes larger than 30 inches, drill and grout the reinforcement into the existing concrete.
5. For holes larger than 48 inches, see the drawings for reinforcement details.

3.4 PATCHING OF LINED HOLES

A. These provisions apply to openings which have embedded material over all or a portion of the inside edge. Requirements for repairing holes in concrete specified above shall apply as modified herein. The Engineer will determine when the embedded material is allowed to remain.

B. Where embedded material is allowed to remain, trim it back a minimum of 2 inches from the concrete surface. Roughen or abrade the embedded material to promote good bonding to the repair material. Completely remove any substance that interferes with good bonding.

C. Completely remove embedded items not securely and permanently anchored in the concrete.

D. Completely remove embedded items larger than 12 inches in least dimension unless composed of a metal to which reinforcing steel can be welded. Where reinforcement is required, weld it to the embedded metal.

E. The following additional requirements apply to concrete in contact with water or soil.

1. Fill lined openings less than 4 inches in least dimension with epoxy grout.
2. Coat lined openings greater than 4 inches but less than 12 inches in least dimension with an epoxy-bonding agent prior to filling with Class I non-shrink grout.
3. Coat lined openings greater than 12 inches in least dimension with an epoxy bonding agent and bond bentonite waterstop to the interior of the opening prior to filling with approved repair material.

3.5 GENERAL CRACK REPAIR

A. Repair cracks identified by the Engineer as caused by shrinkage or thermal movement by injection with chemical grout as specified herein.

B. Repair cracks not caused by shrinkage or thermal movement by epoxy injection or as otherwise directed by the Engineer.

3.6 CHEMICAL GROUT CRACK REPAIR

A. Inject chemical grout into all cracks as directed by the Engineer in those structures included in the scope of work listed herein in accordance with the chemical grout manufacturer's installation instructions and recommendations.

B. Location of Injection Ports: Locate injection ports as recommended by the chemical grout manufacturer and as needed to insure complete penetration of the joint or crack with the grout. Spacing of injection ports shall not exceed 2 feet.

C. Drilling Ports: Drill holes for injection ports to the depth needed for proper distribution of the chemical grout. Take care to not damage any reinforcing steel.

D. Port preparation: Clean holes for injection ports of all debris and fit with an injection fitting as provided by the manufacturer of the chemical grout, or approved equal. Install injection fittings in accordance with manufacturer’s instructions; allow fittings to remain in place until chemical grout injection work is complete in that area. Install caps or valves at injection ports to prevent back flow of uncured chemical grout after it has been injected.

E. Chemical Grout Injection:
1. Follow instructions and recommendations of the chemical grout manufacturer and its representatives for chemical grout mixing and injection procedures.
2. Seal cracks at the surface where needed to assure complete penetration of injected chemical grout and prevent loss of material.
3. Prior to chemical grout injection, inject water into ports to provide water for the reaction process, flush out foreign matter and verify continuity between adjacent ports. Inject water into each port until it begins to flow from an adjacent or nearby port.
4. If the water injection procedure indicates the potential presence of voids within members or behind members resting against soil, notify the Engineer immediately.
5. Beginning at the lowest injection port, inject chemical grout until the grout begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled. In general, port-to-port travel of the injection process will be from low to high in a continuous operation.
6. If port-to-port continuity does not occur at locations where continuity was verified through water injection, mark location and notify the Engineer.
7. Avoid sudden application of high pressure during the injection process.
8. After completion of the grouting operation, remove all ports and surface sealing materials leaving an undamaged surface.

3.7 EPOXY CRACK REPAIR

A. Inject epoxy into all cracks in damaged concrete as indicated by the Engineer in structures included in the scope of work listed herein. Follow installation instructions and recommendations of the epoxy manufacturer.

B. Inject cracks with sufficient pressure to ensure full penetration of epoxy but without causing further damage.

C. Location, drilling and preparation of ports for injection: As specified for chemical grout herein.

D. Epoxy Injection:
1. Follow instructions of the epoxy manufacturer and its representatives for all mixing and injection procedures.
2. Seal all cracks at the surface where needed to provide for complete penetration of the injected epoxy and to prevent loss of material.
3. Beginning at the lowest injection port, inject the epoxy until it begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled.
4. If port-to-port continuity does not occur, mark the location and notify Engineer.
5. Avoid sudden application of high pressure during the injection process.
6. After completion of injection operations, remove all ports and surface sealing materials to leave an undamaged surface.

3.8 REPAIR OF DETERIORATED CONCRETE

A. These provisions pertain to concrete damaged by abrasion, chemical attack or corrosion of reinforcing steel. The only material acceptable for surface repair is repair mortar as specified herein. Where the repaired surface is to be subsequently covered with a PVC liner or other protective material, coordinate finishing details with the liner material manufacturer.

B. Surface Preparation:

1. Remove loose, broken, softened and acid-contaminated concrete to sound, uncontaminated concrete.
2. Notify the Engineer when removal of deteriorated concrete is complete. Schedule three (3) working days for the Engineer to inspect the surface, perform testing for acid contamination, determine if additional concrete must be removed, and to develop any special repair details that may be needed. The pH of the concrete will be measured using pH-indicating papers. PH testing shall be performed once every 50 square feet. Acceptable pH values shall be between 9.0 and 11.0 as measured by a full range (1-12) color indicating pH paper with readable color calibrations and a scale at whole numbers. Use Hydrion Insta-Check Jumbo 0-13 or 0-12 or approved equal. The paper shall be touched to the surface once using moderate gloved finger pressure. The surface shall not be wiped or moved laterally to disturb the surface during pH testing. Following the one touch, lift the paper vertically to not “wipe” the surface. Compare the color indicated with the scale provided and record the pH. Should it be determined that additional concrete must be removed to reach sound, uncontaminated material, schedule another three (3) working days for further evaluation after completion of the additional removal.
3. Follow repair mortar manufacturer's instructions for additional surface preparation.

C. Repair Mortar Placement:

1. Follow manufacturer's recommendations for mixing and placement of repair mortar. After the initial mixing of the repair mortar, do not add additional water to change the consistency should the mix begin to stiffen.
2. Place repair mortar on the walls and ceiling to the minimum thickness recommended by manufacturer but not less than 1 inch. Place repair mortar on all surfaces of the exposed structural steel to the minimum thickness recommended by manufacturer but not less than 1 inch. Should there be areas where less than the minimum repair mortar depth of concrete is removed, Contractor may remove additional concrete to attain the minimum repair mortar thickness or may place repair mortar so as to increase the original thickness of the member. In any case, add repair mortar so that minimum cover over existing reinforcing steel is 2 inches. Do not place repair mortar so as to create locally raised areas. Where there is a transition with wall surfaces that are not in need of repair, do not feather the repair mortar at the transition. Saw cut a score line to not less than the minimum repair mortar depth and chip concrete out to it to form the transition. Take care not to cut or otherwise damage reinforcing steel.
3. Finish repair mortar in an even, uniform plane to restore the member to its original surface. Out-of-plane tolerance: No localized depressions or projections; 0.25-inch maximum gap between repair mortar surface and a 10-foot straight edge in any orientation at any location.
4. All active water leaks will be stopped during application. Leaks that are detected after the lining has been installed will be chipped back, plugged, lined with mortar and coated immediately with the epoxy coating. Apply a wet film thickness of 100 mils, DFT. Allow any areas that have been repaired to cure for 24 hours.

D. Finishing:

1. Apply a smooth magnesium float finish to repair mortar.
2. When completed: No sharp edges. Exterior corners, such as at penetrations: One-inch radius. Interior corners: Square, except 2-inch repair mortar fillet at corners to receive PVC lining.

3.9 PROTECTIVE COATINGS

A. Application of protective coating to concrete:

1. Products. Apply an epoxy coating to the interior walls and ceiling. The coating system shall be manufactured by Raven (405), lll (Epoxy Top Coat), VersaFlex (PCS-320), Tnemec (Perma Glaze 435), Madewell (1103), or Carboline (Plasite 4500S) and be compatible and approved for use as a system with the selected repair mortar.
2. Weather. Do not conduct coating work under unfavorable weather conditions, unless work is well protected and specific approval is obtained from the Engineer. Do not paint when the ambient temperature is below 50°F (unless additional drying time as recommended by the paint manufacturer is allowed), when the surface temperature is within 5°F of the dew point, or when humidity is above that recommended by the coating manufacturer.
3. Submittals: Before purchasing any coating materials, submit to the Engineer a submittal indicating the coating systems to be used. The submittal should indicate planned surface preparation and application rates and include a color chart upon which the Engineer will verify the color selections. The submittal shall also contain copies of the manufacturer's product data sheets for each product used. Before beginning the actual work, provide the Engineer with a certificate from the paint supplier stating that sufficient paint has been purchased to provide the coatings specified in this section. Also, the certificate shall list the quantities and types of paint purchased.
4. Qualifications:
    a. Provide manufacturer documentation that the proposed rehabilitation process (cementitious liner, application process & protective coatings) has a minimum five-year history for rehabilitation of sanitary sewer manholes on projects of similar size and scope.
    b. Submit certification that the equipment to be used for applying the products has been manufactured or approved by the product manufacturer and the applicator personnel have been trained and certified for the proper use of the equipment.
    c. All Protective coatings must be applied by a manufacturer Certified Applicator, with a minimum of two (2) years application experience with all products submitted, and in accordance with the manufacturer’s recommendations and specifications. Provide documentation of manufacturer certification for handling, mixing and application of the products used along. Submit references for previous work experience.
    d. For consideration as an equal product, submitted product must meet all minimum physical properties of the approved products. An independent third party testing laboratory must perform all testing results submitted for consideration. All equal products must be submitted to the Engineer for approval in writing prior to construction and must be installed by a manufacturer certified applicator.

B. Delivery and Storage. Have all paint delivered to the job site in original unopened containers. Contact Engineer for inspection before beginning painting operations. Store materials in an approved location. Keep the storage area clean and repair any damage done. Remove oily rags, waste, or other fire hazards from buildings each night. Take adequate precautions to avoid damage by fire. Place cloths and cotton waste, which might constitute a fire hazard in metal containers or destroy at the end of each workday

C. Application. Procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment. Apply coating to produce an even film of uniform thickness giving special attention to edges, corners, crevices and joints.

1. Installation of epoxy coating shall not begin until concrete substrate or any cementitious coating has properly cured in accordance with manufacturer recommendations. All concrete surfaces must have been prepared in accordance with Section 3.1 PREPARATION AND CURING. Steel or DI surfaces shall be to "commercial" standards in accordance with Steel Structures Painting Council Surface Preparation Specifications SSPC-SP 6 prior to coating.
2. All surfaces shall be approved by the FPR prior to any coating application. The standard of cleanliness for the surface preparation shall be evaluated with the use of SSPC Pictorial Surface Preparation Standards, SSPC-Vis.-1 and "Swedish Standards."
3. The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.
4. Comply with manufacturers printed recommendations for thinning, mixing, handling and application of products used. Keep coating materials thoroughly stirred, strained and of uniform consistency during application.

D. Thickness. Specified surfaces shall be coated by spray application of moisture tolerant, solvent-free, 100% solids, epoxy protective coating as further described herein. Spray application shall be to the following average wet film thicknesses:

Concrete, New/Smooth: 100 mils average thickness with a 80 mils minimum thickness

Concrete, Rough: 125 mils average thickness, with a 100 mils minimum thickness.

E. Curing. Comply with recommendations of the paint manufacturer in regard to drying time for each coat, technique of spray application, ventilation, paint thinning, and safety precautions. The Contractor must fully inform all members of his field crew of these recommendations and allow complete curing before placing the coating system into service.

F. Testing and Inspection

1. Surface preparations, coating applications and repairs are subject to inspection by the Engineer.
2. Give sufficient notice in advance (minimum 24 hours) of coating applications so that the Engineer can perform the following inspections:
   a. Examination and approval of surface preparation prior to any coating.
   b. Examination and approval of each coat prior to application of the next coat.
   c. Inspection of the completed coating for runs, overspray, roughness, and any evidence of improper application.
   d. Direction or observation of testing.
3. Any re-inspection cost will be charged to the Contractor at Sixty Dollars ($60.00) per hour including travel time.
4. During application a wet film thickness gage meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating and uniform thickness during application.

5. After the protective coating has set hard to the touch it shall be inspected with high-voltage holiday detection equipment. Surfaces shall first be dried, an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations.
6. Measurement of bond strength of the protective coating may be required by the Engineer if areas are suspect of having poor adhesion. Bond strength will be measured in accordance with ASTM D4541. Any areas detected to have inadequate bond strength shall be evaluated by the Project Engineer. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Applicator in strict accordance with manufacturer's recommendations.
7. A final visual coating inspection shall be made by the Inspector and manufacturer's representative. Any deficiencies in the finished coating shall be marked and repaired according to the procedures set forth herein by Applicator.

J. Return to Service. The lift station may be put back into non-severe operational service as soon as the final coating Inspection has taken place. However, for severe corrosion duty such as high concentrations of acids, bases or solvents, 3 to 7 days and/or force cure by heat induction to the coated surfaces may be necessary prior to returning to service. Consult coating manufacturer for further details.

END OF SECTION

SECTION 04200
UNIT MASONRY SYSTEM

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for the installation of concrete block buildings. Refer to the construction drawings for specific dimensions of the buildings. The buildings shall be insulated a core fill foam type insulation injected into the voids of the CMU bricks from the top down prior to installing the roof panels. Drilling and injecting from the side will not be acceptable.

B. The interior side of all CMU brick shall have the sealant coating and block filler applied as described in this specification.

1.2 RELATED WORK

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work or materials performed under this section.

1.4 REFERENCE STANDARDS

A. The latest editions of all standard specifications listed below form a part of this specification and are applicable to this project.

1. ANSI/ASTM A82 - Cold-Drawn Steel Wire for Concrete Reinforcement.
2. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
4. ASTM C62 - Building Brick (Solid Masonry Units Made From Clay or Shale).
5. ASTM C90 - Hollow Load Bearing Concrete Masonry Units.
6. ANSI/ASTM C216 - Facing Brick (Solid Masonry Units Made From Clay or Shale).
7. ANSI/ASTM C270 – Mortar for Unit Masonry
8. ANSI/ASTM C476 – Grout for Masonry
9. ANSI/ASTM C1142 – Ready-Mixed Mortar for Unit Masonry
10. UL - Underwriters' Laboratories.

1.4 SUBMITTALS

A. Submit product data as specified in the section on Shop Drawings, Product Data and Samples, Division 1, General Requirements.

B. Submit product data for concrete masonry units, insulation, acoustical spray, and fabricated wire reinforcement.

C. Submit samples as specified in the section on Shop Drawings, Product Data and Samples, Division 1, General Requirements.

D. Submit four samples of concrete masonry units to illustrate color, texture and extremes of color range.

E. Submit manufacturer's certificate as specified in the section on Shop Drawings, Product Data and Samples, Division 1, General Requirements.

F. Control that products meet or exceed specified requirements.

G. Submit manufacturer's installation instructions as specified in the section on Shop Drawings, Product Data and Samples, Division 1, General Requirements.

1.5 QUALIFICATIONS

A. Installer: Contractor specializing in performing the work of this section with a minimum of five (5) years experience.

1.6 MOCK-UP

A. Erect concrete masonry units to 3-foot by 4-foot (3’ x 4’) panel size, include specified mortar and accessories.

B. When accepted, mock-up will demonstrate minimum standard for the work. Mock-up may remain as part of the work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products as per manufacturer's recommendations.

B. Accept units on site. Inspect for damage.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain materials and surrounding air temperature to minimum 50°F (10°C) prior to, during, and forty-eight (48) hours after completion of masonry work.

PART 2 – PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Provide split-faced masonry units. Hollow Load Bearing Block Units: ASTM C90, Type 1, Grade S. Weight classification shall be lightweight. Minimum average net area compressive strength of block shall be 2,800 psi. Minimum compressive strength of block wall construction shall be 2,000 psi. Units shall be moisture controlled with integral water repellant admixture, "Dry-Block System" by W.R. Grace & Co. or approved equal, in exterior applications. Use quantity of admixture recommended by manufacturer.

B. Finish for unscored split-faced units and scored smooth face units shall be integral color. **Color shall be selected by the Owner.**

C. Provide units of size complying with ASTM C90. Provide special shapes where indicated and for lintels, corners, jambs, sash, control joints, bonding, and other special conditions.

2.2 MORTAR AND GROUT

A. Mortar

1. Mortar shall be Type S as indicated on the drawings. Proportion mortar as indicated on drawings. Mortar shall be in compliance with latest editions of ASTM C 270 and ASTM C 1142. All mortar shall incorporate an integral water repellant admixture, "Dry-Block System" by W.R. Grace & Co. or approved equal, in exterior applications. Use quantity of admixture recommended by manufacturer.
2. Mortar shall include natural and synthetic iron oxide and chromium oxide pigments, "Centurion Pigments" by Centurion, "True Tone Mortar Colors" by Davis Colors or approved equal. **Color shall be selected by the Owner.**

B. Grout

1. Grout types and proportions are detailed on the drawings. Grout shall be in compliance with latest editon of ASTM C 476. All grout, even grout for block fill and lintels shall have natural and synthetic iron oxide and chromium oxide pigments, "Centurion Pigments" by Centurion, "True Tone Mortar Colors" by Davis Colors or approved equal. Color shall be selected by Engineer.

2.3 COATING SYSTEM

A. Apply coatings for concrete block in accordance with Specification Section 09921-3.5.D.

B. Contractor to comply with recommendations of the paint manufacturer in regard to drying time for each coat, technique of spray application, ventilation, paint thinning, and safety precautions. The Contractor must fully inform all members of his field crew of these recommendations. Contractor shall provide a submittal for Engineer's review and approval for the coating system used on the interior and exterior of the proposed building.

2.4 WATERPROOF SEALER

A. Provide a field applied clear, penetrating waterproof sealer. Waterproofing sealer shall provide additional protection above that provided by the integral water repellant admixture in the masonry units. Waterproof sealer shall in no way be used as a replacement to the integral water repellant admixture.

B. Coating Systems - <u>Waterproof Block Sealer – CMU Building.</u>

1.	Surface Preparation	Steam clean or use cleaning solution to clean soiled surfaces. Use non-metallic tools for cleaning operation. Remove sharp projections and spurs.
2.	Finish Coat Field Applied Penetrating Waterproof Sealer Color: Clear	Sonneborn 20-40 White Roc 10 Waterproof Sealer Tnemec Prime-A-Pell 200 Series 660 Sealer PPG/Porter 251 Engineer Approved Equal

2.5 REINFORCEMENT AND ANCHORAGE

A. See drawings.

2.6 FLASHINGS

A. See Section 07620 Flashing and Sheet Metal.

2.7 INSULATION

A. Buildings shall be insulated a core fill foam type insulation injected into the voids of the CMU bricks from the top down prior to installing the roof. **Drilling and injecting from the side will not be acceptable.** Contractor shall use Core Fill 500 as manufactured by Tailored Chemical Products, Inc., or approved equal. Insulation foam fill shall comply with the following items:
   1. Fire Safety - ASTM E-84
   2. Fire Wall Rating – ASTM E-119 (minimum 2 hours)
   3. Corrosiveness – DOE (e)(3); HUD 6.2.8 (loss of mass not to exceed 0.2g)
   4. Density - DOE (c)(4); HUD 6.1.4 (0.7 to 0.9 lb/cu. Ft dry, 2.5 to 5.5 lb/cu. Ft. wet)
   5. Water Absorption - DOE (c)(8); HUD 6.2.2 (Not to exceed 15%, no absorption in 1 hour)
   6. Shrinkage - DOE (e)(11); HUD 6.2.5 (Not to exceed 4%)
   7. Thermal Value – R value not greater than 4.9/inch for foam and not greater than 14.2/inch with 8” CMU block at 60 lbs density.

B. K-13 spray-on acoustical insulation shall be applied to all walls and ceiling of MCC Room, Blower Room, and Belt Press Electrical Room.
   1. Apply mils of coating to walls and ceiling.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Verify items provided by other Sections of work are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

D. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Lay concrete masonry units in running bond. Course one unit and one mortar joint to equal eight-inches (8"). Form concave mortar joints.

3.4 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.

B. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.

C. Remove excess mortar as work progresses.

D. Interlock intersections and external corners.

E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.5 WEEPS AND VENTS

A. Provide weep holes in veneer at sixteen-inches (16") on center horizontally above through-wall flashing and at bottom of walls.

3.6 CAVITY WALL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep holes.

B. Build inner wythe ahead of outer wythe to receive redundant cavity insulation air/vapor barrier adhesive.

3.7 REINFORCEMENT AND ANCHORAGES - CAVITY WALL MASONRY

A. Install horizontal joint reinforcement sixteen-inches (16") on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum sixteen-inches (16") each side of opening.

C. Place joint reinforcement continuous in first and second joint below top of walls.

D. Lap joint reinforcement ends a minimum of six-inches (6"). Extend a minimum of sixteen-inches (16") each side of openings.

E. Place and consolidate grout fill without displacing reinforcing.

3.8 MASONRY FLASHINGS

A. Extend flashings through veneer, turn up a minimum of eight-inches (8") and bed into mortar joint of masonry.

B. Lap end joints a minimum of six-inches (6") and seal watertight.

C. Use flashing manufacturer's recommended adhesive and sealer.

3.9 LINTELS

A. Install loose steel lintels over openings.

B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.

C. Reinforce all openings as detailed on drawings.

D. Use single piece reinforcing bars only.

E. Support and secure reinforcing bars from displacement. Maintain position within ½-inch (½") of dimensioned position.

F. Place and consolidate grout fill without displacing reinforcing.

G. Allow masonry lintels to attain specified strength before removing temporary supports.

H. Maintain a minimum of eight-inches (8") bearing on each side of opening.

3.10 GROUTED COMPONENTS

A. Reinforce bond beam as detailed.

B. Reinforce jambs as detailed.

C. Lap splices a minimum of twenty-four (24) bar diameters.

D. Lap splice truss reinforcing a minimum of eight-inches (8") and tie with galvanized wire.

E. Support and secure reinforcing bars from displacement. Maintain position within ½-inch (½") of dimensioned position.

F. Place and consolidate grout fill without displacing reinforcing.

G. At bearing locations, fill masonry cores with grout for a minimum of twelve-inches (12") either side of opening.

3.11 BUILT-IN WORK

A. As work progresses, build in metal door frames, fabricated metal frames, plates and other items furnished by other sections.

B. Build in items plumb and level.

C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.

D. Do not build in organic materials subject to deterioration.

3.12 TOLERANCES

A. Maximum Variation From Unit To Adjacent Unit: $^{1}/_{32}$- inch ($^{1}/_{32}$").

B. Maximum Variation From Plane Of Wall: ¼-inch (¼") in ten-feet (10') and ½-inch (½") in twenty-feet (20') or more.

C. Maximum Variation From Plumb: ¼-inch (¼") per story non-cumulative; ½-inch (½") in two (2) stories or more.

D. Maximum Variation From Level Coursing: ⅛-inch (⅛") in three-feet (3'), ¼-inch (¼") in ten-feet (10'), and ½-inch (½") in thirty-feet (30').

E. Maximum Variation Of Joint Thickness: ⅛-inch (⅛") in three-feet (3').

F. Maximum Variation From Cross Sectional Thickness Of Walls: ¼- inch (¼").

3.13 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval of District Engineer prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.14 CLEANING

A. Clean work as specified in the section on Cleaning and Adjusting, Division 1, General Requirements.

B. Remove excess mortar and mortar smears.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.

E. Use non-metallic tools in cleaning operations.

3.15 PROTECTION OF FINISHED WORK

A. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

PART 4 – MASONRY TESTING AND INSPECTION

A. Specifications in sections of the Conditions of the Contract and applicable sections under Division 1, General Requirements, govern this section.

4.1 GENERAL

A. Tests of the masonry shall be made by an independent testing and inspection laboratory at the expense of the Owner.

B. Not less than one test for each 5,000 sq. ft. of masonry or fraction thereof, for each class of masonry placed will be required, and in any event not less than one (1) test for each day's work of each class of masonry.

C. Specimens shall be made and cured in accordance with latest edition of ASTM C109 and NCMA-TEK 70. Results shall be reported in terms of gross and net area.

D. Samples from which compressive test specimens are molded shall be secured in accordance with latest edition of ASTM C-172.

E. Each test shall consist of not less than three (3) standard prisms, three (3) standard mortar cubes, and three (3) standard grout cubes.
   1. The standard age of test shall be twenty-eight (28) days, but seven (7) day test may be used provided the relation between the seven (7) day and twenty-eight (28) day strengths of the masonry is established by tests for the materials and proportions used.
   2. The prisms shall be tested in accordance with ASTM Specifications C1388-97.

4.2 ENFORCEMENT OF STRENGTH REQUIREMENTS

A. When it appears that strength requirements are not being met, the Owner shall have the right to order changes in mortar mix to produce prism strengths to meet requirements.

B. When prisms fail to conform to strength requirements or when tests of mortar cubes indicate deficiencies in protection and curing, the Owner may require unit masonry tests in accordance with the latest edition of ASTM C140-70.

C. If such tests confirm that strength requirements have not been met, additional testing may be required as directed by Engineer at Contractor's expense.

D. If the above tests indicate the necessity, the defective parts shall be removed and replaced, or shall be reinforced as directed by the Engineer at Contractor's expense, including costs of tests.

E. If such tests indicate that the structure adequately meets specification requirements, the test results of defective cylinders will be waived and the cost of tests will be paid for by the Owner.

4.3 ADDITIONAL REQUIREMENTS

A. Testing lab shall verify proper proportioning of mortar and grout materials before mason begins work and during regular sampling.

B. Testing lab shall report proportioning errors of mortar and grout immediately to Engineer and General Contractor.

C. Masonry tolerances shall be as recommended in the latest edition of NCMA-TEK 132 "Inspector's Guide for Concrete Masonry Construction."

END OF SECTION

SECTION 05501
MISCELLANEOUS METAL

PART 1 – GENERAL

1.1 SCOPE

A. This section in general covers furnishing and installing all metal items except reinforcing steel.

B. The specific items to be furnished and installed under this specification include the following:
1. Railings, pipe sleeves, etc.
2. Frames and covers.
3. Bolts, nuts, washers, and lag screws.
4. Structural shapes and plates.
5. All other metal items not specifically included under other sections of the specifications.

1.2 SHOP DRAWINGS

Submit shop drawings in accordance with Division l, General Requirements.

1.3 PRODUCT HANDLING

A. Avoid bending and other damage to structural steel members and connection material in handling.

B. Store on skids above ground to keep clean and drained.

PART 2 – PRODUCTS

A. Wide flange shapes shall conform to ASTM A-992.

B. All connection plates for canopy shall conform to ASTM A572 Gr. 50.

C. Angles, bars, and channels shall conform to ASTM A36 U.N.O.

D. HSS (Rectangular or Square) shall conform to ASTM A500 GR B (Fy = 46 ksi).

E. Cold formed light gauge shapes shall conform to ASTM A-607 Gr. 50.

F. Cast iron shall conform to ASTM A-48.

G. Cast steel shall conform to ASTM A-27.

H. Steel pipe shall be zinc-coated, welded and seamless, conforming to ASTM A-53, Type "E" or "S," Grade "B," open-hearth or basic-oxygen steel with sulphur content not more than 0.05 percent.

I. Bolts shall conform to ASTM A-307 except that bolts shown on drawings to be "high-strength" shall conform to ASTM A-325.

J. Washers bearing on metal shall be cut steel.

K. Steel chain shall be alloy steel conforming to ASTM A-391.

L. Galvanizing. Except where otherwise specified, hot-dip galvanize all miscellaneous metal after fabrication. Cast iron and items completely embedded in concrete shall not be galvanized. Galvanize in accordance with the following specifications, except that minimum weight of zinc coating shall be two (2) ounces per square foot of area.

ITEM	ASTM Designation
Hardware Bolts, Nuts, etc	A-153
Steel Shapes, Plates and Bars	A-123
Steel Sheets	A-525
Steel Pipe, Welded and Seamless	A-120

Touch-Up Coating:

A. One coat 1.0 to 1.5 mils dry-film thickness, zinc-rich compound.
B. Acceptable products: “Galvanox”, Subox, Inc.

PART 3 – EXECUTION

A. Fabrication and Erection of Structural Steel Components. Methods of installation, tension control, type of wrenches to be used and inspection methods shall conform to AISC S314, “Structural Joints Using ASTM 325 or A490 bolts” or conform to other AISC Specifications for Structural Steel for Buildings.

B. Welding. All welds shall be full seal welds on all sides.. All welds shall be cleaned and passivated, in accordance with ASTM A830 & A967. All stainless steel piping that is marred in the field from pipe wrenches, lifting chains, or contaminated by cut off wheels, etc., shall be field passivated in accordance with ASTM A380 & A967. Passivation treatment shall be Nitric Acid 2 or Citric Acid 3 and a water rinse, or a pre-approved equal treatment. Pipe, fittings, and flange thickness shall be in accordance with the manufacturers certified pressure ratings for the applicable service pressures. The design pressure rating shall be minimum 125 psi for piping within closed or valve sections. Conform to AWS Code for Welding in Building Construction.

C. Installation of Hardware. Conform to requirements specified in the following sections.

END OF SECTION

SECTION 05512
STRUCTURAL STEEL

PART 1 – GENERAL

1.1 SCOPE

A. This section in general covers the furnishing, fabrication and erection of steel for structural use, anchoring and metal items not specifically included under other specification sections.

1.2 SUBMITTALS

A. Submit under provisions of Section 01300 – Submittals

B. Shop Drawings: Indicate profiles, sizes, connections, attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

C. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

D. Submit manufacturer's technical literature and test reports showing certified capacities for concrete anchors.

1.3 QUALIFICATIONS

A. Prepare Shop Drawings under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Texas.

B. Welder's Certificates: Submit under provisions of Section entitled “SUBMITTALS”, certifying welders employed on the Work and verifying AWS qualifications within the previous 12-months.

1.4 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Construction Plans.

1.5 REFERENCE STANDARDS

A. The following reference standards shall be used:
1. AISC Steel Construction Manual
2. ASTM A36- Standard Specification for Carbon Structural Steel
3. ASTM A123- Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. ASTM A307- Standard Specification for Carbon Steel Bolts and Steel, 60000 PSI Tensile Strength
5. ASTM A992 - Standard Specification for Structural Steel Shapes
6. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
7. ASTM A325 — Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength
8. AWS A5.1- Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding. AWS D1.1- Structural Welding Code Steel.

1.6 RELATED SECTIONS

A. All sections of the contract and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General:
1. All structural steel plates, pipe support framing, and bearing plates shall conform to ASTM Standard A36 unless otherwise shown on the plans.
2. Structural steel for curb angles, channels, sheet metal, stairs and miscellaneous items shall conform to ASTM Standard A36 unless otherwise shown on the plans.
3. All structural steel W shapes shall conform to ASTM Standard A992 unless otherwise shown on the plans.
4. Structural steel tubing shall conform to ASTM Standard A500 unless otherwise shown on the plans.
5. Unless otherwise noted on the drawings, all steel not completely embedded shall be hot-dip galvanized after fabrication.

B. Standard Bolts and Nuts:
1. Unless otherwise specified, noted on the drawings, or required, bolts and nuts shall conform to the requirements of ASTM Standard A325, with heavy hex head, hex nuts, and standard washers.

C. Anchor Bolts:
1. Anchor bolts shall be stainless steel, round bar stock, complete with American Standard threads, hex nuts, and washer unless otherwise noted.

D. Pipe Supports:
1. The pipe supports shall be fabricated from steel conforming to ASTM Standard A36, latest edition.

2.2 FABRICATION

A. Fit and shop assemble in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface.

2.3 FINISHES

A. Do not prime surfaces in direct contact with concrete or where field welding is required.

B. Galvanize, after completion of welded fabrication, in accordance with ASTM A123. Provide minimum 1.25 oz/sq. ft. galvanized coating.

PART 3 – EXECUTION

3.1 FABRICATION AND ERECTION

A. General:
1. All welding to be performed in the field shall be by welders having current weld certifications in accordance with AWS for that type/class of weld.
2. All shop fabrication, field fabrication and erection shall be in accordance with the latest edition of the AISC Manual and Specifications for fabrication and erection of buildings. All fabrication shall be welded construction, unless otherwise shown or approved by the Engineer.
3. Verify that field conditions are acceptable and are ready to receive work.

B. Welding:
1. Welding electrodes and welding procedures shall conform to the latest requirements of the AWS A5.1 and D1.1.
2. Clean and strip steel items bare metal where site welding is required.

3.2 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated on shop drawings.

D. Perform field welding in accordance with AWS D1. 1.

E. Obtain Engineer approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed except surfaces to be in contact with concrete.

3.3 ERECTION TOLERANCES

A. Maximum Variation from Plumb: L/500 (L is Column Height)

B. Maximum Offset from true Alignment: 1/4-inch.

END OF SECTION

SECTION 05555
ACCESS HATCHES AND SAFETY GRATES

PART 1 – GENERAL

1.1 SCOPE

A. Contract shall provide all labor, materials and equipment as shown to furnish and install all access hatches, safety grates, and accessories.

1.2 RELATED SECTIONS

A. All Sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Reference Standards:
   1. American National Standards Institute (ANSI)
   2. American Society for Testing and Materials (ASTM)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340. **Hatch submittal shall be part of the pump submittal and shall be coordinated between the pump and hatch vendors to ensure no conflict.**

1.5 QUALITY ASSURANCE

A. Use new materials of high grade, with properties best suited for the application.

1.6 OPERATION AND MAINTENCE DATA

A. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

PART 2 – PRODUCTS

2.1 GENERAL

A. Access Hatches
   1. Access doors shall have an H-20 load rating without utilizing the safety grate.
   2. Fasteners, hinges, and other hardware shall be fabricated with Type 316 stainless steel.
   3. The frame shall be fabricated of extruded aluminum with an integral seat and anchor flange and door leaves of minimum ¼-inch thick aluminum floor plate.
   4. Equip doors with a flush, cast-aluminum drop handle which does not protrude above the cover surface, and provide an automatic hold-open arm with a red vinyl release grip that automatically holds the door in a 90 degree open position utilizing a stainless steel pin at the point where the door meets the hold open arm.

5. Fabricate hinges of stainless steel with stainless steel tamper-proof hardware. Equip doors with a stainless steel locking staple.
6. Apply bituminous paint on all areas that come in contact with concrete.

B. Hatch Safety Grates
1. Provide an OSHA approved rigid hatch safety grate for each access door. Hatch safety grate shall be designed for floor access hatches. The safety grate system shall provide protection during the initial opening of the hatch and maintain protection after access has been gained and shall be within 3" of opening on all sides.
2. The grate shall be tested to withstand a minimum pound force equal to the weight of the proposed pump and shall have a minimum breaking strength of 2,000 pounds. Each grate shall have a permanently attached label with the following information:
   a. Name of manufacturer
   b. Identification of grating material
   c. Date of manufacture
   d. Date of prototype test
   e. Name of testing agency
   f. Serial Number

2.2 ACCEPTABLE MANUFACTURERS

A. Provide access hatches and safety grates of one of the following:
1. Bilco
2. Halliday
3. U.S. Fabricators

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install per the Manufacturer's recommendations for installation.

END OF SECTION

SECTION 07001
PRE-ENGINEERED METAL CANOPY

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provision of all labor, materials, equipment and incidentals to furnish, deliver and install metal building systems that consist of integrated sets of mutually dependent components, including structural framing, roof panels and accessories, for complete structures.

B. This Section does not necessarily include all required equipment, submittal information, certifications, performance requirements, equipment requirements, testing, or services. The Manufacturer shall provide all materials and services necessary to fulfill the intent of this Section and of the Contract.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Reference Standards:
1. American Institute of Steel Construction (AISC)
2. American Iron and Steel Institute (AISI)
3. American Society of Civil Engineers (ASCE)
4. American National Standards Institute (ANSI)
5. American Welding Society (AWS)
6. ASTM International (ASTM)
7. International Building Code (IBC)
8. International Organization for Standardization (ISO)
9. Metal Building Manufacturer's Association (MBMA)
10. National Fire Protection Association (NFPA)
11. Occupational Safety and Health Administration (OSHA)
12. Research Council on Structural Connections (RCSC)
13. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
14. Underwriters Laboratories (UL)

1.4 SUBMITTALS

A. Submit shop drawings, product data, samples, and descriptive literature as specified in Sections 01300 and 01340. Include the following, arranged to facilitate submittal review.
1. Scope of supply including part numbers, quantity, location and manufacturer listed in table format.
2. Construction materials.
3. Product Data: For each type of metal building system component indicated.
4. Dimensioned arrangement and erection drawings showing all plans, elevations, sections, details, and attachments to other work. **Provide building drawings and calculations signed and sealed by a professional engineer licensed in the state of Texas.**

a. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
b. Anchor-Bolt Plans: Submit anchor-bolt plans before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.
c. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provision for openings. Indicate welds and bolted connections, distinguishing between shop and field application. Include transverse cross-sections.
d. Metal Roof Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashing, closures, and special details. Distinguish between factory and field assembled work; show locations of exposed fasteners.
e. Side Panel Layout Drawings: Show layouts of side panels, including methods of support. Include details of edge conditions, joints, panel, trim, flashing, closure, and special details. Distinguish between factory and field assembled work; show locations of exposed fasteners.

5. Samples: For each type of building component and for each color and texture required.

B. The Manufacturer shall provide the following certifications.
1. The Manufacturer has examined the Contract Documents and agrees to the performance requirements, material specifications, warranty conditions, and other requirements of the Contract.
2. Letter of Design Certification: Signed and Sealed by a qualified professional engineer. Include the following:
a. Name and location of project.
b. Order number.
c. Name of manufacturer.
d. Name of contractor.
e. Building dimensions including width, length, height, and roof slope.
f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
g. Governing building code and year of edition.
h. Design loads and load combinations.
i. Building-use category.
j. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in a AISC-Certified Facility by an AISC-Certified Manufacturer.
3. Welding certificates from manufacturer.
4. Erector Certificate: Signed by manufacturer certifying that erector complies with requirements.
5. Manufacturers certificate.
6. Certify their accuracy.

C. Submit operating and maintenance (O&M) data under provisions of the Contract. Prepare O&M manuals specifically for this installation. Include all cut sheets, drawings, equipment lists, descriptions, and materials necessary to instruct the Owner's personnel.

D. Submit record drawings under provisions of the Contract.

E. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. The equipment shall be designed, constructed and installed in accordance with the Manufacturer's best practices and methods. Use only new, high-grade materials of the latest and most modern design with properties best suited to the herein specified performance requirements and installation environment.

C. Manufacturer and Contractor shall coordinate all dimensions to ensure adequate clearances for equipment maintenance, or removal, or replacement.

D. Erector Qualifications: An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this project and who is acceptable to manufacturer.

E. Manufacturers Qualifications: A qualified manufacturer.
   1. AISC certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in a AISC-Certified Facility.
   2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualifies professional engineer.

F. Welding: Qualify procedures and personnel according to AWS D1.1, "structural Welding Code – Steel," and AWS D1.3, "Structural Welding Code – Sheet Steel."

G. Structural Steel: Comply with AICS's "Specification for Structural Steel Buildings – Allowable Stress Design, Plastic Design," or AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings," for design requirements and allowable stresses.

H. Cold-Formed Steel: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members," or AISI's "Load and Resistance Factor Design Specification for Steel Structural Members," for resign requirements and allowable stresses.

I. Pre-Erection Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal building systems including, but not limited to, the following:
   1. Inspect and discuss condition of foundations and other preparatory work performed by other trades.
   2. Review structural load limitations.
   3. Review required testing, inspecting, and certifying procedures.

J. The requirements of this Section shall be considered the minimum limits of acceptability.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Take proper measures to prevent rust and corrosion.

C. Accept units on site. Inspect for damage upon delivery.

D. Stack metal panels horizontally on platforms or pallets in a secure location where it is protected from the public, covered with suitable weather tight and ventilated covering. Store metal panels to ensure dryness and with positive slope for drainage of water. Do not metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.7 PROJECT CONDITIONS

A. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footing. Concrete, reinforcement, and formwork requirements are specified in Section 03300 “Cast-in-Place Concrete.”

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide pre-engineered metal canopy buildings systems designed for the proposed applications and that are compatible with the structural foundations shown and specified in the contract documents.

B. The Structure shall have integrally colored aluminum siding at the locations specified.

C. The building shall have a free span clearance with column locations as shown in the drawings. Tapered columns or straight columns will be allowed. All members shall have a hot dipped galvanized finish with integrally colored aluminum panels. Each design shall include columns only where located on construction drawings. No additional columns will be allowed without Engineers approval. All canopies shall be designed to comply with all applicable building and wind codes and be designed under Class 1 criteria of IBC standards. Contractor shall supply drawings and calculations signed and sealed by a professional engineer licensed in the State of Texas for all pre-engineered metal canopies

2.2 PERFORMANCE REQUIREMENTS

A. In each of the following process areas, the pre-engineered metal canopy shall be designed to meet the following performance requirements under the following conditions:

Design Conditions	**Units**	
Location		**Dewatering Building**
Length (Roof)	ft. - in.	50’-0” (North to South)
Width (Roof)	ft. - in.	22’-¾” (East to West)
Length Between End Columns (Center to Center)	ft. - in.	48’-10” (North to South)
Width Between End Columns (Face of Flange to Face of Flange)	ft. - in.	19’-6” (East to West)
Column Spacing Along Length	ft. - in.	24’-5”
Column Spacing Along Width	ft. - in.	19’-6”
Minimum Clear Height Under Canopy	ft. - in.	19’-8”
Roof Slope	-	1:12
Single Slope or Peaked Roof	-	Single Sloped Roof
Roof Slope Direction	-	East to West
Side Walls	-	Metal Panels
Full Height Walls or Partial Height Walls	-	Partial Height
For Partial Height Walls: Distance from Finished Floor	ft.	7’-0”
Allowable Bracing Types	-	Girts; Portal Framing; Tie Rod
Bracing Location Limitations		Girts on West Side Wall; Girts on East Side for flashing only; Portal Framing at Northwest Bay; Tie Rod bracing at Northeast Bay
Loading Bearing	-	No
Load Bearing Type	-	-
Underhung or Top Mounted	-	-
Crane Span	ft.	-
Minimum Hook Height	ft.	-
Gutter Location(s)		West Side (Low Side)
Downspout Location(s)		Southwest Corner of Canopy
Fabricated Openings in Walls		No

B. System Performance Requirements
1. Structural Performance: Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   a. Engineer metal building systems according to procedures in MBMA’s “Metal Building Systems Manual.”
   b. Design Loads: As required by the applicable building code
   c. Design Loads: As required by MBMA’s “Metal Building Systems Manual.”
2. Seismic Performance: Design and engineer metal building systems capable of withstanding the effects of earthquake motions determined according to ASCE 7, “Minimum Design Loads for Building and Other Structures”: Section 9, “Earthquake Loads.”

3. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation of surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
4. Wind-Uplift Resistance: Provide metal roof panel assemblies and side panel assemblies that comply with UL 580 for Class 90 requirements. Building must comply with comply with all applicable building and wind codes, even if they are not listed in the specification.
5. The frame design shall include the loading and positioning (as shown in the drawings), conveyor roof supports and any other miscellaneous supports. Contractor shall verify loadings of equipment with equipment manufacturer.

2.3 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alliance Steel, Inc.
2. Crown Metal Buildings, Inc.
3. Mid-West Steel Building Company
4. NCI Building Systems, LLP
5. Robert S. Henry Company
6. Southern Structures, Inc.
7. United Structures of America, Inc.
8. Whirlwind Steel Buildings, Inc.
9. Pre-Approved Equal

2.4 STRUCTURAL-FRAMING MATERIALS

A. W-Shapes: ASTM A 992/A 992M; ASTM A 572/ A 572M, Grade 50 or 55 or ASTM A 529/A 529M, Grade 50 or 55.

B. Channels, Angles, M-Shapes and S-Shapes: ASTM A 36.A 36M; ASTM A 572/A 572M, Grade 50 or 55 or ASTM A 529/A 529M, Grade 50 or 55.

C. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 or ASTM A 529/A 529M, Grade 50 or 55.

D. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.

F. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70 or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80, or High-Strength Low Alloy Stell (HSLAS), Grades 45 through 70.

G. Metallic-Coated Steel Sheet: ASTM A 652.A 653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80 with G60 coating designation; mill phosphatized.

H. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80 with G90 coaing designation.
   2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 50 or 80 with Class AZ50 coating.

I. Non-High Strength bolts, nuts, and washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
   1. Finish: Plain.

J. High Strength bolts, nuts and washers: ASTM A 325, type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
   1. Finish: Plain

K. High-strength bolts, nuts, and washers: ASTM A 490, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.

L. Primer: SSPC-Paint 15, Type I, red oxide.

M. All structural framing materials shall have a hot dipped galvanized (HDG) finish.

2.5 MATERIALS FOR FIELD-ASSEMBLED METAL PANELS

a. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel Sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 50 or 870 with Class AZ50 coating designation.
   2. Surface: Smooth, flat finish
   3. Exposed Finishes: Apply the following coil coating, as specified or indicated on drawings:
      a. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 or AAMA 2605 and with coating and resin manufacturers' written instruction, except as modified below:
         i. Humidity Resistance: 2000 hours
         ii. Salt-Spray Resistance: 2000 hours
      b. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored backer finish, consisting of prime coat and wash coat with a total minimum dry film thickness of 0.5 mil (0.013 mm).

2.6 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
   1. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.
   2. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with nylon or polypropylene washer.
   3. Fasteners for Metal Roof Panels: Self-drilling Type 410 stainless-steel or self-tapping Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal panels.

2.7 FABRICATION, GENERAL

A. Tolerances: Comply with MBMA's " Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."

B. Metal Panels: Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.8 STRUCTURAL FRAMING

A. General:
   1. Primary Framing: Shop fabricate framing components to indicated size and section with baseplates, bearing, plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
      a. Make shop connections by welding or by using high-strength bolts.
      b. Join flanges to webs of built-up members by a continuous submerged arc-welding process.
      c. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
      d. Finish: All members shall have a HDG finish.
   2. Secondary Framing: Shop fabricated framing components to indicated size and section by roll-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill and weld secondary framing for bolted field connections to primary framing.
      a. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP2.
      b. Forged Finish: All members shall have a HDG finish.

B. Primary Framing: Manufacturer's standard structural primary framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing. Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
   1. Rigid Clear-Span Frames: I-shaped or tapered beam frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
   2. Rigid Modular Frames: I-shaped or tapered beam frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipe or tube, or shop-welded, built-up steel plates.
   3. Frame Configuration: Multiple gable.

4. Exterior Column Type: Tapered.
5. Rafter Type: Tapered.

C. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assemble to comply with the following:
1. End-Wall and Corner Columns: I-shaped or tapered beam sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 00598 inch (1.5 mm).
2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 inch (1.5 mm); or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.

D. Secondary Framing: Manufacturer's standard secondary framing members, including purlins, grits, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet prepainted with coil coating, unless otherwise indicated, to comply with the following:
1. Purlins: C- or Z-shaped sections; fabricated from minimum 0.0598-inch- (1.5-mm-) thick steel sheet, built-up steel plates, or structural-steel shapes; minimum 2-1/2-inch-(64-mm-) wide flanges.
   a. Depth: As required to comply with system performance requirements.
2. Eave Struts: Unequal-flange, C-shaped sections; fabricated from 0.0598-inch-(1,5-mm-) thick steel sheet, built-up steel plates, or structural-steel shaped; to provide adequate backup for metal panels.
3. Flange Bracing: Minimum 2-by-2-by-1.16-inch (51-by-51-by-3-mm) cold-formed angles to stiffen primary frame flanges.
4. Sag Bracing: Minimum 1-by-1-by-1/8-inch (25-by-25-25-by-3-mm) structural-steel angles.
5. Purlin and Girt Clips: Minimum 0.0598-inch-(1.5-mm-) thick, steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
6. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from minimum 0.0598-inch-(1.5-mm-) thick, [zinc-coated (galvanized) steel sheet] [structural-steel sheet].
7. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

E. Bracing: Provide adjustable wind bracing as follows:
1. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
2. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

F. Bolts: Provide zinc-plated bolts for structural-framing components that are galvanized.

G. Factory-Primed Finish:
1. Prime galvanized members with specified primer, after phosphoric acid pretreatment. All members shall have a HDG finish.

2.9 METAL ROOF PANELS

A. Vertical-Rib, Standing-Seam Metal Roof Panels; Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels. **Color shall be integral and selected by the Owner.**
1. Material: Galvalume, .0239 inch.

2. Clips: Manufacturer's standard, floating type to accommodate thermal movement; fabricated from zinc-coated (galvanized) steel sheet.
3. Joint Type: Panels snapped together.
4. Joint Type: Mechanically seamed, folded as standard with manufacturer.
5. Panel Coverage: 16 inches (406 mm).
6. Panel Height: 2 inches (51 mm).

2.10 PANELS

A. Wall covering shall be either Galvalome or approved equal. Panel coverage will be 36" to the weather. **Color shall be integral and selected by the Owner.**

B. Panels shall be continuous form 1-½" below the column base to the roofline, except where the required length would exceed 35'-0 in which case the panels would lap at a girt. The panel must not rest on the concrete foundation; the panel must sit $\frac{1}{8}$" above the concrete. All panels shall be square cut at the roofline.

C. Panels shall be secured to intermediate framing members with sheet metal screws at a maximum spacing of 12" on center. Sheet metal stitch screws at a maximum of 42" on center shall be installed at the sidelaps.

D. All walls shall be composed of single panel construction. (Panel on outer edge only)

2.11 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including coping, fasciae, corner unite, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel sheet.
4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-(25-mm-) thick, flexible closure strips,; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weather tight construction.

C. Flashing and Trim: Formed from minimum 0.0159-inch-(0.40-mm-) thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel prepainted with coil coating; finished to match adjacent metal panels.
1. Opening Trim: Minimum 0.0179-inch thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door opening, and head, jamb, and sill of other openings.

D. Gutters: Formed from minimum 0.0179-inch-(0.40-mm-) thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of galbe

trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-(2438-mm-) long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

1. Downspouts: Formed from 0.0179-inch-(0.4-mm-) thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot-(3-m-) long sections, complete with formed elbows and offsets.

E. Downspouts: Formed from 0.0179-inch-(0.4-mm-) thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with soil coating; finished to match metal wall panels. Fabricate in minimum 10-foot-(3-m-) long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters; spaced 10 feet (3 m) o.c.

2.12 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following tests and inspections and to submit reports.

B. Special Inspector: Owner will engage a qualified special inspector to perform the following test and inspections and to submit reports. Special Inspector will verify that manufacturer maintains detailed fabrication and quality-control procedures and will review the completeness and adequacy of those procedures to perform the Work.

1. Special inspections will not be required if fabrication is performed by a manufacturer registered and approved by authorities having jurisdiction to perform such Work without special inspection.
    a. After fabrication, submit certificate of compliance with copy to authorities having jurisdiction certifying that work was performed according to Contract requirements.

C. Tests and Inspections:

1. Bolted Connections: Shop-bolted connections shall by inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
2. Welded Connections: In addition to visual inspection, shop-welded connections shall be tested and inspected according to AWS D1.1.

PART 3 – EXECUTION

3.1 ERECTION

A. Before erection proceeds, survey elevations and locations of concrete-and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with Erector present, for compliance with requirements and metal building system manufacturer's tolerances.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

C. Erect metal building system according to manufacturer's written erection instruction and erection drawings.

D. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

E. Set structural framing accurately in locations and to elevations indicated, and according to AISC specifications referenced in this section. Maintain structural stability of frame during erection.

F. Base and Bearing 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. 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.
   3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

G. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure.

H. Primary Framing and End Walls: Erect framing true to line, level, plumb, rigid, and secure. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist cure grout for not less than seven days after placement.
   1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints using ASTM A 325 or A 490 Bolts" for type of bolt and snug-tightened or pretensioned joints.

I. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips with field connections using non-high-strength bolts.
   1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
   2. Locate and space wall grits to suit openings such as doors and windows.
   3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

J. Bracing: install bracing in roof and sidewalls where indicated on erection drawings.
   1. Tighten rod and cable bracing to avoid sag.
   2. Locate interior end-bay bracing only where indicated.

K. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

L. Erection Tolerances: Maintain erection tolerances of structural framing within AISC's "Code of Standard Practice for Steel Buildings and Bridges".

3.2 METAL PANEL INSTALLATION, GENERAL

A. General: Anchor metal panels and other components of the work securely in place, with provisions for thermal and structural movement.
   1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
   2. Install metal panels perpendicular to structural supports, unless otherwise indicated.

3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
4. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment. Stagger panel splices and end lap to avoid a four-panel lap splice condition.
5. Lap metal flashing over metal panels to allow moisture to run over and off the material.

B. Lap-Seam Metal Panels: Install screw fasteners with power tolls having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or metal panels. Install screws in predrilled holes. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal panel manufacturer.

3.3 METAL ROOF PANEL INSTALLATION

A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Install ridge and hip caps as metal roof panel work proceeds.

B. Field-Assembled, Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
1. Install clips to supports with self-tapping fasteners.
2. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
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. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
5. Provide metal closures at peaks each side of ridge and hip caps.

C. Field-Assembled, Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
2. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels; on side laps of ribbed or fluted metal panels; and elsewhere as needed to make metal panels weatherproof to driving rains.
3. At metal panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

D. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.4 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weather tight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
   2. Install components for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. 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. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection.

C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet (1.2 m) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 50 inches (1500 mm) o.c. in between.
   1. Provide elbows at base of downspouts to direct water away from building.
   2. Tie downspouts to underground drainage system indicated on the construction drawings.

E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owners will engage a qualified testing and inspecting agency to perform the following tests and inspections and to submit reports.

B. Special Inspector: Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports.

C. Tests and Inspections:

   1. High-Strength, Field-Bolted Connections: Connections shall be inspected during installation according to RCSC's "Specification for Structural Joints using ASTM A 325 or A 490 Bolts".
   2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1.

3.6 CLEANING AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
   1. Clean and prepare surfaces by SSPC-SP 2, “Hand Tool Cleaning”, or SSPC-SP 3. “Power Tool Cleaning”.
   2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

3.7 SYSTEM INSTALLATION

A. Construct the canopy structures as shown on the plans and described in these specifications for a complete and working facility.

3.8 ACCESSORIES

A. Building Anchorage and Foundations: The Contractor shall construct the canopy structure foundations as shown on the plans and in accordance with the contract specifications. Prior to construction of the foundation, the Contractor shall submit the foundation shop drawings in conjunction with the metal building shop drawings in order to insure proper coordination between the Contractor and the Building Manufacturer. The overall foundation dimensions shall not vary from those shown on the plans, however the square footing locations may vary according to the requirements of the Building Manufacturer. Any such changes mandated by the Building Manufacturer shall be clearly identified and submitted to the Engineer for approval provided the modifications do not alter the intended function of the building or the equipment contained therein.

END OF SECTION

SECTION 07112
WATERPROOFING

PART 1 – GENERAL

1.1 SCOPE

A. The work includes furnishing all labor and materials for complete waterproofing as indicated on drawings.

PART 2 – PRODUCTS

2.1 WATERPROOFING

A. In masonry cavity wall use "Dehydrative 6" as manufactured by A. C. Horn Company or approved equal.

B. Flashing at doors and windows use "2 ounce Copper Armor Sisalkraft" as manufactured by American Sisalkraft Company, or approved equal.

PART 3 – EXECUTION

3.1 PREPARATION OF SURFACES

A. Masonry cavity wall, clean surface of all dirt, grease, and foreign materials.

3.2 APPLICATION

A. In masonry cavity wall, apply mastic by trowels in a continuous unbroken $^{1}/_{16}$-inch ($^{1}/_{16}$") film free from surface breaks and in accordance with manufacturer's written instructions.

B. Flashing, apply as indicated on drawings and in accordance with written manufacturer's instructions.

END OF SECTION

SECTION 07413
STANDING SEAM METAL ROOFING

PART 1 - GENERAL

1.1 SCOPE

A. This section includes design, furnishing, and installation of a factory-formed, prefinished, standing seam metal roof system, complete with panels, clips, fasteners, sealants, underlayment, insulation, and flashings.

B. The roof system shall provide a weather-tight, thermally responsive, and corrosion-resistant enclosure suitable for a water and wastewater pump station environment.

1.2 RELATED WORK

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Reference Standards:
1. American National Standards Institute (ANSI)
2. American Welding Society (AWS)
3. ASTM International (ASTM)
   i. ASTM A653 – Steel Sheet, Zinc-Coated (Galvanized).
   ii. ASTM A792 – Steel Sheet, 55% Aluminum-Zinc Alloy-Coated (Galvalume)
   iii. ASTM E1646 – Water Penetration by Dynamic Pressure.
   iv. ASTM E1680 – Air Leakage of Metal Roof Systems.
   v. ASTM E1592 – Structural Performance of Metal Roof Panels.
   vi. FM Global 4471 – Approval Standard for Class 1 Roof Panels.
4. National Institute for Occupational Safety and Health (NIOSH)
5. Occupational Safety and Health Act/Administration (OSHA)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples. **Coordinate with submittal of hollow core planks.**

B. Roof Data
1. Scope of supply, including list of materials shipped loose and complete bill of materials for roof area.
2. Certified shop and installation drawings showing all details of construction, dimensions, required clearances, panel layout, seam configuration, joint details, flashing, fastener spacing and roof penetrations.
3. Structural details for anchoring, base frames, enclosures, mounts, or stands, including material properties, classifications, dimensions, and thicknesses.
4. Information for all surface preparation and shop coatings.
5. Certified shop test results for wind uplift capacity and panel seam strength with provided clip spacings.
6. Performance characteristics.

C. The Manufacturer shall provide the following certifications.
   1. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
   2. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel.
   3. Samples: One 12"-long panel section showing standing seam and one color chip of specific finish.

D. Record Drawings: Submit record drawings under Submit record drawings under provisions of Section 01720 - Project Record Documents.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 10 years experience producing standing seam metal roof panels

B. Installer Qualifications: Minimum 5 years experience installing similar metal roofing systems.

C. Single Source Responsibility: Roof panels, accessories, and flashings shall be from one manufacturer to ensure compatibility.

D. Mock-Up: Provide minimum 4 ft × 4 ft mock-up showing panel, seam, and flashing assembly for approval.

1.6 WARRANTY

A. Manufacturer's Weather-Tightness Warranty: Minimum 20 years.

B. Finish Warranty: Minimum 35 years for film integrity, chalk, and fade.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store panels and accessories in a dry, ventilated area, elevated above grade.

B. Protect panels from standing water, condensation, and contact with dissimilar metals.

1.8 PROJECT CONDITIONS

A. Standing seam metal roof shall be installed on precast concrete hollow core planks

B. Field Measurements: Verify roof dimensions and substrate elevations prior to fabrication

C. Environmental Requirements: Do not install roofing in high winds or when ambient temperature is below 40°F unless approved by manufacturer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANAUFACTURERS

A. Provide perforated plate screens of one of the following, no others will be allowed:
1. Berridge Manufacturing Company – SL-24 or Zee-Lock System
2. MBCI – LokSeam or DoubleLok
3. McElroy Metal – Maxima 216 System
4. Englert, Inc. – Series 2500

B. Listing as an approved manufacturer will not relieve the manufacturer from conforming to these specifications.

2.2 MATERIALS

A. Roof Panels. Roof panels shall be factory-formed standing seam panels with concealed clips. The base metal shall be 24-gauge minimum Galvalume steel (ASTM A792 AZ50 Coating). Mechanical seams are preferred. Slope shall be minimum ¼" per linear foot (¼ : 12). The panels shall be suitable for mild industrial or wastewater facility conditions.

B. Dimensions. Panel width shall be 16" (16-inch) nominal with 2" seam height.

C. Color/Finish. Factory-applied PVDF coating (Kynar 500 or Hylar 5000), 70% resin, color as selected by Architect.

D. Underlayment. High-temperature self-adhering ice and water shield, minimum 40 mil thick, rated for use under metal roofing. Acceptable Products: Grace "Ice & Water Shield HT" or approved equal.

E. Fasteners and Clips. Stainless steel concealed clips, sliding type to allow thermal movement. Exposed fasteners shall be stainless steel with neoprene washers.

E. Sealants. Butyl-based tape sealant, non-hardening and non-skinning, compatible with panel finish.

F. Insulation (If Required). Rigid polyisocyanurate boards or fiberglass batts as indicated on drawings.

G. Flashing and Trim. Fabricated of same material, gauge, and finish as roof panels. Provide at ridges, eaves, rakes, hips, and roof penetrations.

H. Gutter and Downspouts. Same finish and base metal as roofing panels. Coordinate locations with architectural drawings.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that roof deck and substructure are properly aligned, clean, and dry.

B. Confirm that all penetrations and openings are properly framed and flashed.

3.2 INSTALLATION

A. Install panels in accordance with manufacturer's published installation manual and approved shop drawings.

B. Begin installation at lowest roof point and work upward; align panels true and straight.

C. Secure panels with concealed clips, allowing for thermal expansion/contraction.

D. Provide continuous air seal and watertight joints at ridges, valleys, and penetrations.

E. Lap panels and accessories to shed water and prevent backflow.

F. Seal end joints, laps, and flashings with continuous butyl sealant.

G. Provide expansion joints where indicated or where roof length exceeds manufacturer's limits.

3.3 FIELD TESTING

A. Inspect seams and fastenings for continuity and tightness.

B. Perform hose test or manufacturer's leak test at selected areas if requested by Architect.

3.4 CLEANING AND PROTECTION

A. Remove all metal filings, debris, and unused materials from roof surface.

B. Clean panels with mild detergent and water; avoid harsh abrasives.

END OF SECTION

SECTION 07620
SHEET METAL, FLASHING AND TRIM

PART 1 – GENERAL

A. The work included in this specification includes all sheet metal, flashing and trim on the proposed CMU buildings. This specification does not apply to pre-engineered metal canopies.

1.1 RELATED DOCUMENTS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.2 SUMMARY

A. This Section includes sheet metal flashing and trim in the following categories:
   1. Roof-drainage systems.
   2. Canopy drainage system.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 07920: "Joint Sealants" for elastomeric sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

B. Fabricate and install flashings at roof edges to comply with recommendations of FM Loss Prevention Data Sheet 1-49 for the following wind zone:
   1. Wind Zone 2: Wind pressures of 31 to 45 psf.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

C. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in service performance.

1.6 PROJECT CONDITIONS

A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each Installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

PART 2 – PRODUCTS

2.1 METALS

A. Galvanized Steel Sheet: ASTM A 526, G 90, commercial quality, or ASTM A 527, G 90, lock-forming quality, hot-dip galvanized steel sheet with 0.20 percent copper, mill phosphatized where indicated for painting; not less than 0.0396 inch thick, unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Solder: ASTM B 32, Grade Sn50, used with rosin flux.

B. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

C. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

D. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."

E. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.

F. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.

G. Roofing Cement: ASTM D 4586, Type I, asbestos free, asphalt based.

2.3 FABRICATION, GENERAL

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

D. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.

E. Expansion Provisions: Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

G. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.
   1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.4 SHEET METAL FABRICATIONS

A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.

B. Gutters with Girth up to 15 Inches: Fabricate from the following material:
   1. Galvanized Steel: 0.0217 inch thick.

C. Downspouts: Fabricate from the following material:
   1. Galvanized Steel: 0.0217 inch thick.
   2. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch thick.
   3. Coil-Coated Galvanized Steel: 0.0276 inch thick.

D. Exposed Trim, Gravel Stops, and Fasciae: Fabricate from the following material:
   1. Galvanized Steel: 0.0276 inch thick.

E. Drip Edges: Fabricate from the following material:
   1. Galvanized Steel: 0.0217 inch thick.

F. Roof-Penetration Flashing: Fabricate from the following material:
   1. Galvanized Steel: 0.0276 inch thick.

2.5 ALUMINUM EXTRUSION FABRICATIONS

A. Aluminum Extrusion Units: Fabricate extruded-aluminum running units with formed or extruded-aluminum joint covers for installation behind main members where possible. Fabricate mitered and welded corner units.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal 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 weatherproof.

B. Install exposed sheet metal Work that is without excessive oil canning, 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 to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Roof-Edge Flashings: Secure metal flashings at roof edges according to FM Loss Prevention Data Sheet 1 49 for specified wind zone.

D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches, except where pretinned surface would show in finished Work.

E. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
   1. Use joint adhesive for nonmoving joints specified not to be soldered.

F. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.

G. Roof-Penetration Flashing: Coordinate roof-penetration flashing installation with roofing and installation of items penetrating roof. Install flashing as follows:
   1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION

SECTION 07920
JOINT SEALANTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.2 SUMMARY

A. This Section includes sealants for the following applications:
   1. Exterior joints in the following vertical surfaces and non-traffic horizontal surfaces:
      a. Control and expansion joints in cast-in-place concrete.
      b. Other joints as indicated.
   2. Exterior joints in the following horizontal traffic surfaces:
      a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
      b. Joints between architectural precast concrete paving units.
      c. Joints between different materials listed above.
      d. Other joints as indicated.
   3. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Vertical control joints on exposed surfaces of interior and concrete walls and partitions.
      d. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
      e. Other joints as indicated.

B. Related Sections include the following:
   1. Section 03300 - Cast-In Place Concrete
   2. Section 04200 - Unit Masonry System

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.
   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 needed for adhesion.

B. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.

C. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: 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.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

PART 2 – PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified in the sealant schedules at the end of Part 3.

B. Products: Subject to compliance with requirements, provide one of the products indicated for each type in the sealant schedules at the end of Part 3.

2.2 MATERIALS, 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 sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: Match adjoining material.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

2.4 LATEX JOINT SEALANTS

A. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

2.5 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
1. Type C: Closed-cell material with a surface skin.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26°F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. 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 where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 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 with 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 joint-sealant performance.

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, blast cleaning, 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 from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
      a. Concrete.
   3. Remove laitance and form-release agents from concrete.
   4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
      a. Metal.

B. Joint Priming: Prime joint substrates 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.

C. Masking Tape: Use masking tape where required to prevent contact of sealant 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 of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type 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 sealants by proven techniques to 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 provided for each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 sealants from surfaces adjacent to joint.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3.4 CLEANING

A. Clean off excess sealants 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.

3.5 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 and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.6 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Low-Modulus Nonacid-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
   1 Products: Provide one of the following:
   Products listed below are neutral curing except for "Spectrem 1" from Tremco, which is basic curing.
      a. 790; Dow Corning.
      b. Silpruf; GE Silicones.
      c. UltraPruf SCS2300; GE Silicones.
      d. HiFlex 331; NUCO Industries, Inc.
      e. NuFlex 309; NUCO Industries, Inc.
      f. VP 275; Ohio Sealants, Inc.
      g. 864; Pecora Corporation.
      h. 890; Pecora Corporation.
      i. PSI-641; Polymeric Systems, Inc.
      j. Omniseal; Sonneborn Building Products Div., ChemRex Inc.
      k. Spectrem 1; Tremco.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25.
   4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
   5. Use Related to Exposure: NT (nontraffic).
   6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
      a. Use O Joint Substrates: Control and other joints.
   7. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

3.7 LATEX JOINT-SEALANT SCHEDULE

A. Latex Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
   1. Products: Provide one of the following:
      a. Chem-Calk 600; Bostik Inc.
      b. NuFlex 330; NUCO Industries, Inc.
      c. LC 160 All Purpose Acrylic Caulk; Ohio Sealants, Inc.
      d. AC-20; Pecora Corporation.
      e. PSI-701; Polymeric Systems, Inc.
      f. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
      g. Tremflex 834; Tremco.
   2. Applications: Interior joints to receive latex paint.

END OF SECTION

SECTION 08122
FIBERGLASS DOORS AND FRAMES

PART 1 – GENERAL

1.1 SCOPE

A. This section covers the furnishing and installation of fiberglass doors and frames.

1.2 RELATED WORK

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Reference Standards:
1. American National Standards Institute (ANSI)
2. American Welding Society (AWS)
3. National Institute for Occupational Safety and Health (NIOSH)
4. Occupational Safety and Health Act/Administration (OSHA)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples. For doors show the location, elevation, thickness, and direction of operation, including their installation. Also illustrate the type of frame including anchorage.

B. The Manufacturer shall provide the following certifications.
1. The manufacturers of proposed mechanical and structural systems affecting the performance of the equipment have examined the Contract Documents and agree to the performance and material specifications, warranty conditions, and other requirements set forth herein.
2. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
3. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel. (A written certification of a proper and correct installation shall be provided.)

C. Record Drawings: Submit record drawings under Submit record drawings under provisions of Section 01720 - Project Record Documents.

D. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

E. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

C. The equipment shall be designed, constructed, and installed in accordance with the Manufacturer's best practices and methods. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

D. Manufacturer and Contractor shall coordinate all dimensions to ensure adequate clearances for equipment maintenance, or removal, or replacement.

E. All welding shall be done at the Manufacturer's factory. Field welding shall not be permitted without the Engineer's express written approval.

F. The requirements of this Section shall be considered the minimum limits of acceptability.

1.6 WARRANTY

A. For a period of 12 months from substantial completion of the work, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment.

C. Accept units on site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter, where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs, or caps installed to protect equipment during shipment until the equipment is installed and permanent connections are made.

PART 2 – PRODUCTS

2.1 DESIGN CRITERIA

A. The doors and frames shall meet the following conditions listed in the table below and as shown in the contract drawings:

	Units	Design Conditions	
Door ID No.	-	**11-1A**	**14-1A, 14-1B, 14-2A, 14-2B**
Location	-	Chemical Area	Dewatering Building
Type	-	A	A
Width	in	36	36
Height	in	84	84
Thickness	in	1.75	1.75
Material	-	FRP	FRP
Finish	-	Paint	Paint
Frame Material	-	Fiberglass	Fiberglass
Frame Finish	-	Paint	Paint
Window Width	in	12	12
Window Height	in	12	12

2.2 ACCEPTABLE MANUFACTURERS

A. Provide fiberglass doors and frames from one of the following:
1. Chem-Pruf Door Co., Ltd.
2. Approved Equal

B. Listing as an approved manufacturer will not relieve the manufacturer from conforming to these specifications.

2.3 DOORS

A. Model. Provide a door that is highly resistant to corrosion and deterioration from heat, cold, high humidity, chlorine gas, sulfur dioxide gas, and sunlight exposure. Color to be determined by owner during submittal phase.

B. Operation. Provide doors that open as shown on the plans.

2.3 FRAMES

A. Size. Frames shall fit the openings and construction materials of the building. Use only frames supplied by the door manufacturer.

B. Model. Provide frames of molded fiberglass which is highly resistant to corrosion and deterioration from heat, cold, high humidity, chlorine gas, sulfur dioxide gas, and sunlight exposure. Internal wall frames may be steel if totally enclosed within the wall.

2.4 HARDWARE

A. Provide all stainless-steel hardware including jams, rings, knobs, passage cylinder, closer, panic bars, and anchoring bolts and nuts. Panic hardware shall be supplied on the interior side of each door.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the Work to Engineer.

3.2 INSTALLATION

A. Install doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.

3.3 ADJUSTING AND CLEANING

A. Paint Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer. All doors shall be coated per specification 09921.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION

SECTION 08331
OVERHEAD COILING DOORS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes manual operated overhead coiling service doors.
   1. Insulated service doors.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
   1. Wind Load: Exterior door, uniform pressure (velocity pressure of 20 lbf/sq.ft. (960 a), acting inward and outward.

B. Operation-Cycle Requirements: Provide overhead coiling door components and operators capable of operating for not less than 50,000 cycles.

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples. For doors show the location, elevation, thickness, and direction of operation, including their installation. Also illustrate the type of frame including anchorage.

B. The Manufacturer shall provide the following certifications.
   1. The manufacturers of proposed mechanical and structural systems affecting the performance of the equipment have examined the Contract Documents and agree to the performance and material specifications, warranty conditions, and other requirements set forth herein.
   2. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
   3. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel. (A written certification of a proper and correct installation shall be provided.)

C. Record Drawings: Submit record drawings under Submit record drawings under provisions of Section 01720 - Project Record Documents.

D. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

E. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.4 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

C. The equipment shall be designed, constructed, and installed in accordance with the Manufacturer's best practices and methods. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

D. Manufacturer and Contractor shall coordinate all dimensions to ensure adequate clearances for equipment maintenance, or removal, or replacement.

E. All welding shall be done at the Manufacturer's factory. Field welding shall not be permitted without the Engineer's express written approval.

F. The requirements of this Section shall be considered the minimum limits of acceptability.

1.6 WARRANTY

A. For a period of 12 months from substantial completion of the work, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Take proper measures to prevent rust and corrosion.

C. Accept units on site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter, where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs, or caps installed to protect equipment during shipment until the equipment is installed and permanent connections are made.

PART 2 – PRODUCTS

2.1 DESIGN CRITERIA

A. The doors and frames shall meet the following conditions listed in the table below and as shown in the contract drawings:

	Units	Design Conditions
Door ID No.	-	**14-2C**
Location	-	Dewatering Facility
Width	in	120
Height	in	144
Frame Opening	sq. ft.	120
Material	-	Galvanized Steel
Finish	-	Galvanized Steel
Frame Material	-	Aluminum
Frame Finish	-	Powder Coat

2.2 ACCEPTABLE MANUFACTURERS

A. Basis of Design Product: The design is based on Overhead Door Co. #625 for exterior doors and doors between conditioned and non-conditioned spaces. The design for interior fire rated doors is based on Overhead Door Co. #630. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. Alpine Overhead Doors, Inc.
2. Atlas Door; Division of Clopay Building Products Company, Inc.
3. Cookson Company
4. Cornell Iron Works, Inc., Mountaintop, PA
5. Dynamic Closures Corporation
6. Mahon Door Corporation
7. McKeon Rolling Steel Door Co., Inc., Brooklyn, NY
8. Metro Door
9. Overhead Door Corp., Dallas, TX
10. Pacific Rolling Doors Co.
11. Raynor
12. Southwestern Steel Rolling Door Co.
13. Windsor Door, a MAGNATRAX Corporation

2.3 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Interlocking slats in a continuous length for width of door of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door.
1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel (SS) sheet; complying with ASTM A 653/A 653M, G90 (Z275) coating designation.
2. Slat Type: Flat profile.

3. Insulation: Exterior door, foamed in place polyurethane-foam-type thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within metal slat faces.

B. Endlocks, and Windlocks on Exterior Doors: Malleable-iron casings, secured to curtain slats to comply with wind load.

C. Bottom Bar: Manufacturer's standard to suit type of curtain slats.
1. Astragal: Replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene; as a cushion bumper for interior door.

D. Curtain Jamb Guides: Steel angles or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks on exterior doors. Material and finish to match curtain slats.

E. Hood: Form to act as weatherseal and entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods, and provide fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.
1. Steel Door Hoods: Minimum 0.028-inch- (0.7mm-) thick, hot-dip galvanized steel sheet that matches slat steel.
2. Shape: As indicated.

F. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets fitted to bottom and top of exterior doors, unless otherwise indicated. At door head, use 1/8-inch-(3-mm-) thick, replaceable, continuous sheet secured to inside of hood.
1. Jamb Seals: Replaceable, adjustable, continuous, flexible, 1/8-inch-(3-mm-) thick seals of flexible vinyl, rubber, or neoprene at door jambs for a weathertight installation.

G. Chain Lock Keeper: Suitable for cylinder.

H. Operation: Manual chain.

I. Counterbalancing Mechanism: Adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
1. Mounting Brackets: Cast iron or cold-rolled steel plate.

2.4 FINISHES

A. Galvanized Steel Finish: Powder Coated.
1. Color and Gloss: Custom color as selected by Owner.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Coordinate the work with the adjacent work specified in other sections. Provide electrical connections as specified in other sections.

B. General: Install coiling doors and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports in accordance with manufacturer's instructions.

C. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist or distortion and with weathertight fit around entire perimeter.

3.2 ADJUSTING AND CLEANING

A. Fit, align, and adjust door assembly level and plumb; provide smooth operation. Clean doors of dirt and grease.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain doors.

END OF SECTION

SECTION 08520
METAL WINDOW FRAMES

PART 1 – GENERAL

1.1 SCOPE

A. This section provides requirements for furnishing and installing metal windows, complete with all necessary hardware.

1.2 RELATED WORK

A. All Sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 SHOP DRAWINGS

A. Submit drawings as specified in Division 1 - General Requirements. Show construction of all parts, metal thickness installation and erection details including connections, anchorage, fastening and sealing methods.

1.4 PRODUCT DELIVERY AND HANDLING

A. Deliver to site and store windows in an upright position off the ground. Protect from weather and damage.

PART 2 – PROUCT

A. Acceptable Manufacturer. Ceco Manufacturing Corporation

B. Material. Aluminum projected

C. Style. Ceco Series 500, No. A-4l3

PART 3 – EXECUTION

A. Install frames plumb, rigid and in true alignment with other work.

END OF SECTION

SECTION 08711
FINISH HARDWARE

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for furnishing and installing all finish hardware.

1.2 RELATED WORK

A. Division 8 - Doors and Windows. Fiberglass Doors and Frames.

1.3 SUBMITTALS

A. Hardware Schedule. Submit copies as specified for Shop Drawings in Division 1 - General Requirements. Schedule each item of hardware required for each door or item of equipment. List hardware, item number, manufacturer, manufacturer's number, or symbol and finish.

1.4 ACCEPTABLE MANUFACTURERS

A. This specified items are selected from the catalogs of the following manufacturers.
   1. Sargent
   2. Stanley
   3. Schlage

PART 2 – PRODUCTS

2.1 PACKING, MARKING, AND LABELING

A. Package each item of hardware separately, in an individual container, complete with screws, keys, special wrenches, instructions, and installation templates necessary for accurately locating, setting, adjusting, and attaching hardware.

B. Supply all necessary templates and template information to the manufacture of doors and frames in ample time to prevent delay to the progress of the project.

C. Include all fastenings with exposed surfaces with matching finish of adjacent metal parts of hardware.

D. Mark each container with number of door to which hardware item is to be applied, and with item number corresponding with hardware item number listed in the hardware schedule.

2.2 LOCKSETS

A. Manufacturer. Sargent

B. Model No. 78-8605

C. Finish. Stainless Steel, U.S. 32

2.3 HINGES

A. Manufacturer. Stanley

B. Model No. C131901 with vandal proof pins

C. Finish. Stainless Steel, U.S. 32

2.4 DOOR CLOSERS

A. Manufacturer. Sargent

B. Model No. 1100 Series Size 5

C. Finish. Stainless Steel, U.S. 32

2.5 DOOR HOLDER

A. Manufacturer. Sargent

B. Model No. 1540

C. Finish. Stainless Steel, U.S. 32

PART 3 – EXECUTION

3.1 KEYING

A. Master-key all locking devices specified in this section.

B. Supply keys as follows:
   1. Cylinder locks. Two (2) keys each.
   2. Master Keys. Four (4) keys.
   3. Grand Master Keys. Four (4) keys.

3.2 INSTALLATION

A. Install hardware accurately fitted, securely applied, and carefully adjusted. Install in accordance with the manufacturer's instruction. Use care not to damage adjacent work while installing.

B. Install hardware items from finish floor line to the center line of the items as follows:
1. Door knobs, 38-inches (38")
2. Push and Pull plates, 45-inches (45")
3. Cylinder deadlocks, 52-inches (52")
4. Hinges
   a. Bottom. Bottom of hinge, 10 inches (10")
   b. Top. Top of hinge, five-inches (5") below head rebate.
   c. Center. Spaced midway between top and bottom.

3.3 SCHEDULE OF HARDWARE

A. Write schedule for all hardware sets and include all items in each set. Label as follows:
1. 1½ pair butts
2. One (1) lockset
3. One (1) closer
4. One (1) door holder

END OF SECTION

SECTION 08736
THRESHOLDS AND WEATHERSTRIPPING

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for furnishing and installing thresholds and weatherstripping.

1.2 RELATED WORK

A. Division 8 - Doors and Windows. Fiberglass Doors and Frames

1.3 SUBMITTALS

A. Descriptive Data. Submit catalog cuts or other descriptive data for material specified under this section.

B. Samples. Submit six-inch (6") line section of each item specified under this section.

1.4 ACCEPTABLE MANUFACTURERS

A. Provide weatherstripping from one of the following:
1. Zero Weather Stripping Co., Inc.
2. Southern Metal Products Corp.
3. Pemko Manufacturing Co.
4. National Guard Products, Inc.

B. Listing as an approved manufacturer will not relieve the manufacturer from conforming to these specifications.

PART 2 – PRODUCTS

2.1 THRESHOLDS

A. Model No. No. 80 as manufactured by Zero.

B. Size. 4¼-inch (4¼").

C. Material. Aluminum

2.2 DOOR BOTTOM WEATHERSTRIPPING

A. Model No. No. 25W as manufactured by Zero.

B. Material. Aluminum.

PART 3 – EXECUTION

3.1 WEATHERSTRIPPPING

A. Install according to manufacturer's directions at head and jambs of all exterior doors after completion of finish painting. Fasten with even, symmetrically spaced, countersunk, flat head screws.

3.2 THRESHOLDS

A. Install in full bed of calking compound. Fasten to sub-strate with countersunk, Phillips head screws into lead sleeves. Cope ends to door frame profile.

3.3 ALIGNMENT AND FIT

A. Install all items specified herein level, square and in proper alignment, and relationship to work of other trades. Verify at completion of work that all doors furnished with items under this section are air and water tight.

END OF SECTION

SECTION 08801
GLASS AND GLAZING

PART 1 – GENERAL

1.1 SCOPE

A. This section covers the furnishing and installation of all glass and glazing.

1.2 RELATED WORK

A. Division 8 - Doors and Windows. Fiberglass Doors and Frames.

1.3 QUALITY ASSURANCE

A. All glass products must have manufacturer's labels affixed to each piece. Do not remove labels until products are inspected and approved.

1.4 DELIVERY AND STORAGE

A. Deliver glass to site in suitable containers which will protect glass from weather and breakage. Store in a safe, dry location. Do not unpack until needed for installation. Deliver sufficient material to allow for normal breakage.

PART 2 – PRODUCTS

2.1 SHEET GLASS

A. Standard. Federal Specification DD-G-451c

B. Thickness. 1/8-inch (1/8")

C. Grade. DSB

2.2 GLAZING MATERIALS

A. Provide putty conforming to Federal Specification TT-P-781a for glazing in metal sash.

PART 3 – EXECUTION

3.1 PREPARATION

A. Inspect all sash, frames and surrounds to be glazed to verify there are no defects, improper materials, faulty workmanship, or other conditions which will affect satisfactory installation of the glass. Do not proceed with glazing until faulty conditions have been satisfactorily corrected.

B. Verify that the frames and sash are firmly anchored in proper position. Also, that they are plumb and square within 1/8-inch (1/8") of nominal dimensions on approved shop drawings of frames or sash.

C. Verify that all rivets, screws, bolt heads, and other projections are removed from glazing rabbets to provide specified clearances.

D. Verify that all corners and fabrication intersections are sealed and that sash or frames are weather tight.

E. Verify that rabbets at sill sweep to the outside and that all rabbets are of sufficient depth and width to receive glass and to provide the required overlap of the glass.

F. Clean all sealing surfaces at perimeter of glass in rabbet and stop beads before applying glazing compounds, tape, sealant, or gaskets. Use only solvents and cleaning agents approved by the manufacturer of the compound.

G. Center glass in glazing rabbets, etc., to maintain specified clearances at the perimeter on all four (4) sides.

3.2 FACE GLAZING

A. Apply ample back putty, compound, or sealant to rabbet in which shims have been set, so that compound will squeeze out when glass is pressed into position.

B. Secure glass in place with suitable metal clips as recommended or furnished by window manufacturer.

C. Face putty front pane edge in rabbet with compound to form a smooth, neat bevel $^{1}/_{16}$-inch ($^{1}/_{16}$") short of the sight line and sloping away from the glass. Miter bevel at corners. Strip away excess compound. Strip surplus back putty at slight angle to slope away from the glass.

3.3 REPLACEMENTS AND CLEANING

A. At the completion of the work, and throughout the project warranty period, all glass must be free from cracks, chips, and other defects. Any defect that is a direct result of manufacturing, transporting, or their performance of the Contractor must be rectified without cost to the Owner. Remove and replace defective glass with new glass.

B. Remove from the project site all boxes, crates, containers, and other debris used for glazing operations.

END OF SECTION

SECTION 08900
HANDRAIL

PART 1 – GENERAL

1.1 SCOPE

A. This section specifies the design, fabrication, and installation of handrail systems for walkways and stairways.

1.2 RELATED WORK

A. Division 8 - Doors and Windows. Fiberglass Doors and Frames.

1.3 DESCRIPTION

A. Provide anodized aluminum or fiberglass reinforced plastic (FRP) handrails with two horizontal rails, 42-inches (42") high, with four-inch (4") kick plates. Handrail material shall be as noted on the drawings. The posts shall be connected to concrete or steel surfaces with base plates and stainless steel expansion anchors or bolts as appropriate.

1.4 SUBMITTALS

A. Provide submittals including product data and shop drawings. The shop drawings shall show the proposed handrail installation, including post locations and connection details.

1.5 GUARANTEE

A. For a period of twelve (12) months from final acceptance, the manufacturer shall warrant that the equipment be free from defects in material and workmanship under normal use and service and when properly installed. The manufacturer shall repair or replace; including removal and shipment from and to the site, and reinstallation; such equipment or any part thereof furnished by the manufacturer and found defective after inspection.

1.6 STRENGTH REQUIREMENTS

A. All handrail systems shall meet the load and design requirements of O.S.H.A. In particular, all handrail systems shall be capable of resisting a 200-pound load, either horizontal or vertical, at any point along the top rail including post locations.

PART 2 – PRODUCTS

2.1 ANODIZED ALUMINUM HANDRAIL

A. Furnish handrails fabricated from 1½-inch (1½") diameter schedule 40 anodized aluminum pipe. The handrails shall conform to the following:

1. All fittings shall have the same outside diameter as the pipe used for the rails and posts. Connections between fittings and rails and at splices in rails shall be done internal to the pipe. The pipe shall be fastened to the fittings and splices with stainless steel fasteners. Connections in the rails shall allow temperature expansion of the rails.

2. All base plates shall be fabricated from anodized aluminum. The plates may be floor mounted or wall mounted. Use narrow base plates on stairways to fit the stringer width.

3. A four-inch (4") anodized aluminum kick plate shall be provided at all locations unless otherwise shown on the drawings. The plate shall be connected to the posts with stainless steel screws or rivets. Connections in the kick plates shall allow for temperature expansion of the plates.

2.2 FIBERGLASS REINFORCED PLASTIC HANDRAIL

Furnish handrails fabricated from square fiberglass reinforced plastic (FRP) members with glass rovings, mats, and other forms of reinforcement such as woven fiberglass which is pulled through baths of thermosetting liquid resin and then through heated forming dies to form finished fiberglass shapes. The fiberglass members shall have a polyester resin veil with a UV inhibitor and flame retardant. The members shall be Class 1 fire retardant with an ASTM E-84 flame spread rating of 25 or less. The veil shall be molded in **Toughened Barrier Additive**. The handrails shall conform to the following:

1. Fiberglass rails and posts shall be 1¾-inch (1¾") square in cross section with $\frac{3}{8}$" radius corners.

2. All fittings shall have the same outside dimensions as the rail and post members. Connections at fittings and at splices in rails shall be internal to the members and shall be done with aluminum connectors. The connections shall be secured with epoxy adhesive and shall not require the use of rivets.

3. All base plates shall be FRP or extruded aluminum. Plates may be floor or wall mounted. Use narrow plates on stairways to fit the stringer width.

4. A four-inch (4") FRP kick plate shall be provided at all locations unless noted otherwise on the drawings. The plate shall be fastened to the posts with an epoxy adhesive. The connections in the kick plates shall allow for temperature expansion of the plates.

PART 3 – EXECUTION

Install all handrails as shown on the drawings and in accordance with the manufacturer's instructions. Maximum post spacing shall be six-feet (6'). Inspect completed installation for loose fasteners in base plates, rails, and posts. Where necessary for coordination with installation of piping or equipment, delete or add rails and kick plate as required. However, do not leave a clear horizontal opening of more than six-inches (6").

END OF SECTION

SECTION 09921
PROTECTIVE COATING

PART 1 – GENERAL

1.1 SCOPE

A. This section specifies furnishing labor and materials to prepare surfaces and to apply protective coatings. The term paint as used in this section means the protective coatings specified.

1.2 REFERENCE STANDARDS

A. Work performed and materials used must comply with the requirements of the Society for Protective Coatings (SSPC) Vol. No. 1, "Good Painting Practices", and SSPC Vol. No. 2, "Systems and Specifications", and the Association for Materials Protection and Performance (AMPP); and these technical specifications. Where a conflict exists between these technical specifications and the SSPC Specifications, the technical specifications govern.

1.3 SUBMITTALS

A. Before purchasing any coating materials, submit to the Engineer a submittal indicating the coating systems to be used. The submittal should indicate planned surface preparation and application rates and include a color chart upon which the Engineer will verify the color selections. The submittal shall also contain copies of the manufacturer's product data sheets for each product used. Before beginning the actual work, provide the Engineer with a certificate from the paint supplier stating that sufficient paint has been purchased to provide the coatings specified in this section. Also, the certificate shall list the quantities and types of paint purchased.

1.4 SUBSTITUTIONS

A. Wherever a product is designated by trade name with provision for an approved equal, the product specified must be used unless a written request for substitution is submitted to the Engineer at least 10 days before the receipt of bids. The submittal must include the manufacturer's complete technical data sheets on the proposed product.

B. Consideration will be given only to those products which have been used in wastewater treatment plant service for at least 10 years. The submittal must include a list of at least 10 applications in the Gulf Coast area where the product has been in continuous use for at least five (5) years. Furnish the owner's name, the owner's representative, and name of product used.

1.5 PAYMENT

A. Protective coating will be paid for under the lump sum base bid price unless otherwise indicated on the bid form.

1.6 DELIVERY AND STORAGE

A. Delivery. Have all paint delivered to the job site in original unopened containers. Contact Engineer for inspection before beginning painting operations.

B. Storage. Store materials in an approved location. Keep the storage area clean and repair any damage done. Remove oily rags, waste, or other fire hazards from buildings each night. Take adequate precautions to avoid damage by fire. Place cloths and cotton waste which might constitute a fire hazard in metal containers or destroy at the end of each work day.

PART 2 – PRODUCTS

2.1 COLOR SCHEDULE

A. Refer to Section 15190 – Mechanical Identification for top coat colors for specific pipes and equipment. For pipes and equipment not specified in Section 15190, provide a color chart for selection by Owner.

2.2 ACCEPTABLE MANUFACTURERS

A. See 3.6 COATING SYSTEMS below.

2.3 TEST EQUIPMENT

A. The Contractor shall furnish and use in the presence of the Engineer, the necessary equipment to determine the following:
   1. Anchor Pattern
   2. Wet and Dry Film Thickness
   3. Coating Flaws (Holiday Testing)
   4. Environmental Conditions
   5. Substrate Temperature

B. Additional testing will be as required by the coating system manufacturer.

C. Digital testing equipment is acceptable along with but not limited to the following:
   1. Microtest. Model DFG-100, 0-40 mils film thickness gauge including a set of U.S. Department of Commerce, Bureau of Standards Film Thickness Calibration Standards from 0-8 mils and 10-25 mils.
   2. Tinker-Rasor. Model M-1 low voltage flaw detector. Model AP/W High Voltage Holiday detector per NACE SP0188 for High Solids Epoxy.

PART 3 – EXECUTION

3.1 WORK CONDITIONS

A. Weather. Do not conduct coating work under unfavorable weather conditions, unless work is well protected and specific approval is obtained from the Engineer. Do not paint when the ambient temperature does not meet the manufacturer's recommendation, will fall below 50°F within the initial curing time as stated by the manufacturer (unless additional drying time as recommended by the paint manufacturer is allowed), when the surface temperature or ambient temperature is within 5°F of the dew point, or when humidity is above that recommended by the paint manufacturer.

B. Surface. If surfaces to be painted cannot be put in proper condition for painting by customary cleaning and sanding operations, notify the Engineer in writing or assume the responsibility for and rectify any unsatisfactory finish resulting from application to an unsatisfactory surface. Do not apply paint to a wet or damp surface.

C. Equipment. Maintain equipment in good working order comparable to that described in printed instructions of the coating manufacturer. Clean equipment thoroughly before and after use with the appropriate cleaning solution indicated by the coating manufacturer.

3.2 SURFACE PREPARATION

A. Solvent Cleaning (SSPC-SP1 & NAPF 500-01). Remove heavy deposits of grease or oil from the surface with toluene or xylene solvents **prior to any other surface preparation**. Neutralize and flush chemical contamination prior to any other surface preparation. Remove heavy oil, grease, or debris from ductile iron with stiff fiber or scraper prior to solvent cleaning. Follow the requirements of NAPF 500-03-01 for preparation of ductile iron pipe fittings.

B. Power Tool Cleaning (SSPC-SP3). Clean pumps, blowers, motors, and other sensitive equipment to be coated in accordance with Society for Protective Coatings Surface Preparation Specifications, SSPC-SP 3, Power Tool Cleaning, removing loose mill scale, loose rust, loose paint and other foreign matter. Follow the requirements of NAPF 500-03-03 for preparation of ductile iron pipe and fittings.

C. Near-White Blast Cleaning (SSPC-SP10/NACE No. 2).

1. Use a source that provides compressed air, free of detrimental amounts of water and oil.
2. Abrasive blast only the amount of surface area which can be primed the same day or before any rust starts to form, whichever occurs first. Areas which are not painted the same day must be reblasted on the day the prime coat is applied. Remove abrasive residue from the surface by brush or industrial vacuum, prior to application of any paint.
3. Abrasive blast surfaces to be coated, except those specified in the paragraph Power Tool Cleaning, to "near-white" metal in accordance with Society for Protective Coatings SSPC-SP 10, Near White Cleaning. Remove mill scale, rust dirt, paint or slightly roughened to form a suitable anchor pattern for coating application. The surface profile should be approximately two (2) mils. At least 95 percent (95%) of each square inch of surface area must be free of visible residues and the remainder limited to light discoloration.
4. **All surfaces shall be approved by the Engineer's Field Project Representative prior to any coating application**. The standard of cleanliness for the surface preparation shall be evaluated with the use of SSPC Pictorial Surface Preparation Standards, SSPC-VIS.-1 and "Swedish Standards."
5. Only a non-silica abrasive blasting material shall be used.
6. The abrasive to be used shall be sharp, angular, properly graded, and brought to the job site in moisture proof bags or air tight bulk containers. Blast media shall no be recycled or reused.
7. No cleaned surface shall receive a coating if "rust bloom" or discoloration has occurred.
8. Follow the requirements of NAPF 500-03-04 and NAPF 500-03-05 for preparation of ductile iron pipe and fittings.

D. Surface Preparation of Concrete (SSPC-SP13/NACE No. 6) Dry abrasive blasting and vacuum assisted abrasive blasting, in accordance with AST D4259 and SSPC-SP13, may be used to remove contaminants, laitance, and weak concrete, to expose subsurface voids, and to produce a sound concrete surface with adequate profile and surface porosity. Concrete and repairs must be cured for a minimum of 28 days prior to surface preparation. All contaminants such as form release agents and curing compounds shall be removed during surface preparation. Surface cleaning methods shall be per ASTM D 4258 and shall include vacuum cleaning, air blast cleaning, water/detergent water cleaning, and steam cleaning. Surface protrusions such as burs, fins, and splatter shall be removed prior to or during surface preparation. Defects such as spalling and honeycombing shall be repaired prior to surface preparation.

E. Shop Priming. Do not shop prime any metal work or piping unless prior approval is given by the Engineer in writing. The Contractor shall coordinate with the Engineer's Field Project Representative to make an inspection of any shop primed metal at the factory. Prime coats on piping work will only be allowed with explicit approval by the Engineer. In all other cases complete coating systems must be applied in the field.

3.3 SHROUDING

A. All surfaces to be abrasive blast cleaned shall be shrouded. The shrouding shall remain in place until the painting operation is complete. The shroud shall enclose or surround the area being blasted to minimize the atmospheric entrainment of fine particulates and shall have a control factor of 95 percent (95%) of particles 100 grit or greater.

3.4 COATING APPLICATION

A. Manufacturer's Representative. The coating manufacturer will be responsible, through an authorized representative, to provide technical assistance to the paint contractor as needed.

B. Workers. The Contractor performing this work shall employ workers skilled in the scope of work.

C. Materials.
1. Coating materials, abrasive, and equipment used in painting and blasting are subject to inspection at any time by the Engineer or his representative. Materials shall be delivered to the site for inspection prior to beginning work.
2. Remove blasting residue and dust from the surface to be painted before paint application is begun.

D. Paint Coating Methods.
1. Double lap or stripe coat all welds, bolts, nuts, flanges, and all other hard to reach areas where spraying cannot be applied properly.
2. Spray all paint (except stripe coating as described immediately above) unless permission to roll or brush has been specifically requested and received from the Engineer.
3. Coat areas with a uniform film, free of sags, runs, or brushmarks. Where multiple coats of paint are specified, apply each coat in a different shade than the preceding coat. Each coat must be free of shadows and uniform in appearance.
4. Except where otherwise specified, thin paint only as necessary for workability of coating material in accordance with manufacturer's printed instructions. Use only a thinner supplied by the paint manufacturer.
5. When paint is being applied to any enclosed areas, provide adequate ventilation.
6. Carefully observe minimum drying time between coats as stated in printed instructions of the coating manufacturer.
7. Comply with recommendations of the paint manufacturer in regard to drying time for each coat, technique of spray application, ventilation, paint thinning, and safety precautions. The Contractor must fully inform all members of his field crew of these recommendations.
8. Where inspection shows that the specified thickness is not developed, apply additional coats to produce the required film thickness.
9. Repair and recoat improper applications as recommended by the manufacturer or as required by the Engineer.
10. Do not coat pump and motor name tags, meter and gauge sight glasses, valve operator stems or other items designated by the Engineer.

E. Forced Air Drying.
1. Heated Air. Circulate warm air through the tank for eight (8) hours holding the air temperature between 140ºF and 150ºF. After initial drying, raise air temperature to between 160ºF and 180ºF for at least 24-hours or until all residual solvent odor is dissipated.
2. Without Heat. If heating equipment is not available, forced air ventilation with outside ambient temperature air must continue until all solvent odor is dissipated.

F. Cleaning. Upon completion of the work remove all staging and any scaffolding not required for inspection. Dispose of all containers and rubbish in an approved manner. Remove paint spots, oil or stains on adjacent surfaces. Leave the entire job clean and acceptable. Remove all tape/masking material.

G. Grating Protective Coatings. Aluminum surfaces to be placed in contact with steel shall be given one (1) coat of zinc chromate primer in accordance with Federal Specification II-P-645, or the equivalent, or one (1) coat of a suitable non-hardening joint compound capable of excluding moisture from the joint during prolonged service. Where severe corrosion conditions are expected, additional protection can be obtained by applying the joint compound in addition to the zinc chromate primer. Zinc chromate paint shall be allowed to dry hard (air dry 24 hours) before assembly of the parts. The steel surfaces to be placed in contact with aluminum shall be painted with zinc chromate primer or preapproved equal in accordance with Federal Specification II-P-645, followed by one (1) coat of paint consisting of two (2) lb. of aluminum paste pigment (ASTM Specification D962066, Type 2, Class B) per gallon of varnish meeting Federal Specification TT-V81d, Type II, or the equivalent. Stainless steel, or aluminized, hot-dip galvanized or electro-galvanized steel placed in contact with aluminum need not be painted.

H. Priming Galvanized Steel or Anodized Aluminum. Modify coating systems as necessary to provide proper prime coats per manufacturer's recommendations.

3.5 COATING SCHEDULE

A. Coat each item listed below using the coating system specified. Color guide is typical. All colors are subject to change and must be approved by the engineer

Item To Be Coated	Surface Prep	Coating System	Color
Piping			
Submerged	SSPC-SP10	High Solids Epoxy	Per Section 15190
Non-Submerged - General	SSPC-SP10	Polyurethane	Per Section 15190
Non-Submerged - Lift Station (Dry Well)	SSPC-SP10	High Solids Epoxy	Per Section 15190
Non-Submerged – PVC	SSPC-SP1	Polyurethane	Per Section 15190

Item To Be Coated	Surface Prep	Coating System	Color
Plant Equipment*			
Non-Submerged Pumps and Drives	SSPC-SP3	Polyurethane	Per Section 15190
Metals			
Submerged Metals	SSPC-SP10	High Solids Epoxy	Light Grey
Structural Member and Metals Non-Submerged	SSPC-SP10	Polyurethane	Owner to Select
Structures			
Interior Concrete Walls of Wet Wells, Basins, & Channels (As Specified on Drawings)	SSPC-SP13	High Solids Epoxy	Light Grey or As Available

Buildings			
Masonry Units (interior only)	Pressure Wash (Manufacturer Recommendation)	Concrete Block	Owner to Select
Roof Panels (interior only)	Pressure Wash (Manufacturer Recommendation)	Concrete Block	Owner to Select
Concrete Floors (as specified)	SSPC-SP13	Building Floor Epoxy	Owner to Select

This list is intended as a general guide and may not include each separate item to be coated.

* Contractor shall coordinate with plant equipment manufacturers to verify surface preparation and coatings are acceptable and does not void the warranty. If the manufacturer does not recommend applying the specified system, the manufacturer shall recommend a system for review and approval by the Engineer prior to application.

3.6 COATING SYSTEMS

A. High Solids Epoxy (Piping & Metals).

1.	Surface Preparation Blast Profile: 3.0 mils	As Specified in Section 3.5
2.	Prime Coat High Solids Epoxy Min DFT: Per Manufacturer Color: To Be Selected	Carboline Plasite 4500S Madewell 1103 Raven 405 Quadex Structure Guard Sherwin Williams Dura-Plate 6100 Tnemec Perma-Glaze 435
3.	Finish Coat High Solids Epoxy Min DFT: Per Manufacturer Color: To Be Selected	Carboline Plasite 4500S Madewell 1103 Raven 405 Quadex Structure Guard Sherwin Williams Dura-Plate 6100 Tnemec Perma-Glaze 435

Total minimum dry film thickness: 40.0 mils

B. Polyurethane.

1.	Surface Preparation	As Specified in 3.5 COATING SCHEDULE
2.	Prime Coat Rust Inhibitive Epoxy Primer 2.0 to 6.0 mils DFT Color: Determined by Primer	Carboline Carboguard 893 Tnemec Series 65 Ameron 385 PA Sherwin Williams Macropoxy 646
3.	Intermediate Coat Polyamide Cured Epoxy 4.0 to 6.0 mils DFT Color: To be Selected	Carboline Carboguard 890 Tnemec Series 66 Ameron 385 Sherwin Williams Macropoxy 646

4.	Finish Coat Aliphatic Polyurethane 2.0 to 3.0 mils DFT Color: To be Selected	Carboline Carbothane 134HG Tnemec Series 73 Ameron V450H Series Sherwin Williams Acrolon Ultra

Total minimum dry film thickness: 8.0 mils

*NOTE - For PVC piping, use finish coat only. Solvent clean only - do not blast.

C. High Solids Epoxy (Concrete).

1.	Surface Preparation	As Specified in 3.5 COATING SCHEDULE
2.	First Coat High Solids Epoxy Color: Light Grey or As Available DFT Manufacturer Recommendation	Raven 405 Tnemec Perma Glaze 435 Carboline Plasite 4500S Madewell 1103 Sherwin Williams Dura-Plate 6100
3.	Second Coat High Solids Epoxy Color: Light Grey or As Available DFT Manufacturer Recommendation	Raven 405 Tnemec Perma Glaze 435 Carboline Plasite 4500S Madewell 1103 Sherwin Williams Dura-Plate 6100

Total dry film thickness: New Concrete – 100 mils average, 80 mils minimum
Rough Concrete – 125 mils average, 100 mils minimum

D. Concrete Block.

1.	Surface Preparation	Pressure Wash or Brush Blast Remove Sharp Projections and Spurs
2.	Prime Coat Block Filler Color: Off-White	Carboline Carbocrylic 650 Tnemec Series 54-560 AmerGuard 147 Sherwin Williams B42W46
3.	Finish Coat(s) Latex 5.0 to 7.0 mils DFT Color: Owner to Select	Carboline Carbocrylic 3359 Tnemec Series 6 Ameron 220 Series Sherwin Williams B66 Series

E. Building Floor Epoxy.

1.	Surface Preparation	As Specified in 3.5 COATING SCHEDULE
2.	Prime Coat DFT: Manufacturer Recommendation Color: Clear	Sherwin Williams Resuprime MVT Carboline Carboguard 1340 WB Induron Polyfill Epoxy Block Filler Tnemec Series 201 Epoxoprime

3.	Intermediate Coat Interior Epoxy DFT: Manufacturer Recommendation Color: Owner to Select	Sherwin Williams General Polymers-3746 Epoxy Carboline Carboguard 890 Induron Polyfill PermaClean II Epoxy Tnemec Series 280 or 281 Tneme-Glaze
4.	Finish Coat Interior Epoxy (UV Resistant) DFT: Manufacturer Recommendation Color: Owner to Select	Sherwin Williams General Polymers- 3746 Epoxy Carboline Sanitile 985 PA Induron Indurlux 9400 Epoxy Siloxane Tnemec Series 280 or 281 Tneme-Glaze

*NOTE - Fill all bug holes, air pockets, and other voids with a Steel-Seem FT910, EFS 707, or Carboguard 510 series epoxy surfacer cement patching compound or approved equal. For all walking and operating surfaces, broadcast 30 mesh Aluminum Oxide into the intermediate coat film while it is wet and allow film to dry.

3.7 INSPECTION AND TESTING

A. Pre-Painting Conference.
1. Contractor shall move all necessary equipment, proposed paint, thinner, and supplies on-site.
2. Contractor shall arrange a meeting on-site with the following representatives:
   a. General contractor
   b. Engineer
   c. Paint subcontractor
   d. Paint supplier's qualified field personnel
3. The contractor shall provide a minimum of four (4) hours blasting and painting effort supervised by the paint subcontractor and the paint supplier's representative. The Engineer, Field Project Representative, and Owner may wish to observe and use the blasting and painting equipment during this period. All stages of the paint process will be demonstrated: preparation of equipment, abrasive cleaning, paint application (one coat), and equipment cleanup.

B. Inspection.
1. Surface preparations, coating applications and repairs are subject to inspection by the Engineer. The standards published by the Steel Structures Painting Council, especially SSPC-VISL-635, Pictorial Surface, will be used as guides for acceptance or rejection of the cleaning, painting or coating application. Particular attention will be given hard to reach areas, bolted connections, sway rods, anchor bolts and threaded joints.
2. Give sufficient notice in advance (minimum 24 hours) of coating applications so that the Engineer can perform the following inspections:
   a. Examination and approval of surface preparation prior to any coating.
   b. Examination and approval of each coat prior to application of the next coat.
   c. Inspection of the completed coating for runs, overspray, roughness, and any evidence of improper application.
   d. Direction or observation of testing.
3. Any re-inspection cost will be documented as a re-inspection by the Engineer or Engineer's representative and will be communicated to the Owner. Re-inspection costs may be subject to claims by the Owner under the "Damages" or similar clause of the General Conditions of the Contract.

C. Testing.

1. The Engineer will designate a representative to perform inspection and testing.
2. Should any paint system fail to pass a test, the Engineer will specify corrective measures. The paint system will then be re-tested. Additional expenses, including re-testing, will be charged to the Contractor.
3. The following tests will be made:
   a. Metal substrate surface profile after abrasive blasting.
   b. Dry film thickness will be tested after each coat of interior and exterior paint has been applied, and after the final coat of the exterior system has been applied to the pump, motor, tanks and piping. A test will be made for every 25 square feet of surface and at locations designated by the field project representative.
   c. The interior and exterior systems will be tested for holidays after the final coat has been applied.
4. The Engineer may specify additional tests including but not limited to:
   a. Solvent wipe-off test
   b. Crosshatch adhesion test
5. The Contractor shall provide all appropriate scaffolding and illumination (if needed in interior coatings applications) for the Engineer's inspection. Provide manpower to move scaffolding during inspection.

3.8 STENCILING

A. Provide identification numbers for each pump which correspond to the identification numbers in the motor control panels. These numbers shall consist of one coat of black or white, to contrast the top coat, polyurethane paint applied with a stencil in a location that is visible while standing at the control panel. Number height shall be at least four-inches (4″).

B. Stencil the following in red on the top surface of each wet well hatch: “Warning: Do Not Set Pumps on This Surface”

C. Stencil the following in red on the inside surface of all hatches: “Warning Confined Space Entry!”

D. Provide mechanical identification in accordance with Section 15190 – Mechanical Identification.

END OF SECTION

SECTION 11011
EQUIPMENT GENERAL PROVISIONS

PART 1 – GENERAL

A. Except as modified in this section, General Conditions, Supplementary Conditions, applicable provisions of Division 1, General Requirements, and other provisions and requirements of the contract documents apply to work of Division 11, Equipment.

B. Applicable provisions of this section apply to all sections of Division 11, Equipment.

PART 2 – CONTRACT DRAWINGS

Contract drawings are diagrammatic only, and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

PART 3 – SPACE REQUIREMENTS

Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

PART 4 – NOISE AND VIBRATION

Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced by equipment, piping or other parts of work, rectify such conditions without cost to Owner. If item of equipment is judged to produce objectionable noise or vibration, demonstrate without cost to the Owner that equipment performs within designated limits.

PART 5 – ACCEPTABLE MANUFACTURERS

Where two (2) or more units of same type or class of equipment are required, provide units of a single manufacturer. Manufacturer's names and catalog numbers specified under sections of Division 11 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified may be listed as a substitution, and will be acceptable on approval. Submit complete design and performance data to the Engineer. Regardless of equipment start-up date, all equipment warranties shall remain in effect for a period of 12 months from date of substantial completion.

PART 6 – SUBMITTALS

Within 30 days after award of the contract, and before orders are placed or shop drawings are submitted, submit a list of equipment and principal materials specified. Give names of manufacturers, catalog and model numbers, and such other supplementary information as necessary for identification.

PART 7 – SHOP DRAWINGS

Shop drawing procedures are specified in Division 1, General Requirements. Items requiring shop drawings include:

A. Equipment and Materials. All items of equipment and principal materials proposed for installations, including all equipment listed in the paragraph of acceptable manufacturers.

PART 8 – OPERATING AND MAINTENANCE INSTRUCTIONS

Submit operation and maintenance data under provisions of Section 01720 – Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance.

PART 9 – OPERATING TESTS

After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to insure proper sequence and operation throughout the range of operation. Make adjustments as required to insure proper functioning of all systems. Special tests on individual systems are specified under individual sections.

PART 10 – LUBRICATION

Provide a complete spare charge of the correct lubricant for each item of equipment requiring lubrication.

END OF SECTION

SECTION 11110
SUBMERSIBLE NON-CLOG CENTRIFUGAL PUMPS

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provision of all labor, materials and equipment to furnish and install all submersible, non-clog centrifugal pumps with integral submersible motors, control panel equipment, and accessories; including training, start-up, and field demonstration, for a complete and operable system.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. Anti-Friction Bearing Manufacturers Association (AFBMA)
4. Factory Mutual Approved (FMI)
5. Hydraulic Institute (HI)
6. Institute of Electrical and Electronic Engineers (IEEE)
7. National Electric Code (NEC)
8. National Electrical Manufacturers Association (NEMA)
9. Steel Structures Painting Council (SSPC)
10. Underwriters Laboratory (UL)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples.

B. Submit certified characteristic curves showing head-capacity relationship, brake horsepower, net positive suction head requirements, pump submergence requirements, pump efficiency (ratio of water horsepower to brake horsepower) and pump speed. Curves shall be complete for the entire range of operation from shut-off to zero head conditions. Submit manufacturer's L-10 bearing life calculations for radial and thrust bearings at pressure heads and flow rates shown in Section 2.3 C.

C. Manufacturer's Certifications
   1. Submit certification that the manufacturers of proposed electrical, mechanical, and structural systems affecting the performance of the pumping equipment have examined the Contract Documents and agree to the performance and material specifications, warranty conditions, and other requirements set forth herein.
      a. Submit manufacturer's certification that the maximum power requirement, if used, shall not exceed the motor rating under any operating condition on the pump characteristic curve.
      b. Submit seal manufacturer's certification that the seal is designed for service and application specified and is installed and aligned properly.
      c. Installation approved certification.

D. Record Drawings: Submit record drawings under provisions of Section 01720 - Project Record Documents.

E. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all curves, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

F. Results of Field Testing.

1.5 QUALITY ASSURANCE

A. Use new materials of high grade, and with properties best suited to the work required.

B. All pumps shall be field tested and accepted prior to achieving substantial completion.

C. Existing access hatches shall be demolished and replaced. Proposed access hatch dimensions shall be coordinated with pump dimensions and requirements to ensure adequate clearances are maintained for pump installation and removal.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide submersible, centrifugal, non-clog, solids handling-type pumps which are specifically designed for the pumping application. Refer to the service design conditions outlined in the 2.2 Performance Requirements.

B. Furnish pumps of standard dimensions, built to limit gauges or formed to templates, such that parts will be interchangeable between like units.

2.2 PERFORMANCE REQUIREMENT

*Guarantee Point

Design Conditions	**Units**	**SP-02-101, SP-02-201, SP-02-301, SP-02-401**
Location	-	Onsite Lift Station
Service	-	Raw Sewage
Liquid Temperature Rating	°F	104
Specific Gravity	-	1
Duty Rating	-	Continuous
Variable or Constant Speed	-	Constant
Motor Size (Maximum)	HP	25
Pump Operating Speed (Maximum)	rpm	1800
Solids Passage (Minimum)	in	3
Discharge Diameter	in	6
NPSH Required (Maximum)	ft	25
Shut Off Head (Minimum)	ft	90
Duty Condition No. 1*		
Flow	gpm	1042
Total Dynamic Head	ft	56.6
Pump Efficiency (Minimum)	%	68
Duty Condition No. 2		
Flow	Gpm	1300
Total Dynamic Head	Ft	48.8
Pump Efficiency (Minimum)	%	69
Duty Condition No. 3		
Flow	gpm	800
Total Dynamic Head	ft	62
Pump Efficiency (Minimum)	%	63

1. Provide a pump capable of meeting all Design Point duty conditions.
2. Select equipment which is designed and built for continuous service at all points within the specified range of operation, and at the All Pumps Off elevation shown in the plans, without overheating, without cavitation, and without excessive vibration or strain.
3. All pumps provided by the Contractor shall have a Capacity vs. Head curve with a slope steeper or equal to the slope of the line between the three (3) duty points. The minimum efficiencies listed are applicable to the impeller provided (i.e. the trimmed diameter, not the untrimmed diameter). Pump capacity, head and efficiency defined in the data corresponding to Duty Point One shall be the "guarantee point". Provide a pump with a characteristic performance curve which meets system curve requirements.
4. Pumps shall be designed for continuous operation without cavitation in a wet well installation. The pump shall have an inversely proportional head-capacity, characteristic curve. The pump curve shall have no region exhibiting a slope of zero.
5. The Contractor and/or pump manufacturer shall verify that the available Net Positive Suction Head (NPSH) exceeds the required NPSH under field conditions proposed for the installation.
6. When operating at the maximum output speed of the motor, under load and including slip (at 60 Hz), verify that the selected pump has a curve which meets all conditions listed in this section. The pump motor shall be capable of operating satisfactorily across the entire curve.

2.3 ACCEPTABLE MANUFACTURERS

A. Provide submersible non-clog centrifugal pumps of one of the following, no others will be allowed:
   1. Flygt (N Impeller)

B. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.

2.4 PUMP CASING

1. Provide the volute of a single piece, concentric or non-concentric design, having smooth fluid passages large enough at all points to pass any size solids which can pass through the impeller. Use volutes inlets of a suction bell design for pumps with 6-inch discharge and larger.
2. Construct major pump components of fine grained gray cast iron, ASTM A 48, Class 30 or better, with smooth surfaces devoid of blow holes and other irregularities.
3. Have mating surfaces machined and fitted with rubber o-rings where watertight sealing is required. Achieve sealing by metal-to-metal contact between machined surfaces or by use of embedded gasket to limit vibration and wear. This will result in controlled compression of o-rings without the requirement of a specific torque limit. Do not use secondary sealing compounds, rectangular gaskets, elliptical o-rings, grease or other devices.

2.5 POWER CABLE

1. Provide a cable entry water seal which precludes specific torque requirements to ensure a watertight and submersible seal. Seal the cable entry by an elastomer grommet, epoxy potting material, or a combination of both. Provide a cable entry sealing system with strain relief for the terminal connections and which allows access to the terminal connections without adversely affecting the integrity or function of the seal system.
2. Provide cables that are oil, grease and abrasion resistant. Use cables with an outer jacket of silicone rubber or other material equally suitable for immersion in wastewater.
3. For motors 20 horsepower and less, use cables capable of operating on 460 volt, 3 phase service and under continuous submergence to a depth of 65 feet without loss of watertight integrity. For motors greater than

20 horsepower use cables capable of operating on 460 volt, 3 phase service under these same continuous conditions.

4. No parallel power cables are acceptable unless they are size #1/0 or larger.
5. Provide motors with reconnectable terminal blocks. Number all leads.
6. Connect the submersible pumps to the proposed control panels as applicable.

2.6 SUBMERSIBLE MOTOR

1. Pump Motor Characteristics
   a. NEMA Design B squirrel-cage, induction, shell type design, housed in an air-filled watertight chamber.
   b. Stator winding and stator leads insulated with moisture resistant Class H insulation which will resist a temperature of 356°F.
   c. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable.
   d. Fabricate rotor bars and short circuit rings of aluminum.
   e. Pumps should be designed for continuous duty, capable of sustaining a minimum of 15 starts per hour, evenly spaced.
   f. Capable of operating at liquid temperature of 104°F in conformance with Factory Mutual requirements without overheating or operating in the service factor.
   g. Pumps should be non-overloading over the entire range of the pump operating curve within the nameplate horsepower.
2. Pump motor explosion-proof rating: UL listed or FM approved as explosion-proof, suitable for NEC Class I, Division 1, Group D environments.
3. Provide each unit with an adequately designed cooling system totally self-contained with no external mechanical devices. Select pumps designed to operate continuously with the fluid level at the top of the pump volute.
4. Use thermal sensors to monitor stator temperatures. Equip stator with thermal switches, embedded in the end coils of the stator winding. Wire the sensor to the control panel for use in conjunction with and supplemental to external motor overload protection.
5. For motor sizes larger than 100 horsepower, provide an independent thermal switch to monitor the lower motor bearing temperature.
6. Equip the pump with moisture sensors in the oil-filled seal chamber or stator chamber to indicate seal leakage. Equip motors larger than 20 horsepower with a leakage sensor to detect water in the stator chamber.
7. Size the motor to be non-overloading at the any point on the characteristic curve of the pump, including run-out. Provide a motor with a power draw that does not exceed the nameplate rating while the pump is operating between the normal minimum and maximum system curves, using a service factor of 1.15. Do not exceed the total capacity of the motor, including service factor, while the pump is operating between the normal minimum and emergency, run-out system curves.

2.7 SHAFT

1. Fabricate pump shafts as one piece of AISI Series 400 stainless steel.
2. Make shaft of sufficient diameter to assure rigid support of the impeller and to prevent excessive vibration at all speeds.

2.8 PUMP SEAL

1. Provide each pump with a tandem mechanical shaft seal system fabricated of tungsten carbide.
2. Operate the upper seal of the tandem set of seals in an oil chamber located just below the stator housing. The upper seal shall function as an independent secondary barrier between the pumped liquid and the stator housing.
3. The lower seal of the tandem set of seals shall function as the primary barrier between the pumped liquid and the oil housing.
4. Form each seal with a stationary ring and a positively driven rotating ring both fabricated of solid silicon carbide or tungsten.
5. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring action between upper and lower seal faces are not acceptable.

2.9 BEARINGS

1. Permanently lubricated ball or roller type rated in accordance with AFBMA for an L-10 duty life of at least 50,000 hours at the best efficiency point.

2.10 IMPELLER

1. The impeller shall be of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. Provide a non-clogging impeller design specifically for handling fibrous and abrasive solid. Select an impeller design capable of handling fibrous materials, heavy sludge and other matter found in normal, unscreened sewage. Have the impeller hub accurately fitted and mechanically secured to the motor shaft.

2. Bolts, Studs and Nuts: Stainless steel for all fasteners on the submersible pump and motor casing.

2.11 CONTROLS

1. The existing lift station control panel shall be re-used for the proposed pumps.
2. Ensure instrumentation is in accordance with Section 13340 – Instruments.
3. The PLC panel next to the control panel shall be replaced as part of this scope of work.
4. The pump protection module inside the existing control panel shall be replaced as part of this scope of work.
5. See Section 13441 – Process Control Narratives for a comprehensive lift station and pump control narrative.

2.12 ACCESSORIES

A. Bolts, Studs and Nuts
1. Bolts, studs and nuts: American National form right-hand machine cut threads in conformity with the current ANSI B1.1, Screw Threads, Coarse Thread Series, unless otherwise specified. Provide nuts and bolts with the standard hexagonal shape.
2. Finish for bolt heads and nuts: Semi-finished in conformity with ANSI B18.2, Wrench-Head Bolts and Nuts and Wrench Openings, Heavy Series, unless otherwise specified.
3. Anchor bolts, flange bolts, studs and nuts: Stainless steel in conformity with ASTM A 276.

B. Nameplate
   1. Furnish each pump with a stainless steel data plate containing the manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head and any other pertinent data.
   2. Provide a duplicate plate for installation on the inside cover of the pump control panel.

C. Pump Lifting Chain
   1. Provide Type 316 stainless steel lifting chain with eyes every 10 feet and sling for connection to pump.
   2. Provide a lifting chain for each pump provided.

2.13 COATING SYSTEM

A. Provide a shop-applied epoxy coating system in accordance with manufacturer's recommendations for service application.

B. Field touch-up damaged areas of coating in accordance with manufacturer recommendations.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the Work to Engineer.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's written instructions.

B. Provide sufficient clearances for thermal expansion and contraction.

C. Mount duplicate pump nameplate(s) inside front panel of pump control panel, using stainless steel fasteners.

D. Install pump base plates using Type 316 stainless steel Hilti adhesive anchors.

3.3 FIELD TESTING

A. All equipment will be given running tests by Contractor and Manufacturer's Representative at the Site following installation of the equipment and controls.

B. The Contractor shall provide all necessary test equipment, including temporary flow meters, pressure gages, piping plugs or caps, or temporary bulkheads, and current meters.

C. Contractor shall ensure there is sufficient volume in the wet well to conduct test and that all downstream components are capable of receiving pumped liquid. If there is no flow to the wet well upon start up, the Contractor

shall provide water for testing purposes. If downstream component are not in place, Contractor shall make provisions for recycling pumped water and disposal.

D. Field tests shall consist of operating the pumps under normal and abnormal conditions.

E. Flow, pressure, and current shall be measured and documented for at least three operating points on each pump.

F. Pumps shall be checked for proper alignment to avoid imbalance and excessive vibration. Any misalignment of greater than ¼" shall be remedied prior to demonstration period.

G. Should the tests indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments, and then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the ENGINEER, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

3.4 SERVICES BY MANUFACTURER

A. A factory trained representative of the manufacturer shall provide services for installation supervision, start-up and test services and operation and maintenance personnel training services.

B. Manufacturer's representative shall perform on-site services according to the following schedule, excluding travel time:

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	0.5	1
Pre-demonstration functional and performance testing	0.5	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ pre-demonstration start up
Pre-demonstration start up	0.5	1
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer shall provide a written report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

D. Manufacturer shall operate the system in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. The Manufacturer's Representative shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

F. Contractor will be back charged by the Client for an unsuccessful field testing demonstration. Schedule the field demonstration a minimum of 48 hours following a successful startup procedure.

END OF SECTION

SECTION 11130
SELF-PRIMING PUMPS

PART 1 – GENERAL

1.1 SCOPE

This section includes provisions of all labor, materials and equipment to furnish, and install a horizontal, self-priming centrifugal, pump with motor, control panel and accessories, including training, start-up and field demonstration for a complete and operable system. Pumps will be installed as part of the Peak Shaving Basin pumping system and the NPW pumping system.

A. Furnish, install, startup, and field test the self-priming centrifugal pump, designed and sized as necessary for installation as specified herein and as shown on the Drawings.

B. Furnish all labor, materials, equipment, and incidentals required for a complete installation, proper operation, and successful field testing.

C. Items that are shown in the Drawings as part of the packaged system shall be considered part of the Manufacturer's scope, whether specified in this Section or not.

D. This Section does not necessarily include all required equipment, submittal information, certifications, performance requirements, equipment requirements, testing, or services. The Manufacturer shall provide all materials and services necessary to fulfill the intent of this Section and of the Contract.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Gear Manufacturers Association (AGMA)
2. American National Standards Institute (ANSI)
3. Anti-Friction Bearing Manufacturers Association (AFBMA)
4. ASTM International (ASTM)
5. Hydraulic Institute (HI)
6. Occupational Safety and Health Administration (OSHA)
7. Water and Environment Federation (WEF)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of the Contract as specified in Section 01300 – Submittals. Include the following, arranged to facilitate submittal review.
1. Catalog cuts sheets, construction materials, dimensions, and shop coatings.
2. Performance characteristics and certified pump curves showing head-capacity relationship, brake horsepower, net positive suction head (NPSH) requirements, pump efficiencies, and pump speeds. Pump curves shall be complete for the entire range of operation from shut-off to run-out.
3. Certified dimensional drawings indicating size and locations of the priming recirculation port or ports.
4. Structural details for the base frame, if provided. Include all material properties, classifications, dimensions, and thicknesses.
5. L-10 bearing life calculations for radial and thrust bearings at the herein specified pumping rates and pump discharge pressures.
6. Certified shop test results, including re-prime performance test data.

B. Provide the following Certifications:
1. The Manufacturer has examined the Contract Documents and agrees to the performance and material specifications, warranty conditions, and other requirements of the Contract.
2. The maximum pump power requirements will not exceed the motor rating under operating conditions on the pump characteristic curve.
3. The original equipment manufacturer (OEM) of the seals states that the seals are properly aligned and designed for uses and service conditions specified herein.
4. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel.
5. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
6. The Manufacturer can provide a complete stock of spare parts within 48 hours of request.

C. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all curves, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

D. Submit record drawings under provisions of the Contract.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Shipments shall take place after Engineer approval of factory test results.

C. Manufacturer's on-site services shall be provided via one or more qualified full-time factory employee(s), or service technician(s) with extensive experience in on-site installation and testing of equipment similar to that specified herein.

D. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

E. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

F. Coordinate all dimensions to ensure adequate clearances for pump maintenance, removal, or replacement.

1.6 WARRANTY

A. For a period of 12 months from Substantial Completion, the Manufacturer shall warrant that the equipment shall be free of defects in material and workmanship. The Manufacturer shall repair or replace any defective equipment or components. The Owner shall not be responsible for any related costs, such as removal, shipping, or reinstallation.

B. The seal shall be warranted for a minimum of four (4) years from date of shipment. Should the seal fail within the first year, the manufacturer shall be obligated, upon notification, to furnish a new seal, without charge to Owner, F.O.B. factory. The cost of replacement seals thereafter will be on a pro-rated basis as follows:

FAILURE WITHIN	PERCENTAGE OF NEW SEAL PRICE
2 Years	25%
3 Years	50%
4 Years	75%

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide horizontal, self-priming, centrifugal pumps which are specifically designed for the pumping application(s). Refer to the service design conditions outlined in the 2.2 Performance Requirements.

B. Furnish pumps of standard dimensions, built to limit gauges or formed to templates, such that parts will be interchangeable between units.

2.2 PERFORMANCE REQUIREMENTS

Design Conditions	Units	SPP-04-301	SPP-10-101, SPP-10-201
Location	-	Peak Shaving Basin Pump Station	NPW Pump Station
Service	-	Raw Sewage	Non-Potable Water
Liquid Temperature Rating	°F	104	104
Specific Gravity	-	1.03	1
Duty Rating	-	Continuous	Continuous
Variable or Constant Speed	-	Constant	Variable
Motor Size (Maximum)	HP	15	25
Motor Operating Speed (Maximum)	rpm	870	1800
Solids Passage (Minimum)	in	3	1/4
Discharge Diameter	in	6	3
NPSH Required (Maximum)	ft	24	22
Shut Off Head (Minimum)	ft	37	164
Total Dynamic Suction Lift (Static + Dynamic Head Loss)	ft	12	10.25
Maximum Repriming Lift	ft	10	10
Maximum Static Suction Lift	ft	10	10
Duty Point No. 1*			
Flow	gpm	451	150
Total Dynamic Head	ft	29	151
Static Head (Maximum)	ft	18	12
Pump Efficiency (Minimum)	%	50	41
Duty Point No. 2			
Flow	gpm	225	75
Total Dynamic Head	ft	21	157
Static Head (Maximum)	ft	18	12
Pump Efficiency (Minimum)	%	40	25

***Guarantee Point**

2.3 ACCEPTABLE MANUFACTURERS

A. Provide the following self-priming centrifugal pumps for the Peak Shaving Basin Pump Station, no others will be allowed:
   1. Cornell

B. Provide the following self-priming centrifugal pumps for the NPW Pump Station, no others will be allowed:
   1. Griswold
   2. Gorman-Rupp
   3. ITT Goulds

C. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.

2.4 PUMP CONSTRUCTION

Each pump shall include a single suction connection and a single discharge connection.

A. No special tools shall be required for replacement of pump components. Equip each pump with a removable cover plate, allowing access to pump interior for clearance of stoppages, and providing access for service and repairs without removal of suction or discharge piping.

B. Pump components that are exposed to sewage shall be Class 30 cast iron. All openings, internal passages, and internal recirculation posts shall be large enough to permit the passage of a solid sphere as defined below, stringy material, or other debris commonly found in domestic sewage. Do not use screens or any internal devices that create a maintenance nuisance or affect pump performance.

C. Fit each pump with a replaceable wear plate. Replacement of the wear plate, impeller, seal, and suction check valve shall be accomplished through the removable cover plate. The entire rotating assembly, including bearings, shaft, seal, and impeller, shall be removable as a unit without removing the pump volute or piping.

D. Each pump shall incorporate a suction valve that can be removed or installed through the removable cover plate opening, without disturbing the suction piping. The check valve shall eliminate re-priming with each cycle. Pumps shall not require suction check valves for priming or re-priming.

E. Means shall be provided for external adjustment of the clearance between the impeller and wear plate.

F. The impeller shall be dual-vane, semi-open, non-clog, cast in ductile iron with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lock screw.

G. The pump shaft shall be protected from leakage by a mechanical seal. Both the stationary sealing member and mated rotating member shall be of tungsten titanium carbide alloy. Each mating surface shall be lapped to a flatness of 3 light bands (35 millionths of an inch), as measured by the optical flat under monochromatic light. The stationary seal seat shall be double floating. Shock loads shall not affect the face alignment or cause deflection, vibration, or axial/radial movement of the pump shaft.

H. The seal shall be lubricated with oil from a separate, oil filled reservoir. The same oil shall not be used to lubricate both shaft seal and shaft bearings.

I. Impeller shaft bearings shall be anti-friction ball or tapered roller bearings, of ample size and proper design to withstand all radial and thrust loads which can reasonably be expected during normal operation. Bearings shall be

lubricated from a separate reservoir. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal shall not be acceptable.

J. Each pump shall be equipped with a flanged one-piece, cast iron suction spool. Each spool shall have one ¼" NPT and one ¼" NPT tapped hole with pipe plugs for mounting of gauges or other instrumentation.

2.5 SELF PRIMING REQUIREMENTS

A. Debris may occasionally lodge between the pump suction check valve and seat, causing loss of the suction leg and/or liquid syphoning from the pump casing to the impeller center line. This shall be considered normal with proper installation of air release lines. Hence, design each pump for automatic, unattended repriming at rated speed, in an open system, without suction check valves, and with a dry suction leg.

B. Each pump shall be capable of a 10-foot re-prime lift, at the selected speed and impeller diameter. For purposes of this Section, re-prime lift height shall be the height of pump suction above the priming liquid level. Re-priming shall be considered as delivery within five (5) minutes of liquid remaining in the pump casing after pump shut-down and removal of the suction check valve.

2.6 DRIVE UNIT

A. For the Peak Shaving Basin Pumps, each drive assembly shall have a minimum of two (2) V-belts. In no case will a single belt drive be acceptable. Each drive assembly shall be selected on the basis that adequate power will be transmitted from drive to pump.

A. Drive systems with a safety factor of less than 1.5 to 1 shall not be considered sufficient for the service intended. Computation of safety factors shall be based on performance data published by the drive manufacturer.

B. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one (1) or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½-inch (½").

C. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component.

D. All metal shall be free from burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than five-inch (5") spacing. Tack welds shall not exceed a four-inch (4") spacing.

E. The guard shall be primed with a minimum of 1.5 mils of zinc-based synthetic primer. A finish acrylic enamel coating (minimum 1.5 mils) shall be applied in accordance with Section 3, Color Definitions of ANSI 253.1; 1967, Safety Color Code for Marking Physical Hazards.

2.7 MOTORS

A. The pump motors shall be horizontal, TEFC, severe duty, mill and chem, induction type, NEMA Premium Efficient with normal starting torque and low starting current characteristics, suitable for three continuous service at (3) phase, 60 hertz, 460 volts. Refer to section 16013 – Electric Motors for additional requirements.

2.8 PEAK SHAVING BASIN PUMP STATION CONTROLS

A. The peak shaving basin self-priming centrifugal pump will be controlled by a new local PLC control panel provided by the Contractor PCSS. Refer to specification 13441 – Process Control Narrative for software logic details.

B. Provide instrumentation in accordance with Section 13340 – Instruments.

2.9 NON-POTABLE WATER PUMP STATION CONTROLS

A. The Automatic Controls for operation of the non-potable water pumps shall be controlled by a custom NPW control panel, furnished fully assembled, wired and preprogrammed, ready for field mounting and wiring in a UL certified NEMA 4X Type 316 stainless steel enclosure. The control system shall include a circuit breaker disconnect, transformer, motor circuit breakers, variable frequency drives, motor overloads, GFI receptacle, micro-processor controller, operator interface, selector switches, pilot lights, relays, control circuit breakers. All electrical components shall be NEMA rated, IEC components will not be accepted. For items not included in this section, reference Section 13330 – Control Panel Enclosures and Panel Equipment, and for Process Control Narrative, reference Section 13441 – Process Control Narratives.

B. UL Listed Variable Frequency Drive(s) (VFD) shall be provided to control the non-potable water pump(s) in accordance with Section 16175 – Variable Frequency Drives. The VFD's shall control motor speed via a manual setting. It functions only as a manual adjustment to the motor rpm so that the appropriate speed is provided. The VFD output frequency shall be programmable. The VFD shall be located inside the NPW control panel and rated for an operating temperature of -4° to 140°F (-20° to 60° C).

C. Provide instrumentation in accordance with Section 13340 – Instruments.

2.11 ACCESSORIES

A. Bolts, Studs, and Nuts
1. Bolts, studs and nuts: American National form right-hand machine cut threads in conformity with the current ANSI B1.1, Screw Threads, Coarse Thread Series, unless otherwise specified. Provide nuts and bolts with the standard hexagonal shape
2. Furnish for bolt heads and nuts: semi-finished in conformity with ANSI B18.2, Wrench-Head Bolts and Nuts and Wrench Openings, Heavy Series, unless otherwise specified.
3. Anchor bolts, flanges bolts, studs and nuts: Stainless steel in conformity with ASTM A 276.

B. Nameplate
1. Furnish each pump with a stainless-steel data plate containing the manufacturer's name, pump size and type, serial number speed, impeller diameter, capacity and head and any other pertinent data
2. Provide a duplicate plate for installation on the inside cover of the pump control panel.

2.12 COATING SYSTEM

A. Provide shop applied epoxy coating system in accordance with manufacturer's recommendations for service application. A shop-applied or field-applied polyurethane top coat shall be provided. Top-coat shall be in compliance with the shop-applied epoxy coating and in accordance with manufacturer's recommendations.

B. Field touch-up damaged areas of coating with same coating system in accordance with manufacturer's recommendations.

C. For the Peak Shaving Basin Pump Station, finish color shall match existing peak shaving basin pumps.

D. For the Non-Potable Water Pump Station, finish color shall be purple.

PART 3 – EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. Crate and protect all equipment against damage during shipment. Exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

B. Store equipment off the ground in enclosed shelter. Store and maintain equipment in accordance with Manufacturer's recommendations and per provisions of the Contract.

3.2 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the Work to Engineer.

3.3 INSTALLATION

A. Install and adjust equipment in accordance with the Drawings, approved shop drawings, and the manufacturer's instructions

B. Do not operate the equipment until the installation is approved by the Manufacturer's on-site representative.

C. Remove temporary bracing supports and other construction debris that may damage equipment.

D. Remove any temporary protective coatings and oils used for protection during shipment.

E. Check equipment for correct operation and freedom of moving parts.

F. Align equipment to Manufacturer's tolerances. Adjust clearances and torques.

G. Flush and fill lubricated systems in accordance with Manufacturer's instructions.

H. Provide sufficient clearances for thermal expansion and contraction.

I. Mount duplicate pump nameplates(s) inside front panel of pump control panel, using stainless steel fasteners.

3.4 FIELD TESTING

A. Prior to startup, the Manufacturer's representative, shall inspect all equipment for proper assembly, alignment, and proper operation.

B. Pumps shall be checked for proper alignment to avoid imbalance and excessive vibration. Any misalignment of greater than ¼" shall be remedied prior to demonstration period.

C. The Manufacturer's representative with assistance from the Contractor shall perform equipment tests in order to certify compliance with the herein specified performance requirements.

D. The Contractor shall provide all necessary test equipment, including temporary flow meters, pressure gauges, piping plugs or caps, or temporary bulkheads, and current meters.

E. Contractor shall ensure there is sufficient volume in the basin to conduct test and that all downstream components are capable of receiving pumped liquid. If there is no flow to the basin upon start up, the Contractor shall provide water for testing purposes. If downstream components are not in place, Contractor shall make provisions for recycling pumped water and disposal.

F. Place the system into operation. All components shall continue to operate without alarms or shut downs, except as intended, for eight consecutive hours to be considered ready for startup.

G. Field tests shall consist of operating the pumps under normal and abnormal conditions.

H. Operate each pump through its entire performance range. Adjust, balance, and calibrate and verify that the equipment, safety devices, controls, and process system are operating as intended. Test safety devices for proper settings and signals.

I. Flow, pressure, and current shall be measured and documented for at least three operating points on each pump.

J. Re-prime tests shall be done with clean water and repeated at least five (5) times under the following conditions:
   1. Piping shall incorporate a spring loaded discharge check valve downstream from the pump.
   2. A 10-foot (10') length of one-inch (1") pipe shall be installed between pump and discharge check valve. This line shall be open to atmosphere at all times to duplicate the air displacement rate of a typical pump station fitted with an air release valve.
   3. No restrictions shall be present in pump or suction piping which could serve to restrict the rate of siphon drop of the suction leg.
   4. Suction pipe configuration for re-prime test shall incorporate an appropriate length of horizontal pipe (2' minimum) and one (1) 90-degree elbow, and vertical run at the specified lift.
   5. Impeller shall be set at the clearances recommended by the manufacturer in the pump service manual.

K. Should the tests indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments, and then re-test the equipment. Such test and adjustments shall be repeated until, in the opinion of the ENGINEER, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

L. A copy of all information from functional tests, including data, worksheets, and other materials shall be turned over to the Owner at the completion of the testing program, and copies shall be included in the Operations & Maintenance Manual for the project.

3.5 MANUFACTURER SERVICES

A. A factory trained representative of the manufacturer shall provide services for installation, supervision, start up and field testing services, and operation and maintenance personnel training services.

B. Manufacturer's representative shall perform on-site services, including training of Owner's personnel, according to the following schedule, excluding travel time.

Work	Person Days	Trips
Installation assistance and inspection	1	2 (one per PCS)
Functional and Performance Testing	1	2 (one per PCS)
Pre-startup on-site training of Owner personnel	0.5	Can combine with equipment tests
Startup	0.5	Can combine with equipment tests
Post-startup on-site training of Owner personnel	0.5	2 (one per PCS)

C. Manufacturer shall provide a written report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

D. Manufacturer shall operate the system in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. The Manufacturer's Representative shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

F. Contractor will be back charged by the Client for an unsuccessful field testing demonstration. Schedule the field demonstration a minimum of 48 hours following a successful startup procedure.

END OF SECTION

SECTION 11144
MULTI-STAGE VERTICAL TURBINE PUMP

PART 1 – GENERAL

1.1 SCOPE

A. Provide all labor, materials, and equipment as shown and specified to furnish and install multi-stage vertical turbine pumps, electric motors, pump columns, shafts, bases, bearings, and all appurtenances.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor supplier or manufacturer of complying with the requirements herein.

1.3 REFERENCES

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. Anti-Friction Bearing Manufacturers Association (AFBMA)
4. Hydraulic Institute (HI)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. National Electric Code (NEC)
7. National Electrical Manufacturers Association (NEMA)
8. Steel Structures Painting Council (SSPC)
9. American Water Works Association (AWWA)
10. National Sanitation Foundation (NSF)

1.4 SUBMITTALS

A. Provide submittal data, manuals and drawings as specified in Section 01340, Shop Drawings.

B. Pump Data
1. Certified pump curves shall identify shut-off head, duty point, and range at which the pump operates without vibration and cavitation.
2. Net positive suction head requirements
3. Brake horsepower
4. Pump efficiency and pump speed
5. Materials used in fabrication of all pump components including dimensions, weights, coating requirements, and cross sectional views
6. Factory performance test results and certifications
7. Performance test results with permanent pump installed and vibration analysis
8. Names and addresses of the nearest factory authorized service organization
9. Elevation drawings noting sizes, depths, lengths, and dimensions; foundation and anchoring details; total weight of pump unit including pump, column, head, and motor
10. Factory non-witness test requiring Engineer approval prior to shipment
11. Minimum submergence requirements
12. Manufacturer’s specification

13. Engineering data
14. Impeller diameter
15. Critical Speed
16. L-10 bearing life calculations

C. Motor Data
1. Horsepower
2. Electrical characteristics
3. Bearing life ratings
4. Insulation ratings
5. Weight
7. Wiring Diagram
8. Space Heaters
9. Dimensions
10. Nameplate Data

D. Instruction Books
1. Service and maintenance manual
2. Service parts list
3. Outline drawing

E. Manufacturer's Certifications
1. Submit manufacturer's certification that Contract Documents have been examined by the manufacturer for proposed electrical, mechanical, and structural systems affecting performance of the pumping equipment.
2. Submit manufacturer's certification that the maximum power requirement, if used, shall not exceed the motor rating under operating conditions on the pump characteristic curve.
3. Submit seal manufacturer's certification that the seal is designed for service and application specified and is installed and aligned properly.

1.5 QUALITY ASSURANCE

A. Pumping units shall be specifically designed for heavy duty, continuous use, and municipal industrial grade. Irrigation or agricultural grade units are not allowable. Use new materials of high grade, and with properties best suited to the work required.

B. Pumping units and motors shall be the product of manufactures with at least 10 years of successful experience in the design, manufacturing and application of pumping units of the type, size and performance capabilities as specified. The pump manufacturer shall have at least three similar size pumps of the model, type, and size of pump in service and operational for at least five years. Manufacturers shall provide a list of references for the same.

C. All components of the pump shall be supplied, assembled, and warranted by one of the approved pump manufacturers. Pump components shall not be acquired from separate entities and assembled as a final product by a manufacturer's representative. All pumps shall be supplied by the same manufacturer.

D. Pumps, as an assembled unit, shall be compliant to NSF/ANSI Standard 61 and Annex G and meet the requirements of the US Safe Drinking Water Act.

E. Pumps shall include a nameplate displaying NSF-G compliant.

F. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of Work.

G. Store material to permit easy access for inspection and identification. Keep all materials off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. Store and maintain equipment in accordance with manufacturer's direction.

H. The pumping unit manufacturer shall perform both lateral and torsional critical speed analyses on the assembled pumping units to identify and ensure:
1. That the first lateral critical speed is at least 20% above or below the operating speed of the pumping unit over the entire operating speed range defined;
2. On constant speed applications, that no torsional natural frequencies occur within a range extending from 20% below to 20% above the operating speed of the pumping unit over the entire operating speed range defined;
3. On constant speed pumping units, that any blade excited resonant frequency shall be no closer than plus or minus 20% of the natural frequency of any part of the installed assembled pumping unit over the entire operating speed range defined.

I. Factory Tests
1. Pump Test
a. The pump manufacturer shall perform a non-witness factory performance test of the entire pump assembly to demonstrate compliance with the specifications and to verify guaranteed performance of the pump. A calibrated factory driver may be used in lieu of the job driver.
b. The factory test shall include the actual flow, total dynamic head, pump horsepower, and pump efficiency for all the duty points listed.
c. Tests shall be sufficient to determine the curves of head, input horsepower, and efficiency relative to capacity from shutoff to 150% of design flow.
d. Test pump and recirculate water for at least one hour under simulated service conditions.
e. The test shall also check for excessive vibration and leaks in all piping and seals.
f. A minimum of six points, including shutoff, shall be taken for each test. At least one point of the six shall be taken as near as possible to each specified condition.
2. Motor Test
a. The motors to be installed shall be tested by the motor manufacturer and a full written report provided to the engineer.
b. The testing shall be performed in accordance with IEEE 112 method B at 60 Hz, 50 Hz, 40 Hz and 30 Hz.
c. The test shall include percent slip, no load current, full load current, locked rotor current, locked rotor torque, efficiency, and power factor at the frequencies listed above, megger, winding resistance and high potential.
3. The Contractor shall submit the factory test results and certification to the Engineer for approval before the pump is released for shipment.

1.6 OPERATION AND MAINTENANCE DATA

A. The manuals shall be prepared specifically for this installation and shall include all required cut sheets, drawings, equipment lists, descriptions, etc. In addition to the requirements of Section 01720, the manuals shall include the following at a minimum:
1. Complete column assembly, pumping equipment, discharge head, oiler, parts list, test reports, maintenance data and schedules, spare parts information, and cross-referenced to exploded view of assembly drawings.
2. Dimensional drawings for all provided components with their respective weights.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide vertical, multistage turbine pumps complete with electric motor, column assembly, discharge head, bearings, and all accessories and appurtenances necessary to provide a complete operating pumping system. Select pump and motor combination on overall efficiency. Pump and all components shall conform to ANSI B58. 1-1961 "American Standard for Vertical Turbine Pumps" and the Hydraulic Institute Standards for Centrifugal Pumps.

2.2 PERFORMANCE

A. When operating at the maximum output speed of the motor, under load and including slip (at 60Hz), the pumping units shall meet all minimum conditions listed in the table below. Pump capacity, head and efficiency defined in the data corresponding to Design Point One shall be the “guarantee point”.

Design Conditions	**Units**	VMP-14B-101, VMP-14B-201
Location	-	Dewatering Bldg
Liquid Being Pumped	-	Non-Potable Water
Temperature	°F	60 to 104
Specific Gravity	-	1
Variable or Constant Speed	-	Constant
Max. Motor Size	HP	2
Max. Pump Operating Speed	RPM	1750
Discharge Flange Diameter	inches	2
Shaft Bearing Lubrication	-	-
Max. Number of Stages	-	3
Type of Impeller	-	Stainless Steel
Type of Shaft	-	Stainless Steel
Min. Upstream Pressure	psi	30
Duty Condition 1 *Guarantee Point		
Design Flow	gpm	41
Total Dynamic Head	psi	32.5
Required Booster Pressure	psi	62.5
Minimum Bowl Efficiency	%	60
Duty Condition 2		
Design Flow	gpm	60
Total Dynamic Head	psi	27.7
Required Booster Pressure	psi	57.7
Minimum Bowl Efficiency	%	71

B. The pump shall have a Capacity vs Head curve with an increasingly rising slope steeper or equal to the slope of the line between the two duty points.

C. Select equipment which is designed and built for continuous service at all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain.

D. Select a pump and impeller that meets the performance requirements using an impeller that is at least one size smaller than the largest impeller size that can be furnished with that pump size.

2.3 ACCEPTABLE MANUFACTURERS

A. Provide skid-mounted vertical multi-stage pumps of one of the following manufacturers.
   1. Goulds, e-SV series

2.4 PUMP COMPONENTS

A. Pump Casing
   1. Provide pump casings with integral base plate constructed of fine grained, high tensile strength cast iron (ASTM A 48, Class 30 or better), Type 304 stainless steel or Type 316 stainless steel. Provide casings with smooth surfaces devoid of blow holes and other irregularities. Use clean, sound casting without defect. Do not plug, weld or otherwise repair defects.
   2. Furnish pump casings able to withstand a hydrostatic pressure twice the pressure at rated capacity or 1½ times shutoff head, whichever is greater.
   3. Provide flanged or threaded inlet and discharge connections with sizes and connection types as referenced on the construction drawings. Inlet and discharge connections shall be located on opposite sides of the pump for an in-line type installation.

B. Wear Rings
   1. Provide wear rings constructed of polyphenylene sulfide (PPS) or Type 304 stainless steel within each pump stage. Wear rings must be easily replaceable.

C. Impellers
   1. Provide enclosed type impellers constructed of Type 304/304L stainless steel or Type 316/316L stainless steel.
   2. Impellers shall be balanced hydraulically and dynamically within each stage.
   3. Do not coat impellers with porcelain, enamel, or any other material.

D. Diffuser Bowls
   1. Provide diffuser bowls constructed of Type 304/304L stainless steel or Type 316/316L stainless steel for each pump stage.

E. Mechanical Seal
   1. Provide a mechanical seal for the pump shaft. Mechanical seal shall be bellows or cartridge type. The stationary face shall be silicon carbide imbedded with graphite. The rotary face shall be carbon or silicon carbide imbedded with graphite. The elastomer shall be Viton or EPDM.

F. Shaft
1. Provide a pump shaft constructed of Type 316 stainless steel or Type 431 stainless steel. Pump shaft shall be machined, precision ground and polished.
2. Select shafts of ample size to operate the pump without distortion or vibration.

G. Shaft Coupling
1. Provide a shaft coupling constructed of aluminum or cast iron (ASTM A 48, Class 25 or better) or stainless steel.

H. Shaft Sleeves
1. Provide pump shaft sleeves constructed of tungsten carbide or Type 316 stainless steel.

I. Shaft Bearings
1. Provide shaft bearings constructed of tungsten carbide or silicon carbide.
2. All bearings shall be lubricated by the pumped fluid.

J. Anchor Bolts
1. The Contractor shall provide stainless steel anchor bolts to attach each pump casing/base plate to the foundation.

2.5 ELECTRIC MOTOR

A. Pump Motor Characteristics
1. Motor shall be vertical, mill and chemical duty, TEFC severe duty rated, induction motor rated for 460V, 3 Phase, 60 Hz service. Motor shall also be NEMA Premium Efficient and shall also follow all requirements of Section 16013 – ELECTRIC MOTORS.
2. The motor shall be designed for an ambient temperature of 40°C. Stator winding and stator leads insulated with moisture resistant inverter duty insulation which will resist a temperature of at least 356°F. The magnet wire shall be specially made for inverter duty and the end turns and phase-to-phase insulation shall be increased. Motors not used in conjunction with VFDs may use class F non-hygroscopic insulation.
3. Designed for continuous duty, capable of sustaining a minimum of 6 starts per hour, evenly spaced. The motor shall meet or exceed the requirements of NEMA MG10 Table 7.
4. Capable of operating at liquid temperature of 104°F in conformance with Factory Mutual requirements without overheating or operating in the service factor.
5. Non-overloading over the entire range of the pump operating curve within the nameplate horsepower.
6. The motor shall include properly sized space heaters. Provide a conduit box for the power leads.
7. Size the motor to be non-overloading at the any point on the characteristic curve of the pump, including run-out. Provide a motor with a power draw that does not exceed the nameplate rating while the pump is operating between the normal minimum and maximum system curves, using a service factor of 1.15. Do not exceed the total capacity of the motor, including service factor, while the pump is operating between the normal minimum and emergency, run-out system curves.
8. Provide in addition to the manufacturer's standard data a certified dimensional print, performance curves, reed critical frequency data, speed vs. torque vs. amps curves.

2.6 DEWATERING NPW BOOSTER PUMP CONTROLS

A. The PCSS shall provide a control panel capable of operating all proposed pumps as described below.

B. Construct panel in accordance with Section 13330 – Control Panel Enclosures and Panel Equipment.

C. Provide instrumentation in accordance with Section 13340 – Instruments.

D. PLC tag database shall be provided to PCSS and/or Owner for incorporating into top end SCADA for Monitoring and Controls. At minimum the following shall be provided:
   a. The following statuses shall be monitored at the plant SCADA:
      i. All motor Hand/Off/Auto
      ii. All motor running status
      iii. All pressure statuses
      iv. All faults and alarms

E. Provide a PLC in accordance with 13311 PLC Hardware and Software.

F. Refer to 13441 Process Control Narratives for a complete process control description.

2.7 ACCESSORIES

A. Nameplates
   1. Provide each pump and motor with a stainless steel nameplate securely affixed in a conspicuous place.
   2. Do not paint over nameplate.
   3. Nameplates shall be imprinted.
   4. Pump Nameplate
      a. Each pump nameplate will show the duty point, at rated speed in revolutions per minute, serial number, impeller number, and number of stages.
   5. Motor Nameplate
      a. See Section 16013 – ELECTRIC MOTORS.

2.8 COATING SYSTEM

A. Shop prime in accordance with the manufacturer's recommendations for transportation and storage. Field prep and coat in accordance with Section 09921 – Protective coatings.

2.9 LIFTING, ALIGNMENT, AND ACCESS

A. Provide lifting lugs capable of supporting the weight of the entire pump and motor.

B. Provide the motor support pedestal with an accurate, machine-registered fit for alignment of the driver.

C. Provide suitable openings for each access to the seal.

PART 3 – EXECUTION

3.1 INSPECTION

A. Install all equipment and connecting piping in accordance with Manufacturer's instructions. Prior to testing and start-up, FPR and manufacturer's representative to inspect to verify the system is complete.

B. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which adversely affect installation.

C. Promptly report defects which may affect Work to Engineer.

3.2 INSTALLATION

A. Clean all new piping prior to testing.

C. Install products in accordance with manufacturer's written instructions.

D. Provide sufficient clearances for thermal expansion and contraction.

E. Anchor pumps to foundation with Type 316 stainless steel threaded anchor rods with adhesive.

F. Tolerances for plumbness shall be in accordance with Hydraulic Institute standards.

3.3 FIELD PAINTING

A. Field painting shall conform to the requirements of Specification Section 09921.

B. Number the pumps with 6-inch or larger stencils using black alkyd paint. Pump numbers are to correspond to wiring in control panels.

3.4 FIELD PERFORMANCE TEST

A. After pumps have been completely installed and started-up under the direction of the Manufacturer, conduct field tests to demonstrate that pump operation conforms to these Specifications.

B. If the pump performance does not comply with Specifications, take corrective measures or remove and replace pumps with pumps which satisfy the conditions specified, at no additional cost.

C. The Contractor shall provide all necessary test equipment, including temporary flow meters, pressure gauges, piping plugs or caps, or temporary bulkheads, and current meters.

D. Contractor shall ensure there is sufficient volume of water available to conduct test and that all downstream components are capable of receiving pumped liquid. If there is no available water, the Contractor shall provide water for testing purposes. If downstream components are not in place, Contractor shall make provisions for recycling pumped water and disposal.

E. Contractor shall verify that all structures, pipes, and equipment are installed correctly and make any adjustments required before start-up of pump. Any component parts which are damaged as a result of this testing or which fail

to meet the requirements of these specifications shall be replaced, reinstalled, and re-tested at the Contractor's expense.

F. No form of energy shall be turned on to any part of the system prior to approval of Manufacturer's service representative.

G. Field tests shall consist of operating the pumps under normal and abnormal conditions.

H. Flow, pressure, and current shall be measured and documented for at least three operating points on each pump.

I. Pumps shall be checked for proper alignment to avoid imbalance and excessive vibration. Any misalignment of greater than ¼-inch shall be remedied prior to demonstration period.

J. Provide vibration testing of pumps at 1Hz increments throughout the entire operating range.

K. Provide a testing acceptance letter from the Manufacturer on his letterhead that states the pump was installed in accordance with the manufacturer's instructions, has met all performance requirements, and has been accepted by the Manufacturer.

L. Should the tests indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments, and then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the ENGINEER, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

M. Manufacturer will be back charged by the Owner for an unsuccessful field testing demonstration.

N. **The non-potable water pumps form part of the dewatering PCS system and therefore should be tested as part of the dewatering system to achieve acceptance.**

3.6 SERVICES BY MANUFACTURER

A. A factory trained representative of the Manufacturer shall provide services for installation supervision, start-up and test services and operation and maintenance personnel training services.

B. Manufacturer's representative shall perform on-site services according to the following schedule, excluding travel time:

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	0.5	1
Pre-demonstration functional and performance testing	0.5	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ testing and pre-demonstration start up
Pre-demonstration start up	1	Can be combined w/ testing and pre-demonstration start up
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer shall provide a written report certifying that the installation has been checked, is adequate for the intended purpose, all power connections have been checked, all controls are functional, and that the equipment is ready to be placed into service.

D. Manufacturer shall start-up and operate the system in the presence of the Engineer, and conduct the field performance test to verify that the equipment meets or exceeds the specified requirements. Manufacturer shall revisit the site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. The Manufacturer shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the Owner.

3.7 FINAL ACCEPTANCE

A. Final acceptance use will not occur until after the following activities have been performed and accepted by the Engineer.
   1. Training the Owner's operating and maintenance personnel by the Manufacturer's Representative.
   2. Satisfactory completion of the Demonstrative Period under the Owner's control.

END OF SECTION

SECTION 11152
DOUBLE DISC DIAPHRAGM PUMPS

PART 1 – GENERAL

1.1 SCOPE

A. Provide all labor, materials, and equipment as shown and specified to furnish and install double disc diaphragm pumps, electric motors, skids, bearings, and all appurtenances.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor supplier or manufacturer of complying with the requirements herein.

1.3 REFERENCES

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. Anti-Friction Bearing Manufacturers Association (AFBMA)
4. Hydraulic Institute (HI)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. National Electric Code (NEC)
7. National Electrical Manufacturers Association (NEMA)
8. Steel Structures Painting Council (SSPC)
9. American Water Works Association (AWWA)
10. National Sanitation Foundation (NSF)

1.4 SUBMITTALS

A. Provide submittal data, manuals and drawings as specified in Section 01340, Shop Drawings.

B. Pump Data
1. Certified pump curves shall identify shut-off head, duty point, and range at which the pump operates without vibration and cavitation.
2. Net positive suction head requirements
3. Brake horsepower
4. Pump performance curves
5. Materials used in fabrication of all pump components including dimensions, weights, coating requirements, and cross sectional views
6. Factory performance test results and certifications
7. Performance test results with permanent pump installed and vibration analysis
8. Names and addresses of the nearest factory authorized service organization
9. Elevation drawings noting sizes, depths, lengths, and dimensions; foundation and anchoring details; total weight of pump unit including pump and motor
10. Factory non-witness test requiring Engineer approval prior to shipment
11. Minimum submergence requirements
12. Manufacturer’s specification

13. Engineering data
14. Critical Speed
15. L-10 Bearing Life Calculation

C. Motor Data
1. Horsepower
2. Electrical characteristics
3. Bearing life ratings
4. Insulation ratings
5. Weight
6. Wiring Diagram
7. Space Heaters
8. Dimensions
9. Nameplate Data

D. Instruction Books
1. Service and maintenance manual
2. Service parts list
3. Outline drawing

E. Manufacturer's Certifications
1. Submit manufacturer's certification that Contract Documents have been examined by the manufacturer for proposed electrical, mechanical, and structural systems affecting performance of the pumping equipment.
2. Submit manufacturer's certification that the maximum power requirement, if used, shall not exceed the motor rating under operating conditions on the pump characteristic curve.
3. Submit seal manufacturer's certification that the seal is designed for service and application specified and is installed and aligned properly.

F. Record Drawings
1. Submit record drawings under provisions of Section 01720 – Project Record Documents.

G. Operation and Maintenance Instructions
1. Submit operation and maintenance data under provisions of Section 01720 – Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include curves, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Pumping units shall be specifically designed for heavy duty, continuous use, and municipal grade. Use new materials of high grade, and with properties best suited to the work required.

B. Pumping units and motors shall be the product of manufactures with at least 10 years of successful experience in the design, manufacturing and application of pumping units of the type, size and performance capabilities as specified. The pump manufacturer shall have at least three similar size pumps of the model, type, and size of pump in service and operational for at least five years. Manufacturers shall provide a list of references for the same.

C. All components of the pump shall be supplied, assembled, and warranted by one of the approved pump manufacturers. Pump components shall not be acquired from separate entities and assembled as a final product by a manufacturer's representative. All pumps shall be supplied by the same manufacturer.

D. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of Work.

E. Store material to permit easy access for inspection and identification. Keep all materials off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. Store and maintain equipment in accordance with manufacturer's direction.

F. The pumping unit manufacturer shall perform both lateral and torsional critical speed analyses on the assembled pumping units to identify and ensure:
   1. That the first lateral critical speed is at least 20% above or below the operating speed of the pumping unit over the entire operating speed range defined;
   2. On constant speed applications, that no torsional natural frequencies occur within a range extending from 20% below to 20% above the operating speed of the pumping unit over the entire operating speed range defined;

G. Factory Tests
   1. Pump Test
      a. The pump manufacturer shall perform a non-witness factory performance test of the entire pump assembly to demonstrate compliance with the specifications and to verify guaranteed performance of the pump. A calibrated factory driver may be used in lieu of the job driver.
      b. The factory test shall include the actual flow, total dynamic head, pump horsepower, and pump efficiency for all the duty points listed.
      c. Tests shall be sufficient to determine the curves of head, input horsepower, and efficiency relative to capacity from shutoff to 150% of design flow.
      d. Test pump and recirculate water for at least one hour under simulated service conditions.
      e. The test shall also check for excessive vibration and leaks in all piping and seals.
      f. A minimum of six points, including shutoff, shall be taken for each test. At least one point of the six shall be taken as near as possible to each specified condition.
   2. Motor Test
      a. The motors to be installed shall be tested by the motor manufacturer and a full written report provided to the engineer.
      b. The testing shall be performed in accordance with IEEE 112 method B at 60 Hz, 50 Hz, 40 Hz and 30 Hz.
      c. The test shall include percent slip, no load current, full load current, locked rotor current, locked rotor torque, efficiency, and power factor at the frequencies listed above, megger, winding resistance and high potential.
   3. The Contractor shall submit the factory test results and certification to the Engineer for approval before the pump is released for shipment.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide double disc pumps which are specifically designed for pumping aerobically digested waste activated municipal sludge.

B. Furnish pumps of standard dimensions such that parts will be interchangeable between like units.

2.2 ACCEPTABLE MANUFACTURERS

A. Provide double disc diaphragm pumps of one of the following, no others will be allowed:
1. Penn Valley Pump Company, Inc.

B. Listing as an acceptable manufacturer will not relive the manufacturer from confronting to these Specifications.

2.3 PERFORMANCE REQUIREMENTS

A. Provide pumps capable of meeting all design point duty conditions.

Design Condition	**Units**	**Volute Press Feed Pumps**
Location	-	Sludge Holding Tank
Pump Type (single/duplex)	-	Single
Number of Reciprocating Discs	-	2
Required Displacement	gal/rev	1.07
Service	-	Municipal WAS
Liquid Temperature Rating	°F	60-105
Specific Gravity	-	1.03
Duty Rating	-	Continuous,24-hr/day
Drive Type	-	V-belt and Pulley
Max. Drive Size	hp	15
Max. Pump Operating Speed	rpm	400
Max. NPSH Required	ft	32.35
Solids Content	%	0.75 - 2
Suction Condition	-	Flooded Suction
Suction & Discharge Size	in	6
Solid's Passage	in	2
Duty Point No. 1		
Design Flow	gpm	260
Total Head	ft	10
Min. Efficiency	%	60
Duty Point No. 2		
Design Flow	gpm	195
Total Head	ft	8
Min. Efficiency	%	60

B. The double disk pump shall operate by means of two free floating, reciprocating disks attached to connecting rods driven by a rotating eccentric shaft to create suction, discharge and induced flow through the pump.

C. Pumps shall be capable of operating dry for an indefinite period of time without damage.

D. Pump shall have a Class 30 cast iron body, ASTM A48.

E. The discs shall be constructed of neoprene and shall be of the integral type, mounted on a threaded stub shaft constructed of high tensile 400 series stainless steel. The discs shall be a homogenous assembly with the trunnion seals and have no exposed metal parts. Pumps utilizing flat externally supported type discs with exposed metal parts will not be acceptable.

F. The suction and discharge discs shall be interchangeable with each other.

G. Sealing of the pump fluid chamber shall be achieved by flexible trunnions. The trunnion construction shall be of fabric reinforced, neoprene, and shall be capable of withstanding pressures from 0 to 110 psi on an intermittent basis. Maximum operating pressure is 140' TDH. Packings, mechanical seals, or water seal systems will not be acceptable.

H. The drive shaft of pump shall be of sufficient size and strength to withstand a dead head situation. The shaft shall be constructed of high tensile, stainless steel and shall be mounted on a minimum of (4) four, self aligning, sealed bearings. The eccentric cams shall be constructed of high tensile, Nickel-Aluminum Bronze Alloy # A021, Cast, Machined, and fitted to a high tensile stainless steel shaft. Eccentric cams shall be pinned to the shaft by spiral drive pins to allow for absorption of reciprocating loads generated by the pumping action. All drive bearings must be completely sealed with no provision for scheduled grease lubrication. No grease fittings shall be supplied for the bearings.

I. All pumps shall be of the end suction - discharge configuration with standard C110/A21.10 - C153/A21.53 and ANSI B16.1 Class 125 lb. flanged ports.

J. Pump shall be provided with OSHA approved guards. All guards shall be manufactured of 304 stainless steel with stainless steel fasteners.

2.4 PULSATION DAMPENERS

A. On each pump, one (1) pulsation dampener shall be provided on the suction and discharge lines for a total of two (2) dampeners per pump. Each dampener shall be provided with a 1 inch nipple located near its top. A stainless steel plug valve shall be screwed into the nipple. The opposite end of the valve shall be fitted with a universal quick acting coupling, suitable for compressed air. This valve connection will be suitable to charge the dampener with compressed air and to connect pressure and vacuum gauges as specified in this section.

2.5 PRESSURE SENSOR AND SWITCH ASSEMBLY

For each pump, provide one (1) pressure gauge switch assembly on one (1) of the discharge pulsation dampeners. Each pressure gauge switch assembly shall consist of the following:

A. Model PVP420 or series 42 Red Valve Pressure Sensor, stainless steel with neoprene elastomer and 0-1000 psi, 4” dial face.

B. Adjustable 120 volt Barksdale or Ashcroft N-series pressure switch. Each unit shall be of NEMA 4 construction, complete with adjustable needle valve and preset at 30 psi. Switch shall be adjustable over the entire pump operating range. The pressure switch shall stop the affected pump upon reaching the pre-set, adjustable, discharge pressure setting.

C. All necessary fittings, isolation valves, manifolds, and piping for a complete and properly operating system.

2.6 VACUUM SENSOR AND SWITCH ASSEMBLY

For each pump, provide one (1) vacuum gauge switch assembly on the suction pulsation dampener. Each vacuum gauge switch assembly shall consist of the following:

A. Model PVP420 or series 42 Red Valve Pressure Sensor, stainless steel with neoprene elastomer and 0-30/0-30 psi, 4" dial face compound gauge.

B. Adjustable 120 volt Barksdale or Ashcroft N-series pressure switch. Each unit shall be of NEMA 4 construction, complete with adjustable needle valve and preset at 10" Mercury. Switch shall be adjustable over the entire pump operating range. The pressure switch shall stop the affected pump upon reaching the pre-set, adjustable, vacuum pressure setting.

C. All necessary fittings, isolation valves, manifolds, and piping for a complete and properly operating system.

2.7 SUB BASE

Each pump and V-Belt assembly shall be mounted on a common, 304 stainless steel fabricated piggyback sub base. Each sub base shall be sufficiently reinforced and braced to withstand all shock loads and resist all wearing and buckling during pump operation The V-belt drive assemblies shall be selected such as to withstand the torque created between pump and drive and shall be sized to provide for a maximum pump speed of 500 rpm.

2.8 MOTOR

A. Pump Motor Characteristics
   1. Motor shall be vertical, mill and chemical duty, TEFC severe duty rated, inverter duty, induction type for 460V, 3 Phase, 60 Hz service. Motor shall also be NEMA Premium Efficient and shall also follow all requirements of Section 16013 – Electric Motors.
   2. The motor shall be designed for an ambient temperature of 40°C. Stator winding and stator leads insulated with moisture resistant inverter duty insulation which will resist a temperature of at least 356°F. The magnet wire shall be specially made for inverter duty and the end turns and phase-to-phase insulation shall be increased. Motors not used in conjunction with VFDs may use class F non-hygroscopic insulation.
   3. Designed for continuous duty, capable of sustaining a minimum of 6 starts per hour, evenly spaced. The motor shall meet or exceed the requirements of NEMA MG10 Table 7.
   4. Capable of operating at liquid temperature of 104°F in conformance with Factory Mutual requirements without overheating or operating in the service factor.
   5. Non-overloading over the entire range of the pump operating curve within the nameplate horsepower.
   6. The motor shall include properly sized space heaters. Provide a conduit box for the power leads.
   7. Size the motor to be non-overloading at the any point on the characteristic curve of the pump, including run-out. Provide a motor with a power draw that does not exceed the nameplate rating while the pump is operating between the normal minimum and maximum system curves, using a service factor of 1.15. Do not exceed the total capacity of the motor, including service factor, while the pump is operating between the normal minimum and emergency, run-out system curves.
   8. Provide in addition to the manufacturer's standard data a certified dimensional print, performance curves, reed critical frequency data, speed vs. torque vs. amps curves.

2.9 VARIABLE FREQUENCY DRIVE (VFD)

A. Refer to Section 16175 – Variable Frequency Drive.

2.10 PROCESS CONTROL NARRATIVE

A. Double Disk Diaphragm pumps shall be controlled from Volute Press Control Panel CP-14D-001
B. Provide VFD control of all proposed pumps as described below.
C. Provide instrumentation in accordance with Section 13340 – Instruments.
D. PLC tag database shall be provided to PCSS and/or Owner for incorporating into top end SCADA for Monitoring and Controls. At minimum the following shall be provided:
    a. The following statuses shall be monitored at the plant SCADA:
        i. All motor Hand/Off/Auto
        ii. All motor running status
        iii. All available VFD fault alarms
        iv. All available VFD speeds and status
        v. All pressure statuses
        vi. All levels and alarms
        vii. Flow & totalized flow

Process Description:	Two (2) Double Disk Diaphragm pumps (one duty, one spare) shall be provided to pump Waste Activated Sludge (WAS) from the existing Sludge Holding Tank to feed the Volute Press at the Dewatering Facility. Each pump shall be operated by a VFD to regulate the flow. WAS flow shall be monitored via a proposed flow meter at the Dewatering Press Feed Pumps. The operator shall be able to set the desired flow, and the feed pumps shall operate to maintain that flow via a PID control loop. Any variations from the preset flow shall cause the dewatering system to shut down and alarm. The Double Disc Diaphragm Pumps form part of the dewatering PCS system. See Specification Section 11445 – Volute Press for process control narrative.
P&ID:	14A-I-1 Dewatering Press Feed Pumps P&ID 14D-I-1 Volute Dewatering Press P&ID
Controlled Devices:	DDP-14A-101 Dewatering Press Feed Pump No. 1 DDP-14A-201 Dewatering Press Feed Pump No. 2
Instrumentation Devices:	PS-14A-101 Dewatering Press Feed Pump No. 1 Low/High Pressure Alarm PS-14A-201 Dewatering Press Feed Pump No. 2 Low/High Pressure Alarm VSH-14A-101 Dewatering Press Feed Pump No.1 High Vacuum Alarm VSH-14A-201 Dewatering Press Feed Pump No.2 High Vacuum Alarm FIT-14A-101 Sludge Flow
Local Functions:	None
MCC Functions:	None
HMI Functions:	None
PLC Functions:	In AUTO, Dewatering Press Feed Pumps shall be called at the start of the dewatering sequence from panel CP-14D-101 if the Interlocks in the INTERLOCKS section below are not active. WAS flow shall be monitored via a proposed flow meter at the Dewatering building. The operator shall

	be able to set the desired flow, and the Dewatering Press Feed Pumps shall operate to maintain that flow via a PID control loop. Any variations from the preset flow shall cause the dewatering system to shut down and alarm. Each pump shall alternate which pump is the LEAD pump and LAG pump upon each successive pump call from the Volute Dewatering System. Dewatering Press Feed Pumps shall shut off either based on an operator adjustable internal flow totalizer setpoint or using the timers set by the PLC during the dewatering shutdown sequence from CP-14D-101, any clock settings that are set, by manual pushbutton selection from the OIT screen, remote SCADA stop signal, or any shutdown alarm per the manufacturer's Alarm Shutdown Table. Any E-Stop being pressed shall immediately stop ALL equipment.
SCADA Functions:	See specification 13441 – Process Control Narratives.
Interlocks:	Interlocks below are hardwired: LSH-14D-101 Volute Press High Level Lockout PSH-14A-101 Press Feed Pump No. 1 Pressure Switch High PSH-14A-201 Press Feed Pump No. 2 Pressure Switch High LSL-13-001 Sludge Holding Tank Low Level Alarm LSL-13-002 Sludge Holding Tank Low Level Alarm ES-14D-100 E-Stop Activated ES-14D-101 E-Stop Activated ES-14D-102 E-Stop Activated FIT-14A-101 Low Sludge Flow Cutoff
Alarms and Indications:	Alarms Indicated on SCADA: See Specification Section 13441 – Process Control Narratives and Attachment 13311A - IO list for a complete list of alarms and status indications

2.11 SPARE PARTS AND ACCESSORIES

A. Each double disc diaphragm pump shall be provided with the following spare parts in a lockable toolbox:
   1. Two discs.
   2. Two trunnions.
   3. One complete set of gaskets.
   4. One clack valve.
   5 One set of V-belts.
   6. One universal, adjustable tool to aid in disc removal.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that equipment has no defects on the structure or surface that will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the work to the Engineer.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's written instructions.

B. Provide sufficient clearances for proper operation.

3.3 FIELD START-UP

A. All equipment shall be given running tests by the Contractor and Manufacturer at the site following installation of the equipment and controls.

B. The Contractor shall provide all necessary test equipment including water, temporary piping, and other required incidentals.

C. Field Tests shall consist of operating the pumps under all design conditions.

D. Should the tests indicate any malfunction, the Contractor shall make any necessary repairs and adjustments, then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

E. **The press feed pumps form part of the dewatering PCS system and therefore should be tested as part of the dewatering system to achieve acceptance.**

3.4 SERVICES BY MANUFACTURER

A. A factory trained representative of the Manufacturer shall provide services for installation supervision, start-up and test services and operation and maintenance personnel training services.

B. Manufacturer's representative shall perform on-site services according to the following schedule, excluding travel time:

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	1	1
Pre-demonstration functional and performance testing	1	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ testing and pre-demonstration start up
Pre-demonstration start up	1	Can be combined w/ testing and pre-demonstration start up
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer shall provide a written report certifying that the installation has been checked, is adequate for the intended purpose, all power connections has bene checked, all controls are functional, and that the equipment is ready to be placed into service.

D. Manufacturer shall start-up and operate the system in the presence of the Engineer, and conduct the field performance test to verify that the equipment meets or exceeds the specified requirements. Manufacturer shall revisit the site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. The Manufacturer shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the Owner.

E. Manufacturer will be back charged by the client for an unsuccessful field testing demonstration. Schedule the field demonstration a minimum of 48 hours following a successful start-up procedure.

3.5 FINAL ACCEPTANCE

A. Final acceptance use will not occur until after the following activities have been performed and accepted by the Engineer.
   1. Training the Owner’s operating and maintenance personnel by the Manufacturer’s Representative.
   2. Satisfactory completion of the Demonstrative Period under the Owner's control.

END OF SECTION

SECTION 11160
PERISTALTIC PUMPS

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provision of all labor, materials, equipment and incidentals required to install, test and place in satisfactory operation peristaltic pumps for each chemical system equipped complete, as shown on the construction drawings and as specified herein. The work of this section includes, but is not limited to, providing skid mounted peristaltic chemical metering and pump replacement within existing skids with accessories for the application of each chemical as described herein and shown on the drawings. All necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in this section or not shall be furnished and installed as required for an installation incorporating the highest standards for this type of service.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American National Standards Institute (ANSI)
2. American Society of Mechanical Engineers (ASME)
3. American Society for Testing and Materials (ASTM)
4. National Electric Code (NEC)
5. National Electrical Manufacturers Association (NEMA)
6. Occupational Safety and Health Administration (OSHA)
7. Underwriters Laboratory (UL)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples.
1. Certificate of Compliance or complete list of all deviations from the drawings and specifications.
2. Complete fabrication, assembly, and installation drawings for pumps and pump skids, showing the Manufacturer's dimensions, weights, and loadings, and descriptive information in sufficient detail to show the kind, size, weight, arrangements.
3. Performance characteristics, shown for at least 5 different operating speeds, showing operational limits
4. Detailed specifications and data covering materials used, parts, instrumentation devices.
5. Certification of material compatibility of hoses provided with chemicals used
6. Shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

7. Electrical data including control wiring and schematics. Electrical/pneumatic requirements, schematic diagrams, and details of components including enclosures.
8. Complete motor and drive data.
9. Manufacturer's recommended spare parts.
10. Certification of installation by a factory certified Engineer or local Field Service Representative as required in Paragraph 3.2.
11. Installation, start-up, and test schedule with installation and test procedures shall be furnished prior to installation of the equipment.

B. Results of field testing and initial calibration

C. Manufacturer's Certification: Provide a letter of certification addressed to the Owner and signed by an authorized representative of the Manufacturer. The letter shall state the following:
1. The equipment will efficiently and thoroughly perform the required functions in accordance with the Contract Documents, the materials are best suited for the chemicals handled, and that the Manufacturer accepts joint responsibility with the Contractor for coordination of equipment, including motors, variable speed drives, controls, and services required for proper installation and operation of the completely assembled and installed unit.
2. The equipment has been installed in accordance with the Manufacturer's recommendations, and is in proper adjustment and operating condition, the Manufacturer is prepared to warrant the equipment to perform in full compliance with these specifications, and the equipment is ready to be turned over to the Owner for operation.
3. The Manufacturer has inspected the installation and verified training of the Owner's operations and maintenance personnel upon completion of the system installation.

D. Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all curves, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

1.5 QUALITY ASSURANCE

A. The equipment specified herein is intended to be peristaltic pumps for a municipal water application with a proven ability as manufactured by parties having extensive experience (at least five (5) installations of the same design, with a minimum of three years successful operation) in the production of such equipment.

B. Manufacturer or their authorized service contractor shall provide a one (1) year service contract for preventive maintenance of pump systems.

C. All components of the pump shall be supplied and warranted by one of the approved pump manufacturers. Pump components shall not be acquired from separate entities and assembled as a final product by a manufacturer's representative or a system integrator. All pumps shall be supplied by the same manufacturer.

D. Factory assembled parts and components shall not be dismantled for shipment or storage unless recommended by the Manufacturer in writing to the Engineer.

E. Provide all specified equipment of the latest, most modern design and guaranteed by the manufacturer to meet the performance requirements as specified herein.

F. Provide a qualified technical representative of the manufacturer to inspect the completed equipment installation, make all the adjustments necessary to place the equipment in trouble-free operation, and to instruct operating personnel in the proper care and operation of the equipment furnished.

G. If submitted equipment requires arrangement differing from that which is indicated on the drawings or specified, prepare and submit for review complete structural, mechanical, and electrical drawings and equipment lists showing all necessary changes and embodying all special features of equipment proposed. Any changes are at no additional compensation and the Contractor will be responsible for all Engineering costs of redesign by the Engineer, if necessary.

H. If specified herein, the fabricated pump skid and piping and wiring shall be constructed by and furnished by the Manufacturer of the peristaltic pumps. Construction of the pump skid by an Integrator is only allowed as approved by the Engineer.

I. Factory Testing
   1. Each pump skid shall be fully assembled and tested at the Manufacturer's own shop to ensure compliance with pressure and operational requirements. Any defects or problems shall be corrected at no additional cost.
      a. Conduct integrity testing on each pump including pressure test of all fittings and joints.
   2. Functional Testing: Perform Manufacturer's recommended functional testing, including standard tests, as follows:
      a. Conduct performance testing on each pump and submit the total head, pressure, line amps, and speed of each pump unit.
      b. Complete performance testing at design flow and design pressure as specified, and at pump's minimum and maximum rated output.
      c. Verify operation of alarms and shutoff.
      d. Verify communications, signal inputs, and output.
   3. Submit all testing results, including corrective actions for approval prior to shipment.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store equipment as per manufacturer's recommendations.

B. All equipment shall be stored in a secure location where it is protected from the public. All equipment shall be stored in a dry location that is protected from flooding.

C. Accept units on site. Inspect for damage upon delivery.

D. Do not remove shipping blocks, plugs or caps installed to protect the equipment during shipment until the equipment is installed and connections are made.

PART 2 – PRODUCTS

2.1 GENERAL

A. General Description
1. Pumps shall be of the peristaltic type, intended for long-term service in a municipal treatment facility chemical area.
2. Pumps shall be "case" type, furnished as an integrated unit with motor, controls, variable speed drive, and pump head, inside a common casing. Systems requiring a separate control panel, even if the control panel is mounted onto the pump or its skid, will not be allowed.
3. Pumps shall be furnished along with valves, suction and discharge header piping, calibration column, power receptacle, instrumentation, all on a common factory-fabricated skid or installed on an existing fabricated skid.
    a. The manufacturer of the peristaltic pumps shall be responsible for the fabrication and testing of the skid assemblies to include pumps, piping, valves, conduits, electrical components, structural components, and hardware. Skids made by local fabrication shops will not be accepted.
    b. The complete skid assemblies shall be shop-tested, and a test report shall be submitted to Engineer prior to shipment to the job site.

2.2 PERFORMANCE REQUIREMENTS

A. Provide pumps capable of meeting all conditions described herein.

B. The combination of pump speed, hose/tube size, and capacity shall be balanced for each pump selection to provide a pump that can meet the Design Operating Flow within a range of 30% to 70% of the pump's maximum continuous speed. Pumps shall also be selected so that pump capacity can be increased by either changing to a large diameter hose/tube with the same pump head, or, with the ability to change the pump head to a larger size.

C. Pumps shall be intended for use in an aggressive environment; all exposed and wetted materials shall be corrosion resistant.

D. Pumps shall be dry self-priming, capable of being run dry without damaging effects to pump or tube, and shall have a maximum suction lift capability of up to 30 foot vertical water column.

E. Pump Schedule

Parameters	Units	Design Conditions		
Equipment Tag	-	PSP-11A-101 & 201	PSP-11B-101 & 201	PSP-11C-301
Service	-	12.5% Sodium Hypochlorite	38% Sodium Bisulfite	48.5% Aluminum Sulfate
Location	-	Chemical System Canopy		
No. of Pumps	ea.	2	2	1
Liquid Temp Rating	°F	32-100	32-100	32-100
Specific Gravity	-	1.2	1.34	1.33
Duty Rating	-	Continuous (24Hrs/d)	Continuous (24Hrs/d)	Continuous (24Hrs/d)
Variable or Constant Speed	-	Variable	Variable	Variable
Motor	Volts/Hz/ Phase	120/60/1	120/60/1	120/60/1
Pump Operating Speed (Max)	rpm	220	220	265
Tube Diameter (Max)	mm	9.6	9.6	12
Tube Material	-	Marprene® or Flex-a-prene®	Marprene® or Flex-a-prene®	Marprene® or Flex-a-prene®
Design Feed Rate/Pump	gph	0.89 to 8.33	0.12 to 0.74	0.1 to 37.19
Min Feed Rate/Pump	gph	0.01	0.01	0.01
Max Continuous Feed Rate/Pump	gph	55.48	55.48	158.5
TDH (maximum)	psi	125	125	125

2.3 ACCEPTABLE MANUFACTURERS

A. Peristaltic metering pumps shall be manufactured by one of the following:
   1. Watson-Marlow 530UN/REL (Sodium Hyphochlorite & Sodium Bisulfite) & 630 UN/REL (Alum)
   2. Blue-White M3 (Sodium Hyphochlorite & Sodium Bisulfite) & M4 (Alum)

B. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.

2.4 PUMP CONSTRUCTION

A. General: Pump components shall be constructed of corrosion resistant materials suitable for the chemical specified. Wetted parts of all metering pumps and appurtenances specified herein shall be confirmed by the Manufacturer to ensure optimum corrosion and erosion free operations for the chemicals involved. Manufacturer shall provide written certification that the equipment and materials have been selected for the chemicals being pumped.

B. Pumps shall be 100 % integral in design with the pumphead, motor, controls, and pump case being manufactured by the pump manufacturer themselves. All controls, motors, and gear reduction shall be housed in a single chemically resistant pump case. Pumps that require separate base plates, external gear reducers and /or gear motors, and separate controls– even if mounted on a base plate and pre-wired to the motor- are not acceptable.

C. Pumphead shall consist of a fixed track, a guard door, and spring-loaded roller rotor assembly. Pump tubing shall be in contact with the inside diameter of the track through an angle of 180 degrees. At all times, one roller shall be fully engaged with the tubing providing complete compression and preventing back flow or siphoning. Tube occlusion and spring tension shall be factory set to accommodate 2.4mm wall thickness tubing and shall not require adjustment

D. Pumphead guard shall be clear for viewing of rotation direction. When closed, the pumphead guard shall seal against the pump track for leak containment and controlled waste through the pumphead waste port (if required) in the event of a tube failure. For operator and environmental safety, pumps in which the direction of rotation cannot be visually verified are not acceptable.

E. Pumphead Assembly
   1. Pump Track Geometry must have a minimum 96.6 mm swept diameter through a minimum track angle of 180 degrees.
   2. Provide high corrosion impact materials as specified.
      a. Track Construction: Polyphenylene Sulfide (PPS) or Valox PBT
      b. Guard Construction: Hinged impact-resistance polycarbonate breakaway guard, tool un-lockable for operator safety. The pump can also have an annealed acrylic pump head cover with magnetic interlock which shuts off the pump when opened.
      c. Rotor Construction: Polyphenylene sulfide (PPS) or Valox.

F. Rotor Assembly

1. Provide rotor assembly that ensures gradual tube occlusion and compensates for tube tolerance:
   a. If a spring system is required, provide twin spring-loaded roller arms located 180 degrees apart, each fitted with stainless steel helical springs and compression roller for occlusion of the tube twice per rotor revolution.
   b. Provide non-compressing guide rollers constructed of corrosion resistant Nylatron or equivalent corrosion resistant material.
2. Equip rotor with a central handgrip and manually activated clutch to disengage the rotor from the drive for manual rotor rotation during tube loading. Clutch shall automatically reengage rotor to gearbox upon one complete revolution. Pump shall have a quick change tube system where the pump can be rotated at 6 RPM to provide access for tube removal and installation.
3. Mounting: To prevent slip, the rotor assembly shall be axially secured to dogged output shaft of the gearmotor via a slotted collet and central retaining screw. The pumps may also have a chrome plated steel "D" shaped motor shaft with corresponding "D" shaped rotor mounting access.
4. Pumpheads requiring disassembly or special tools for tube changing are not acceptable.

G. Tubing: Thermoplastic or extruded elastomer tubing shall be designed specifically for use with peristaltic pumps and working pressures to 125 psi. They shall be constructed from the highest quality compounded thermoplastic materials and have a minimum durometer rating of 60 Shore A. Tubing shall be selected to provide an approximate service life of 6 months under constant operations. Tubing lubrication shall be food-grade silicon grease as required per Manufacturer.

H. Connections: Cam-lock/quick connect, flanged or MNPT port connection size to be determined by model.

I. Leak Detector: Provide one sensor per pump to detect leakage of pumped product in the housing. Sensor shall be interlocked with the controls to signal an alarm and automatically shut down the pump in the event of a tube or hose failure. The leak detector shall be adjustable for the specific chemical being pumped.

J. Pumps Placed on Existing Skid(s): The proposed Sodium Bisulfite and Sodium Hypochlorite pumps will be installed in place in the field, on existing pump skids. Required fittings and connections shall be made to ensure pump compatibility with the existing skids during installation. Proposed Sodium Bisulfite and Sodium Hypochlorite pumps shall conform to all pump-specific requirements as outlined in this section and specified by the pump manufacturer.

2.5 FABRICATED SKID:

A. **A factory assembled fabricated pump skid shall be supplied for the proposed Alum peristaltic pump. The proposed Sodium Hypochlorite and Sodium Bisulfite pumps shall be placed on existing skids.** The alum skid shall be completely self-contained and shall include:
   a. Peristaltic pump.
   b. Piping and valves
   c. Power and controls junction boxes shall be located on skid so that no pipe containing chemical runs over or above the junction boxes. Junction boxes shall be FRP or molded plastic, NEMA 4X.
   d. Specified appurtenances

B. The skid shall be constructed from solid black UV protected HDPE having a minimum thickness of ½ inch. The skid shall be assembled using thermal plastic welding technology. Bolted or screwed construction is not acceptable. The skid shall include a solid base, back panel and side panels with an open front and top to ensure ease of access to all components, with support legs and baseplate suitable for floor mounting. A minimum two-inch lip shall be provided on the base of the skid to offer a spill containment basin, which will contain a 1/4-inch FNPT drain fitting.

C. All piping shall be Schedule 80 PVC, or suitable with the chemical being pumped, with solvent welded or threaded joints. A medium bodied solvent cement suitable for use with the applicable chemical shall be used on all applicable joints. All threaded connections shall utilize PTFE tape, or suitable threaded sealant or both. Piping shall be rigidly supported with corrosion-resistant non-metallic clips. The piping shall be attached to the chemical feed skid with a non-metallic corrosion resistant support system. All supports shall be welded to the chemical feed skid. Bolted, screwed, or strapped construction is not acceptable. Rigid piping shall have an NPT by barbed end for connection to the pump tubes. All inlet /outlet connections shall be clearly marked for installation.

D. Skid Appurtenances

1. One (1) diaphragm protected combined pressure gauge and pressure switch setup per chemical metering pump shall be provided for indication of system pressure. PVC gauges shall be utilized, and the isolators shall have a PVC body with Teflon sealing diaphragm and suitable liquid filling. Pressure gauges shall be 2.5 inches in diameter, scaled from 0 to 150% of the pump operating pressure.
2. One (1) pressure relief valve per pump, of polyvinylchloride construction, and having Hypalon or Teflon diaphragms, suitable for the fluid being pumped, to protect upper works of valve from process fluid. Provide spring opposed diaphragms with loading pressures adjustable by means of screw in top works. Field-adjust valves to settings required of the system. Setting to be the maximum pressure to occur downstream of the valve, as installed in system, while pump is operating. Provide a soft tubing discharge for each valve.
3. Provide each pump skid with a common calibration column for measuring pump output.
    a. Provide columns of Schedule 40 clear PVC pipe with Schedule 80 fittings. Thin wall tubing and acrylic plastics are not acceptable.
    b. Equip each column with flanged connection to suction piping, and fitted with ball valve for air venting.
    c. The measurable capacity of the column shall be approximately one and one-half minutes discharge of each pump at maximum pumping capacity. Permanently calibrate each column in tenths of gallons.
4. Provide automatic degassing valves to be installed on the existing Sodium Hypochlorite skid, designed to automatically vent gases and vapors that are commonly released from chemicals. Degassing valves shall be of CPVC corrosion-resistant wetted materials of construction. Valves shall be as manufactured by Accu-Vent, or Plast-o-Matic.
5. Provide a discharge high pressure switch connected to the Chemical System PLC Panel (CP-11-001).
6 Provide a flow verification sensor on the discharge of each pump. The sensor shall output high-speed digital pulse signal or 4-20mA, while pump is running only, to verify chemical injection.
    a. Flow verification sensor shall be an ultrasonic transit time sensor.
    b. Wetted components shall be PVDF (optional PVC), PEEK, and TFE/P (optional EP).
    c. End fittings shall be PVDF with optional PVC slip fittings. All are included.
    d. Shall provide a scalable 4-20 mA sourcing output.

e. Shall provide a scalable 0-10,000 Hz open collector frequency output
f. Shall provide a programmable Form C Solid State Relay rated for a maximum load capacity of 24 VDC and 100 mA.
i. Programmable for high/low flow rate alarm.
ii. Programmable to energize on specified flow total.
g. Power Requirements: 5 VDC; 5 Watts maximum.

h. Accuracy shall be +/- 0.75% full scale. Accuracy shall be +/- 0.25% at the field calibrated setpoint.

7. Pressure Switch
a. The discharge of each pump shall be equipped with a pressure switch that shall turn off the pump, via hardwire, upon over pressurization. The pressure shall also report a signal of over pressurization, back to the Chemical System PLC Panel (CP-11-001). Low pressure
b. Shall have NEMA 4X enclosure, Type 316 stainless steel wetted materials.
c. Pressure switch shall include true union isolation ball valve and diaphragm isolator.
d. Manufacturer:
i. Ashcroft Model A-Series

2.6 ELECTRICAL:

A. Motor: Voltage shall be 120 Volts, single phase, 60 Hz with NEMA 5-15P.

B. Provide a three-prong cord for connection to the skid's power receptacle.

2.7 CONTROLS

A. Each pump shall have an integral controls interface screen with the following features:
1. Backlit graphical LCD capable of up to four lines of text with up to 16 characters per line to display pump speed, running status, flow rate, and programming instructions.
2. Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
3. Menu driven on screen programming of manual or auto control, flow and remote signal calibration, and general programming.
4. Programmable "Auto Restart" feature to resume pump status in the event of power outage interruption.
5. Programmable "Keypad Lock" to allow operator lockout of all keys except emergency start/stop.
6. Programmable "Maximum Speed" to allow operator to set the maximum speed of the pump within 0.1-125 rpm.

B. The pump will contain the following logic devices for proper operation of the equipment:
1. Outputs shall include:
a. Pump Running
b. Pump Failure
c. Analog Feedback Rate (4-20 mA)
d. High Pressure
e. Pump Tube Life
2. Inputs shall include:
a. Discrete – Start/Stop

b. Analog Speed Setpoint (4-20 mA)

The pump shall be able to communicate via Modbus/TCP/IP protocol. Programmable parameters shall be remotely adjustable via an RJ45 port integral to the pump.

1. Programmable Parameters
   a. Pump Start/Stop
   b. Pump speed
   c. Solution Concentration (for Sodium Bisulfite and Alum)
   d. Available Chlorine (for Sodium Hypochlorite)
2. Communication Outputs
   a. Pump feedback rate
   b. Pump flow pace
   c. Pump fail
   d. Pump start command
   e. Pump run status
   f. Pump low pressure
   g. Pump high pressure

D. Process Control Narrative: See Specification 13441 – Process Control Narratives for the Sodium Hypochlorite, Sodium Bisulfite, and Alum Feed System Process Control Narratives.

2.8 SPARE PARTS

A. Furnish manufacturer's recommended spare parts and any special tools required for disassembly. Spare parts are to be vacuum sealed and labeled as to pump size and series.

B. Spare parts shall include:
   1. One (1) Maintenance kit for each installed chemical feed pump.
   2. Five spare tubes of each size and type

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect and verify the function of all existing and proposed equipment prior to installation.

C. Promptly report defects which may affect the work to Engineer.

D. Inspect and verify the functionality of all equipment, existing and proposed, after installation is complete. If any equipment does not function properly after the modification as part of this scope of work is completed, it will be the responsibility of the contractor to ensure the equipment is restored to working order.

3.2 INSTALLATION

A. All equipment and accessories shall be installed in accordance with the Manufacturer's written recommendations, as approved by the Engineer, and as shown on the Drawings. Mount systems as indicated.

B. The Contractor shall be responsible for installing equipment that the Manufacturer could not ship assembled as an integral part of the system due to shipping restrictions. These items shall be identified on the Manufacturer's approval drawings.

C. Do not begin fabrication or erection prior to submittal approval.

D. The peristaltic pump factory certified representative shall inspect the complete installation and provide written certification stating that the installation of the equipment is satisfactory. The certification must also indicate the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and core of the system.

3.3 FIELD TESTING

A. All equipment will be given running tests by Contractor and Manufacturer's Representative at the Site following installation of the equipment and controls. all equipment shall be inspected by the Manufacturer for proper alignment, quiet operation, proper connection and satisfactory performance. Upon written certification from the metering pumps certified service Engineer that the equipment is approved for start-up, the system shall be placed into service and tested in the presence of the Engineer.

B. The Contractor shall provide all necessary test equipment, including temporary flow meters, pressure gages, piping plugs or caps, and current meters.

C. In addition to the requirements outlined in Section 01650 – Facility Start-Up, field tests shall consist of operating the pumps under normal and abnormal conditions, including, but not limited to:
1. Measuring output using the calibration columns over at least 5 operating speeds
2. Simulating a high pressure scenario
3. Simulating a low level in the supply tank
4. Simulating a tube leak in the pump head

D. Should the tests indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments, and then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the ENGINEER, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

E. Any component parts which are used up, or damaged as a result of this testing or which fail to meet the requirements of these specifications, shall be replaced, reinstalled and re- tested at the Contractor's expense.

3.4 SERVICES BY MANUFACTURER

A. Provide the services of a factory certified service technician specifically trained in the installation, start-up, testing, operation, and maintenance of the peristaltic chemical metering pumps as herein specified. Such services shall be provided by a representative who is a direct, full-time employee of the peristaltic chemical metering pump manufacturer(s) or local representative certified by the manufacturer in installation and startup of the equipment.

B. The peristaltic pump factory certified technician shall advise, consult, and instruct the Contractor on installation procedures and adjustments and inspect the operators during installation as a condition of acceptance of the work.

C. The peristaltic pump factory certified service technician shall again be present during all start-up and testing operations to make final adjustments as a condition of acceptance of the work.

D. Owner training shall be provided and shall include operational instructions to two separate operational teams over a minimum of two separate time periods. Training shall be given at times convenient to the operational team being trained in light of 12- hour operational shifts and duties while on shift. Accordingly, some operational training will have to be conducted during hours outside a normal Monday through Friday, 8:00am to 5:00pm, work day. Operational training shall include the following at a minimum:
1. Control and operation of all pumps and appurtenances.
2. Trouble shooting guidance.
3. Recognizing normal and abnormal operating conditions.

E. Owner training shall also include maintenance instructions to one maintenance team. Maintenance training shall be conducted during the hours of 9:00am to 3:00pm, Monday through Friday, with exact schedule being determined in light of on-going maintenance team duties. Maintenance training shall include the following, at a minimum:
1. Step-by-step assembly and disassembly procedural requirements.
2. Replacement part identification and ordering procedures.
3. Lubrication procedures.
4. Torque and limits switch adjustment.
5. Recommended routine maintenance procedures.
6. Trouble-shooting and diagnostic procedures.

F. Person-hour requirements tabulated below are exclusive of travel time and do not relieve the Contractor of obligation to provide sufficient services to place all equipment and appurtenances into satisfactory operation.

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	3	3 (1 Per Chemical System)
Pre-demonstration functional and performance testing	3	3 (1 Per Chemical System)
Pre-demonstration onsite training of owner personnel	3	Can be combined w/ pre-demonstration start up
Pre-demonstration start up	3	3 (1 Per Chemical System)
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

G. Manufacturer's Representative shall provide one (1) additional follow-up trip approximately three (3) months after start-up to review system operation and address any training questions.

END OF SECTION

SECTION 11171
MULTI-STAGE CENTRIFUGAL BLOWERS

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for furnishing, installation, and training of multi-stage centrifugal blowers, including motor, couplings, coupling guards, and all associated piping, filters, silencers, valves and other appurtenances for a complete working unit.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Reference Standards:
1. Air Movement and Control Association International (AMCA)
2. American National Standards Institute (ANSI)
3. American Gear Manufacturers Association (AGMA)
4. American Welding Society (AWS)
5. ASTM International (ASTM)
6. Institute of Electrical and Electronic Engineers (IEEE)
7. International Organization for Standardization (ISO)
8. National Electric Code (NEC)
9. National Electrical Manufacturers Association (NEMA)
10. National Fire Protection Association (NFPA)
11. Occupational Safety and Health Administration (OSHA)
12. Underwriters Laboratories (UL)

1.4 SUBMITTALS

A. Submit shop drawings, product data, samples, and descriptive literature as specified in Specifications 01300 and 01340. Include the following, arranged to facilitate submittal review.
1. Scope of supply including part numbers, quantity, location and Manufacturer listed in table format.
2. Cut sheets, construction materials, dimensions, weights, electrical power requirements, and shop coatings.
3. Performance characteristics and motor data.
4. Inlet filter ratings.
5. Certified shop test results.
6. L-10 bearing life calculations based on the proposed design conditions.

B. The Manufacturer shall provide the following certifications.
1. The Manufacturer has examined the Contract Documents and agrees to the process performance guarantee and material specifications, warranty conditions, and other requirements of the Contract.
2. The maximum power required of any motor will not exceed the motor rating under the proposed operating conditions.

3. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel.
4. Owner's personnel have received sufficient training and are qualified to operate the equipment.
5. Written certification of a proper and correct installation.
6. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
7. The Manufacturer can provide a complete stock of spare parts within 48 hours of request.

C. Submit operation and maintenance (O&M) data under provisions of Section 01300 – Submittals. Operation and maintenance manuals shall be prepared specifically for this installation and shall include curves, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance manuals.

D. Submit record drawings under provisions of the Contract.

E. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents.

B. Test each blower at the factory before shipment. All tests shall be in conformity with ASME and shall extend from surge to 120 percent (120%) of design volume. ASME tests are not required for blowers built as parts cast in patterns, from which previous units have been cast, built, and tested. Only ship after Engineer approval of factory test results.

C. Each furnished equipment item shall be designed and rated for its intended service environment, performance requirements, and area classification.

D. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

E. Manufacturer and Contractor shall coordinate all dimensions to ensure adequate clearances for equipment maintenance, removal, or replacement.

F. The requirements of this Section shall be considered the minimum limits of acceptability.

1.6 WARRANTY

A. For a period of 12 months from substantial completion of the work, the Manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The Manufacturer shall repair or replace such equipment or any part thereof furnished by the Manufacturer and found defective after inspection by the Manufacturer

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Exposed flanges shall be covered and sealed with shrink wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

C. Ship packaged or pre-fabricated equipment in the largest sections permitted by carrier regulations, properly match-marked for ease of field assembly. The control panel of each system shall be shipped separately.

D. Accept units on site. Inspect for damage upon delivery.

E. Store equipment off the ground in a secure, enclosed shelter, where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

F. Do not remove shipping blocks, plugs, or caps installed to protect equipment during shipment until the equipment is installed and permanent connections made.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide multi-stage centrifugal blowers which are specifically designed for the blower application. Refer to the service design conditions outlined in Section 2.2 Performance Requirements.

B. Furnish blowers of standard dimensions such that parts will be interchangeable between like units.

2.2 PERFORMANCE REQUIREMENTS

Design Conditions	Units	MSB-09-601
Location (Indoor/Outdoor)	-	Outdoor
Ambient Temperature (max)	°F	110
Ambient Relative Humidity (max)	-	60%
Setting Elevation for Critical Equipment	ft	507.00
Design Capacity	scfm/ea	1,200
Discharge Pressure	psig	8.00
Maximum Motor Size	HP	75
Speed	rpm	3,600

2.3 ACCEPTABLE MANUFACTURERS

A. Provide multi-stage centrifugal blowers of one of the following Manufacturers. No others will be allowed:
1. Lone Star Blower

B. Listing an acceptable Manufacturer will not relieve the Manufacturer from conforming to these specifications.

2.4 CENTRIFUGAL AIR BLOWERS

A. Performance and Design Requirements.
1. Provide curves which show blower performance at 120°F, 105°F, 68°F, and 20°F.

2. When the volume of flow is reduced by at least 50 percent (50%), the blower under specified inlet conditions shall develop at least 0.5 PSIG above the specified discharge pressure without surging or overloading the motor.
3. Test each blower at the factory before shipment. All tests shall be in conformity with ASME and shall extend from surge to 120 percent (120%) of design volume. ASME tests are not required for blowers built as parts cast in patterns, from which previous units have been cast, built, and tested.
4. After installation, as soon as conditions permit, the blower unit will be subjected to running tests. These tests are to determine that units operate satisfactorily throughout entire operating pressure and capacity ranges at rated speeds.

B. Blowers. The blower unit shall be multi-stage, direct-coupled and mounted on a skid-type frame..
1. The blower casing shall be of rigid cast iron sections with inlet and discharge connections having an ASA 125 lb. flange pattern.
2. Impellers shall be cast of high grade aluminum with a ground and polished steel shaft. Dynamically balance shaft and impeller as a unit with tip speeds not exceeding 375 FPS.
3. All bearings are to run in an oil bath, with reservoir, and be of the anti-friction type having a minimum B-10 life of 40,000 hours.

C. Motors shall conform to the requirements of Section 16013, Electric Motors:
1. The motor shall be 460 Volt, 3 Phase, 60 HZ, 3600 RPM, 1.15 service factor, NEMA design B type motor with NEMA MG-1, Class “F” insulation, severe duty rated TEFC enclosure and a maximum of 75 HP.

D. Motor/Blower Drive Coupling. After installation of the blowers, air piping, check valves, and all other appurtenances, the Contractor shall have the blower Manufacturer’s representative verify the alignment of the blower to the motor and check the vibration levels under normal operating conditions. The alignment tolerance shall be within plus or minus 2 mils (0.002 inches), and the vibration levels shall not exceed 0.3 in/sec (peak). Vibration readings shall be in the vertical, horizontal, and axial planes, and shall be taken at both the inboard and outboard bearings. The Contractor shall provide a written report of all readings including maximum, minimum, and mean vibration readings. If any readings are found in excess of these levels, the Contractor shall remedy the cause of the excursions, and retest the alignment and vibration levels. The blowers may not be placed into service until the report(s) are approved by the Engineer. Couplings shall be covered with 16-gauge base mounted sheet metal guards.

E. Accessories.
1. Provide the following filter/silencers rated at 120 percent (120%) of the blower capacity to be mounted on the inlet piping as shown on the plans:
   a. AF-09-601

2. The blower Manufacturer may provide the following as a part of a complete and working package. However, it is the responsibility of the blower Manufacturer to coordinate with all applicable specifications and the Contractor to provide valves, fittings, and accessories that are compatible with the system.
   a. BFV-09-601
   b. BFV-09-602
   c. SAE-09-601
   d. DCV-09-601

2.5 ELECTRICAL CONTROLS AND DEVICES

A. Provide separately mounted NEMA 4X stainless steel white epoxy coated Surge Panel at each blower with:
1. An HMI capable of displaying Amps, Surge, and alarm status.
2. Provide a means of UV protection for digital displays.
3. Nameplates.
4. Provide the current transformer (shipped loose), for each blower, to be installed at MCC.

B. Provide a PLC in accordance with 13311 PLC Hardware and Software.

C. Process Control Narrative:

Process Description:	One (1) multistage centrifugal blower will be provided to supply air, along with five (5) existing blowers, to a common bifurcated air header at the blower slab. Three blowers supply air to the secondary processes, chlorine contact basin, scum pump stations, and RAS/WAS pump stations (Air Header No. 2), Two blowers will be dedicated to the sludge holding tank (Air Header No. 1), and one blower will be a common spare. The blowers will be operated continuously at a constant speed. Each blower will have a Local Protection Panel (Vendor Provided) and local padlock-able Lock-Stop Switch (By Contractor). Three low pressure switches, one on each branch of the air header, will send an alarm when the pressure drops below a set point.
P&ID:	9-I-1 Blowers P&ID
Controlled Devices:	MSB-09-601 – Multistage Blower No. 6
Instrumentation Devices:	See Specification Section 13441 – Process Control Narratives
Local Functions:	Blower Local Surge Panel will be vendor supplied and controlled by the vendor supplied control panel which will at a minimum provide the following: • An On-Off switch. In the On position, the blower will operate if the switch at the MCC is also in the Hand position or is in the Auto position and the PLC has engaged a Call relay if the interlocks listed in the INTERLOCKS section below are not active. • An Emergency Stop Switch (E-Stop) • HMI for status and alarm indication
MCC Functions:	Blower MCC section will have the following: • A Hand-Off-Auto switch. In the Hand position, the blower will operate if the switch at the Local Protection Panel is also in the On position and if the interlocks listed in the INTERLOCKS section below are not active. • An SSRV providing fault status indication • A Standby Power Bypass On-Off switch. In On position, the blower will be locked out under standby power. • Phase Failure Bypass On-Off Switch • Running Status Light • Elapsed Time Meter (Shipped loosed by vendor) • Current Transformer (Shipped loosed by vendor) • The blower shall incorporate user-adjustable time delays for the startup

HMI Functions:	HMI shall have a graphical layout similar to what is shown on the five existing blowers HMI. At a minimum the graphic provided at the blowers local control panel will include indication of the following status and alarms: • Hand/Off/Auto • Running • Overload • Surge • CFM • Amps • Runtime • SSRV Fail
PLC Functions:	When the Hand-Off-Auto switch Is in the Auto position, the PLC will call the blowers to run when it receives an operator call from the SCADA interface, if the interlocks listed in the INTERLOCKS section below are not active. The PLC will sequence the restart of the blowers when the plant goes on stand-by power. The PLC will automatically call the blowers to run once power is returned. In case of blower failure, the PLC will automatically re-sequence the blower rotation order. MSB—09-601 will not be included in this blower rotation as it is dedicated to the Sludge Holding Tank. All other blowers will rotate and be re-sequenced to operate upon blower failure.
SCADA Functions:	See Specification Section - 13441 – Process Control Narratives
Interlocks:	<u>Interlocks below are hardwired:</u> MSB-09-601 Phase Failure MSB-09-601 E-Stop MSB-09-601 SSRV Fail MSB-09-601 Surge MSB-09-601 Overload MSB-09-601 Lock Stop Switch MSB-09-601 Standby Power Lockout
Alarms and Indications:	<u>Alarms Indicated at the HMI</u> MSB-09-601 Surge Alarm MSB-09-601 Overload MSB-09-601 E-Stop <u>Alarms Indicated on SCADA</u> MSB-09-601 Phase Failure MSB-09-601 E-Stop MSB-09-601 SSRV Fail MSB-09-601 Surge MSB-09-601 Overload See Specification Section - 13441 – Process Control Narratives for a complete list of SCADA alarms See IO list for a complete list of alarms and status indications

2.6 COATING SYSTEM

A. Shop prime in accordance with the Manufacturer's recommendations for transportation and storage. Field prep and coat in accordance with Section 09921 – Protective Coatings.

B. Field touch-up damaged areas of coating with same coating system in accordance with Manufacturer's recommendations.

2.7 SPARE PARTS

A. Provide one (1) year's supply of inlet filters for each blower and one (1) year's supply of oil for each blower.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the Work to Engineer.

3.2 INSTALLATION

A. Install and adjust equipment in accordance with the Drawings, approved shop drawings, and the Manufacturer's instructions.

B. Do not operate the equipment until the installation is approved by the Manufacturer's on-site representative.

C. Remove temporary bracing supports and other construction debris that may damage equipment.

D. Remove any temporary protective coatings and oils used for protection during shipment.

E. Check equipment for correct operation and freedom of moving parts.

F. Align equipment to Manufacturer's tolerances. Adjust clearances and torques.

G. Flush and fill lubricated systems in accordance with Manufacturer's instructions.

H. Provide sufficient clearances for thermal expansion and contraction.

I. Mount duplicate blower nameplates(s) inside front panel of blower control panel, using stainless steel fasteners.

3.3 FIELD TESTING

A. Prior to startup, the Manufacturer's representative, shall inspect all equipment for proper assembly, alignment, and proper operation.

B. Blowers shall be checked for proper alignment to avoid imbalance and excessive vibration. Any misalignment of greater than ¼" shall be remedied prior to demonstration period.

C. The Manufacturer's representative with assistance from the Contractor shall perform equipment tests in order to certify compliance with the herein specified performance requirements.

D. The Contractor shall provide all necessary test equipment, including temporary flow meters, pressure gauges, piping plugs or caps, or temporary bulkheads, and current meters.

E. Contractor shall ensure there is sufficient volume in the basin to conduct tests. If there is no flow to the basin upon start up, the Contractor shall provide water for testing purposes. If downstream components are not in place, Contractor shall make provisions for recycling and/or disposal of the provided water.

F. Place the system into operation. All components shall continue to operate without alarms or shutdowns, except as intended, for eight consecutive hours to be considered ready for startup.

G. Field tests shall consist of operating the blowers under normal and abnormal conditions.

H. Operate each blower through its entire performance range. Adjust, balance, and calibrate and verify that the equipment, safety devices, controls, and process system are operating as intended. Test safety devices for proper settings and signals.

I. Flow, pressure, and current shall be measured and documented for at least three operating points on each blower.

J. Should the tests indicate any malfunction, the Contractor shall make any necessary repairs and adjustments, and then re-test the equipment. Such test and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment functions properly and accurately and is ready for permanent operation.

K. A copy of all information from functional tests, including data, worksheets, and other materials shall be turned over to the Owner at the completion of the testing program, and copies shall be included in the Operations & Maintenance Manual for the project.

3.4 MANUFACTURER'S REPRESENTATIVE

A. A factory trained representative of the Manufacturer shall provide services for installation, supervision, start-up, field testing services, and operation and maintenance personnel training services.

B. Manufacturer's representative shall perform on-site services according to the following schedule, excluding travel time:

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	1	1
Pre-demonstration functional and performance testing	1	1
Pre-demonstration onsite training of owner personnel	1	Can be combined w/ pre-demonstration start up
Pre-demonstration start	1	1
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer shall provide a written report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

D. Manufacturer shall operate the system in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. The Manufacturer's Representative shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the Owner.

F. Contractor will be back charged by the Client for an unsuccessful field testing demonstration. Schedule the field demonstration a minimum of 48 hours following a successful startup procedure.

END OF SECTION

SECTION 11221
PERFORATED PLATE SCREEN

PART 1 - GENERAL

1.1 SCOPE

A. This section provides for furnishing and installing all labor, materials, equipment, controls and incidentals for a perforated plate mechanical screen. Included are side frames with sealing elements, covers, screen elements, rotating brush, spray nozzles and solenoid valves, electrical controls and drive motors and gearboxes, and all accessories for a complete and properly operating system.

B. The perforated plate screen shall be provided with the washer compactor as a package. The manufacturer for the perforated plate screens and the washer compactor shall be the same.

C. The existing screen and NPW booster pump shall be integrated into the headworks system.

1.2 RELATED WORK

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Reference Standards:
1. American National Standards Institute (ANSI)
2. American Welding Society (AWS)
3. National Institute for Occupational Safety and Health (NIOSH)
4. Occupational Safety and Health Act/Administration (OSHA)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples. **Coordinate the submittal of the perforated plate screens with the submittal of the washer compactor system as specified in Section 11700 – Screenings Washer Compactor.**

B. Perforated Plate Screen Data
1. Scope of supply, including list of materials shipped loose and complete bill of materials for all equipment.
2. Descriptive literature, bulletins and/or catalog data sheets of the equipment and major components (e.g. drive, motor, instrumentation, etc.)
3. Certified shop and installation drawings showing all details of construction, dimensions, required clearances, motors, control panels, attachments, supports, connections, couplings, and panel layouts.
4. Structural details for anchoring, base frames, enclosures, mounts, or stands, including material properties, classifications, dimensions, and thicknesses.
5. Detailed process and instrumentation (P&ID) diagrams, electrical wiring diagrams, and control narratives.
6. Complete wiring diagrams and control schematics.
7. Information for all surface preparation and shop coatings.

8. Certified shop test results.
9. Performance characteristics.
10. Calculations of bearing life (L-10), drive size, screenings head losses, screenings generation rate, estimated % solids of screenings.

C. The Manufacturer shall provide the following certifications.
1. The manufacturers of proposed electrical, mechanical, and structural systems affecting the performance of the equipment have examined the Contract Documents and agree to the performance and material specifications, warranty conditions, and other requirements set forth herein.
2. The maximum power required of any motor will not exceed the motor rating.
3. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
4. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel. (A written certification of a proper and correct installation and start-up, including all set points and calibrations, shall be provided.)
5. Owner's personnel have received sufficient training and are qualified to operate the equipment

D. Record Drawings: Submit record drawings under Submit record drawings under provisions of Section 01720 - Project Record Documents.

E. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

F. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

C. The equipment shall be designed, constructed, and installed in accordance with the Manufacturer's best practices and methods. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

D. Manufacturer and Contractor shall coordinate all dimensions to ensure adequate clearances for equipment maintenance, or removal, or replacement.

E. All welding shall be done at the Manufacturer's factory. Field welding shall not be permitted without the Engineer's express written approval.

F. The requirements of this Section shall be considered the minimum limits of acceptability.

1.6 WARRANTY

A. A single supplier shall take system responsibility for the perforated plate screen and washer compactor system controls and shall ensure that the components of the system are properly integrated to form a complete and operating system.

B. For a period of 12 months from substantial completion of the work, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Exposed flanges shall be covered and sealed with shrink wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

C. Accept units on site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter, where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs, or caps installed to protect equipment during shipment until the equipment is installed and permanent connections made.

PART 2 - PRODUCTS

2.1 GENERAL

A. The screen system shall be a self-contained, screening system used to positively clean and remove debris from incoming flow by means of a continuous rotating assembly of perforated panels, roller chain, channel frame, drive assembly, spray wash system, screen cleaning brush with drive assembly and guards.

B. All permanently or intermittently wetted parts (including spray and splashing areas) shall be constructed of a minimum 316 stainless steel or ultrahigh molecular weight polyethylene (UHMW).

2.2 DESIGN REQUIREMENTS

The screen system shall be designed to meet the following conditions:

Design Conditions	Units	MFS-03-301
Location		Headworks
Process Fluid		Unscreened Municipal Sewage
Liquid Temperature Rating, (Maximum)	°F	104
Size of perforation, in	inches	0.24
Allowable Range for Inclination Angle	degrees	75° from Horizontal
Design average daily flow through each unit	MGD	0.75
Peak two (2)-hour flow through each unit	MGD	2
Channel width	in	48
Screen width (Minimum)	in	36
Depth of channel	ft	5.5
Downstream Depth at ADF	ft	1.74
Downstream Depth at Peak Flow	ft	1.88
Maximum headloss at Peak Flow w/ 30% blockage	in	3.5
Screen Motor Size (Maximum)	HP	1
Brush Motor Size (Maximum)	HP	2

2.3 ACCEPTABLE MANAUFACTURERS

A. Provide perforated plate screens of one of the following, no others will be allowed:
   1. SAVÉCO North America, Inc.

B. Listing as an approved manufacturer will not relieve the manufacturer from conforming to these specifications.

2.4 PERFORATED PLATE SCREEN

A. The screen will consist of perforated panels intermittently rotating through the wastewater flow. Panels shall be made of stainless steel. Manufacturer shall supply two spare screen elements in case of repair. Stainless steel debris combs shall be intermittently affixed to panels. Screens without debris combs will not be accepted.

B. Each screen panel shall be manufactured from 3/16-inch (3/16") minimum thickness Type 316 stainless steel to create a frame to hold the 0.12 inch minimum thickness perforated panels. Each panel shall be provided with a seal that will close up the space between panels side seals mounted on each end of the panels. The side seals shall be 1/4-inch (1/4") minimum thickness ultra-high molecular weight polyethylene or 1/4-inch (1/4") minimum thickness glass fiber reinforced polypropylene.

C. Screen Torque Protection. The fine screen shall be equipped with a limit switch or over-current sensing unit to detect any overtorque conditions. The limit switch will sense movement of the gearmotor. Over-current detectors will monitor the current to the motor. Provide over-torque shutdown function with a manual reset.

D. Screen Emergency Stop Local Push Button Station and cable pull switches. NEMA 7/4X stainless steel emergency stop push button stations and cable pull emergency stop switches will be mounted to the screen frame. E-stops will be rated for use in 120 volt circuits and provided with ½ inch conduit openings. E-stops shall be explosion proof. E-stops will be wired to the control panel to cause all unit function to cease upon pressing the E-stop.

E. Screen Ultrasonic Level Sensing System. An ultrasonic level sensing system shall be provided to measure the upstream and downstream liquid level across the screen. The level sensing system shall include two (2) transducers and level controller. The transducer shall be explosion proof and rated NEMA 7/4X for use in a class 1 division 1 area. The controller shall be mounted in the vendor supplied control panel with viewing window on swing out panel. The transducer mounting bracket shall be provided by the manufacturer and the bracket shall be made of stainless steel.

F. Screen Spray Solenoid Valve. When the screen is in operation, the water spray will be actuated by a normally closed solenoid valve. The solenoid valve will have a brass body with NPT pipe connections. The solenoid valve shall require 115 volt, 60 Hz power and shall be provided with an 18" long 14/3 lead. Electrical housing shall be explosion proof and NEMA 8 rated with an NPT conduit connection sized as required by the Manufacturer.

G. Debris Lifting Element. The screen shall have a lifting mechanism such as debris hooks or debris combs that are mounted at multiple locations on the rotating screen assembly that are specifically designed to lift larger debris such as rocks and rags from the bottom of the channel. The removal method shall prevent the build-up of heavy material immediately in front of the screen.

H. Screen Travel Speed. Each screen shall have a travel speed that will quickly remove debris from the channel and resubmerge clean screen panels. High travel speeds are critical for efficient solids removal and to limit the head loss across the screen. Screens shall have a screen travel speed between 20 and 30 feet per minute (fpm)

2.5 CHAINS, SPROCKETS AND DRIVE SHAFT ASSEMBLIES

A. Each screen panel shall be mounted to the 316 stainless steel roller chains driven by 316 stainless steel sprockets mounted on the drive shaft. The use of non-roller chain designs will not be acceptable.

B. The roller chains shall have an 8 inch pitch with a minimum 16,000 lbf breaking strength. The side bars shall be 1-1/2 inch wide by 0.2-inch thick 316 stainless steel. The rollers shall be 1.88 inches in diameter with a 0.75-inch diameter pin. The rollers, pins and bushings will be 17-4 stainless steel hardened and tempered.

C. The stainless-steel drive shaft will be supported on each side by grease lubricated take-up bearing assemblies.

D. The two 316 stainless steel sprockets shall have a minimum pitch diameter of 13.375 inches. Units without stainless steel sprockets will not be acceptable.

2.6 SIDE FRAMES

A. The screen will include side frames and bracing as required. The side frames will be constructed of min. 3/16-inch 316 stainless steel plate. The frame must fit within the designated channel at the location shown on the plans. If there are gaps between the frame and the channel wall, the Contractor shall install grout between the frame and the wall to prevent unscreened influent from bypassing of the screening equipment. In lieu of grout, the Contractor may install plating, provided by the Manufacturer, to match the existing screen configuration.

B. Each side frame will have a lower tracking system or lower sprocket.

1. Lower Tracking Systems. Each side frame will have a replaceable UHMWPE, stainless steel or other approved tracking system. The vertical tracking system will be constructed of 1-3/8 by 2 inch bars. The bottom tracking system will consist of a 1 inch thick inner ring and a 1-3/8 by 2 inch outer ring.

2. Lower Sprockets. The lower sprocket bearings shall be slide bearings with a slide bushing made of silicon carbide and with a shaft of white cast iron. The slide bushing shall have an interior diameter of 2 3/8" (59 mm) and a length of 2" (50 mm). Ball or roller bearings, or slide bushings made of metal or plastic material shall not be accepted as lower sprocket bearings.

C. The system supplier shall supply an inlet chute made of stainless steel, which encloses the screen discharge and screenings compactor inlet hopper. The cover shall be easily removable with the use of clamp assemblies (such as Hoffman A-FC412SS) to allow pivoting of the screen. The side slopes shall be a minimum of 60° from the horizontal.

2.7 SPRAY WASH ASSEMBLY

A. The spray wash assembly shall consist of a spray wash manifold, solenoid operated valve, and manually operated ball-valve. Existing solenoid valves may be reutilized if approved by vendor. Otherwise, existing solenoid valves shall be replaced.

B. The spray wash manifold shall be of stainless steel pipes and fittings.

C. The manually operated ball valve shall be of ANSI 316 stainless steel and shall provide adjustment for the spray wash water flow.

2.8 ROTATING BRUSH ASSEMBLY

A. A rotating brush assembly shall be used to help with the removal of the screenings from the panels. The brush assembly will have a separate drive. The brush assembly will be mounted on an adjustable pivot for easy access and adjustments.

B. The brush will be replaceable in 4 inch sections and have a minimum diameter of 12.75 inches. One piece brush assemblies will not be acceptable. Manufacturer to also provide one (1) spare set of replacement brushes.

C. The shaft will be stainless steel. Tube will not be acceptable.

2.9 STATIONARY SEAL ASSEMBLY

A. A stationary brush and rubber assembly shall be bolted to the bottom of the screen frame to eliminate debris from bypassing the screen.

2.10 GUARDS

A. The portion of the screen above the operating floor level will have 316 stainless steel guards. The guards provide quick access panels for equipment maintenance.

2.11 DRIVE ASSEMBLIES

A. Screen Belt Drive. The screen drive motor shall be a 230/460 V, 3 Ph, 60 Hz, 1 HP (maximum) motor with 1.15 service factor and rated for use in a class 1 division 2 area. The motor shall be provided in a NEMA C-face frame and close coupled to the gear reducer.

B. Brush Drive. The brush drive motor shall be a 230/460 V, 3 Ph, 60 Hz, 2 HP (maximum) motor with a 1.0 or 1.15 service factor and rated for use in a class 1 division 2 area. The motor shall be provided in a NEMA C-face frame and close coupled to the gear reducer.

2.12 DISCHARGE CHUTE

A. The new screen and conveyor will be constructed in a way that will utilize the existing discharge chute at the headworks.

2.13 CONTROLS

Electrical Devices. All electrical components shall be NFPA 70 and NFPA 820 compliant, meet the requirements of the NEC and be NEMA standard. No IEC components are allowed. In addition to the drive motor, the following electrical devices will be supplied with the unit. All items listed in this specification must comply with Division 13 and 16 specifications. Contractor shall provide and install all necessary programming, instrumentation, field wiring, conduits and devices.

(1) A 480 volt, 3 phase, UL Listed, control panel will be provided to control the screen and wash press. All controls shall be rated for outdoors installation in Class 1, Division 2 area. The panel shall be a NEMA 7/4X Type 316 Stainless Steel enclosure mounted on freestanding or integral stainless-steel legs. The control panel and floor kit shall have a maximum depth of twenty four inches (24”). The control panel shall have a back panel, interior swing-out panel with all control switches and indicating lights, and a solid exterior door with a pad-lockable hasp. A quick release, three point latch shall be provided. Refer to specification section 13441 for logic devices. Refer to Wash Compactor Control System for interface requirements.

(2) The control panel shall include a 480 volt main circuit breaker, secondary motor circuit protectors and motor controllers (starters) for each motor and control power transformer associated with the perforated plate screen, screening washer compactor and related equipment. The secondary motor protectors will include pad lockable device to “LOCK OUT” power to each motor. The starter for the screen shall be a NEMA rated full voltage reversing starter (FVR) to allow operators a means of clearing matted obstacles that would obstruct normal operation of the screen. The starter shall be equipped with a Class 10 ambient compensated adjustable overload relay. The starter for the wash press system motor shall be a full voltage non-reversing (FVNR) starter equipped with a Class 10 ambient compensated adjustable overload relay.

(3) Provide green run lights for the screen, red alarm lights for motor overload and over-torque conditions. Provide an amber control power light and manual reset buttons for each starter.

(4) Provide relay contacts number as required rated for 10 amps at 240 VAC to activate non-potable water booster pump motor starter, wash compactor solenoid valve and related drive motors in accordance with the perforated plate screen water requirements and equipment logic. Provide all required instruments and interface terminals including but not limited to the water solenoid valves, non-potable water pump, over-torque protection devices, level elements and all related equipment for a complete and operational system.

(5) Level indicating transmitter/controllers are to be mounted in the control panel. The level elements with field wire are included and connected to the level indicating/controllers.

(6) Provide and install a PLC for automatic operation, mounted inside the control panel. The components shall consist of a base unit, expansion I/O modules, and memory module. All input and output points supplied (including unused) shall be wired to terminal blocks. The controller user memory shall consist of a minimum 20K words of program and data. All hardware shall be UL Listed and operate at an ambient temperature of -4°F to 140°F (-20°C to 60°C).

(7) Provide a PLC in accordance with 13311 PLC Hardware and Software.

(8) All panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. The internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel. Submit A/C sizing calculations for the Engineer to review

(9) PLC tag database shall be provided to the PCSS and/or Owner for incorporating into top end SCADA for Monitoring and Controls. At minimum the following shall be provided:
   a. The following statuses shall be monitored at the plant SCADA:
      i. All motor Hand/Off/Auto
      ii. All motor running status
      iii. All set point levels
      iv. All available alarms

(10) All control panel wire shall be 14 AWG multi-strand machine tool wire minimum with MTW insulation.

(11) All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing.

(12) Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122º F. Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.

(13) All control components shall be mounted internal to the enclosure and be mounted with stainless steel hardware. The enclosure and internal control components must be clearly identified with plastic engraved name tags secured to the panel with stainless steel self-tapping screws.

(14) Provide “pull-cord” emergency stop switches for the mechanical bar screen MFS-03-301 and Screenings Wash Compactor WC-03-001 that will provide an immediate equipment shutdown when activated. Any e-stop shall shut down all headworks equipment.

(15) The PCSS shall provide an explosion-proof NEMA 7/4X Local Control Station that includes:
   a. MFS-03-101 Screen HOA
   b. MFS-03-301 Screen HOA
   c. WC-03-001 HOA
   d. WC-03-001 F/O/R
   e. E-Stop Push Button

(16) Provide explosion-proof NEMA 7/4X Local Control Station that includes:
   a. E-Stop Push Button

2.14 PROCESS CONTROL NARRATIVE

Process Description:	One (1) in channel mechanical perforated plate screen and one (1) washer compactor shall be installed in the existing headworks alongside one (1) existing mechanical perforated plate screen and a bypass channel containing a manual bar screen. The proposed and existing mechanical perforated plate screens shall screen raw influent and discharge screenings to the proposed washer compactor. The washer compactor shall collect and compact the screenings and convey the compacted screenings into a dumpster at the base of the existing headworks. The proposed screen shall be operated through a new vendor supplied local control panel. The system shall monitor the liquid levels in the screen channel via ultrasonic transducers located on the upstream and downstream sides of the channel and operate the screen based on differential level setpoints. A new high-level float switch shall be installed to serve as backup, operating both screens and sending an alarm, should the transducer fail. Additionally, the screens shall operate when a user-adjustable time has passed without operation. The washer compactor shall be called from the existing control panel and operated on a time delay based on the screen's operation. The existing panel shall also provide washer compacter running and fault status. The new control panel shall send a run call to the NPW booster pump controls, located in the existing panel. The existing panel controls shall call the NPW Booster Pump motor starter to run and energize (open) solenoid valves at the wash water connections providing wash water for the mechanical screen and the washer compactor while the equipment is running. The existing panel shall also provide the NPW booster pump running and fault status. A high level alarm shall be triggered when either of the ultrasonic transducers detects that the level in the channel has reached the high level setpoint, or the high-level float switch is activated. A high level alarm in either channel shall call both systems to begin their cycle.
P&ID:	3-I-1 Elevated Headworks P&ID
Controlled Devices:	<u>Existing</u> MFS-03-101 – Mechanical Fine Screen No. 1 VMP-03-001 – NPW Booster Pump <u>Proposed</u> MFS-03-301 – Mechanical Fine Screen No. 2 WC-03-001 – Washer Compactor No. 1
Instrumentation Devices:	<u>Proposed</u> LE-03-301 – MFS-03-301 Upstream Level Element LE-03-302 – MFS-03-301 Downstream Level Element LIT-03-301 – MFS-03-301- Differential Level Indicating Transmitter SV-03-001 – Wash Water Solenoid Valve No. 1 SV-03-302 – Wash Water Solenoid Valve No. 2 LSH-03-301 - Headworks Level High Alarm ZS-03-301 – Inspection Door Safety Lockout

Local Functions:	When any H-O-A switch is in the HAND mode for a unit, that unit shall run continuously. The fine screen drive, brush drive and spray shall run continuously, and the wash press spiral shall run continuously. When spray wash Hand mode is selected, the PLC shall call the NPW Booster Pump motor starter to run and energize (open) solenoid valves so that the spray wash shall run continuously. Placing the selector switch in the off position shall stop all units. In the case of the fine screen, after the switch is returned to the Off position, the unit shall stop when the moving blade returns to the home position. The wash press shall continue running until the switch is put in the Off position. Fault Conditions. Provide a general red flashing alarm beacon and horn with silence relay and pushbutton. Provide indicating lights and isolated relay dry contacts for remote indication of, at minimum: CP-03-002 Fault & Alarm Conditions: (1) Current (Torque) overload (2) Motor starter thermostat (overload) trip. (3) Emergency high water level indication Emergency Stop: Any E-STOP or pull-cord emergency switch pushbutton being pressed shall stop the Press, Brush, Screen, and Booster Pump, and deenergize (close) all solenoid valves. System Reset shall only occur if all E-STOPS and emergency stop pull-cords are re-enabled and the inspection doors are closed (safety lockout), upon pressing the System Reset pushbutton.
MCC Functions:	None
HMI Functions:	None
PLC Functions:	When the system is in automatic operation mode, the following minimum specifications shall be required: Fine Screens. When all of the selector switches are in AUTO mode, the screens and brush drive motors and spray shall be controlled by automatic control logic. The screen shall run via the upstream/downstream liquid level transducers or a timer. When the hydraulic differential between the ultrasonic transducer detects the 'On' switch point, the screen, brush and spray water shall operate continuously. Screen, brush and spray shall be turned off 5 minutes (adjustable) after the liquid level drops below the 'Off" switch point. An adjustable time clock override shall be provided to ensure that the screen runs for a minimum amount of time. When the temperature drops below 35 degrees F the screen shall operate continuously to prevent damage. In the event of an overload condition the screen shall immediately shut down, a fault light shall illuminate, and SCADA shall notify the respective management. Provide a dry contact for remote fault indication. Provide a dry contact for interlocking the wash press system. Wash Compactor. The control panel shall be equipped to control the wash cycle, spiral movement, and flush cycle. Each wash or flush cycle and the spiral movement shall be controlled independently through the use of timers and counters. The drive motor and

	spray washes shall be controlled by the automatically when the selector switches are placed in the AUTO mode. The press motor starts after an adjustable run time from the interlocked fine screen equipment. The press motor shall run for an adjustable length of time, typically set at 3 seconds. The press motor continues to run and the washing solenoid opens for an adjustable length of time, typically set at 4 seconds. The press motor stops for an adjustable length of time, typically set at 4 seconds, while the washing solenoid remains open. Motor stop/start cycle repeats for an adjustable number of counts, typically set at 6. The washing solenoid closes, and the press motor runs for an adjustable length of time, typically set at 30 seconds, to dewater and discharge the screenings. The flush solenoid opens for an adjustable length of time after the press motor stops, typically set at 10 seconds. The system shall reset after the flush solenoid opens. NPW Booster Pump. The control panel shall be equipped to control the NPW booster pump. The control panel shall send a run call to the existing panel to call the NPW booster pump, and energize (open) solenoid valves at the wash water connections for the mechanical screen and the washer compactor while the equipment is running. All alarms shall be sent to the plant's SCADA system. PCSS shall coordinate with vendor for full list of indications, alarm points, Modbus addressing, and IP Addresses.
SCADA Functions:	See 13441 – Process Control Narratives for SCADA functions.
Interlocks:	All interlocks below are hardwired: Existing MFS-03-101 Emergency Stop MFS-03-101 Overload MFS-03-101 Mechanical Brush Motor Overload MFS-03-101 Mechanical Screen Motor Overload Proposed MFS-03-101 Pull-Cord E-Switch MFS-03-301 Pull-Cord E-Switch WC-03-001 Pull Cord E-Switch MFS-03-301 Emergency Stop MFS-03-301 Mechanical Brush Motor Overload MFS-03-301 Mechanical Screen Motor Overload WC-03-001 Emergency Stop WC-03-001 Motor Overload
Alarms and Indications:	Specific Alarms Indicated at CP-03-002 CP-03-002 - Control Power On LSH-03-301 - Headworks Level High Alarm MFS-03-101 Pull-Cord E-Switch MFS-03-301 - Emergency Stop MFS-03-301 Pull-Cord E-Switch MFS-03-301 Mechanical Brush Motor Overload MFS-03-301 Mechanical Screen Motor Overload MFS-03-301 – Screen Fault

	MFS-03-301 – Brush Fault WC-03-001 - Emergency Stop WC-03-001 Pull Cord E-Switch WC-03-001 Motor Overload VMP-03-001 – Booster Pump Fail <u>Alarms Indicated on SCADA:</u> See 13441 – Process Control Narratives for SCADA functions See IO list for a complete list of alarms and status indications
Local Set Points:	Water Level Differential – 14.11 inches Wash Press On Delay – 20 seconds Was Press Off Delay – 120 seconds Screen Jam Reverse – 30 seconds
Component Specification References:	11700 – Screenings Washer Compactor

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the Work to Engineer.

3.2 INSTALLATION

A. Install products in accordance with Manufacturer's written instructions. Contractor shall coordinate installation with the perforated plate screens specified din Section 11700 – Screenings Washer Compactor.

B. Contractor shall carefully examine existing headworks structure and roughing in to verify actual locations of perforated plate screens before installation.

C. Provide sufficient clearances for proper operation.

D. Mount duplicate pump nameplate(s) inside front panel of control panel, using stainless steel fasteners.

3.3 FIELD TESTING

A. All equipment shall be given operational tests by the Contractor and Manufacturer's Representative at the site following installation of the equipment and controls.

B. The Contractor shall provide all necessary test equipment including water, temporary piping, and other required incidentals.

C. Field tests shall consist of operating the washer compactor system under normal and anormal conditions. This includes operating the system concurrently with the screen system.

D. Should the tests indicate any malfunction, the Contractor shall make any necessary repairs and adjustments, then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

3.4 MANUFACTURER SERVICES

A. A factory trained Representative of the Manufacturer shall provide services for installation supervision, start-up and test services, and operation and maintenance personnel training services.

B. Manufacturer's Representative shall perform on-site services, including training of Owner's personnel, according to the following schedule, excluding travel time.

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	1	1
Pre-demonstration functional and performance testing	1	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ pre-demonstration start up
Pre-demonstration start up	0.5	1
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer's Representative shall provide a written start-up report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

D. Manufacturer's Representative shall operate the system during the field test in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. The representative shall revisit the site as often as necessary until all problems are corrected and the installation is entirely satisfactory. The Manufacturer's Representative shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals, and incidentals for additional visits shall be at no additional cost to the Owner

END OF SECTION

SECTION 11310
COARSE BUBBLE SINGLE-DROP DIFFUSION SYSTEM

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for furnishing the diffused aeration equipment for the influent mixing basins, RAS/WAS and Scum pump stations, and other miscellaneous locations. This section includes all air diffusion equipment and appurtenances with all related piping, support structures, valves, and fittings.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Reference Standards:
1. Air Movement and Control Association International (AMCA)
2. American National Standards Institute (ANSI)
3. American Gear Manufacturers Association (AGMA)
4. American Society of Mechanical Engineers (ASME)
5. ASTM International (ASTM)
6. National Electrical Manufacturers Association (NEMA)
7. National Electric Code (NEC)
8. National Fire Protection Association (NFPA)
9. Occupational Safety and Health Administration (OSHA)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples.

B. Diffusion System Data
1. Scope of supply including part numbers, quantity, location and manufacturer listed in table format.
2. Cut sheets, diffusion system basin layouts, air release elevations, construction materials, dimensions, weights, shop coatings, and anchor system details.
3. Supports.
4. Diffusion system performance characteristics.
5. Clean water transfer efficiency testing data.
6. Headloss calculations.

C. The Manufacturer shall provide the following certifications.
1. The Manufacturer has examined the Contract Documents and agrees to the process performance guarantee and material specifications, warranty conditions, and other requirements of the Contract.
2. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.

3. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel. (A written certification of a proper and correct installation and start-up shall be provided.)
4. Owner's personnel have received sufficient training and are qualified to operate the equipment.

D. Record Drawings: Submit record drawings under provisions of Section 01720 - Project Record Documents.

E. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all curves, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

F. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

C. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

D. Coordinate all dimensions to ensure adequate clearances for maintenance, removal, or replacement of diffusers.

E. The requirements of this Section shall be considered the minimum limits of acceptability.

1.6 WARRANTY

A. For a period of 12 months from substantial completion of the plant, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Take proper measures to prevent rust and corrosion.

C. Accept equipment on-site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs or caps installed to protect the equipment during shipment until the equipment is installed and permanent connections are made.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide single, coarse bubble diffusers which are specifically designed for the application. Refer to the design conditions outlined in Section 2.2 Performance and Design Requirements.

B. The air distribution and air diffusion equipment must be able to distribute the design and maximum airflows for each aerated basin as well as all airflows required for airlift pumps. Air diffusion and piping systems must be capable of handling 150% of design airflows within the maximum pressure limits.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

Location	**Units**	Rapid Mix Basin No. 2	Clarifier Loading Basin No. 3	RAS Pit No. 3	WAS Pit No. 3	Scum Pit No. 3
Static Volume	ft^3	1,214	652	590	277	277
Static Water Depth	ft	16.19	14.93	14.83	14.83	14.83
Static Submergence	ft	15.00	13.93	13.83	13.83	13.83
Diffuser Diameter	in	1	1	1	1	1
Minimum Mixing Air	$scfm/ft^3$	30	30	30	30	30
Design Airflow	scfm	36	20	18	9	9

2.3 ACCEPTABLE MANUFACTURERS

A. Provide fine bubble disk membrane diffusion systems of one of the following:
requirements and system operating conditions.
1. EDI
2. Sanitaire

B. Listing as an acceptable manufacturer does not relieve the Manufacturer from conforming to these specifications.

2.4 AIR DIFFUSION EQUIPMENT

A. The air diffusion equipment must be capable delivering the design air flow at average water depths without exceeding the top of dropleg pressure outlined in Section 2.2 Performance and Design Requirements.

B. The air diffusion equipment must generate a minimum orifice pressure loss to ensure adequate air distribution at lower airflows.

C. The equipment manufacturer shall be solely responsible for proper design of the air diffusion orifices to provide:
1. Air distribution to suit Engineer's design requirements
2. Minimum pressure losses

D. No air diffusion equipment using underwater air orificing or restricting devices for air distribution shall be considered for this project. Individual air diffusers must be positively cleaned from above the water surface without being removed or the air supply interrupted.

E. The air diffuser supplied must have a clean history of efficient operation, free from clogging, back-pressuring of structural failure when applied to service conditions similar to those indicated for this project.

F. Air piping shall be sized so that the velocity of the air in the pipe at peak air flow is less than or equal to the values in the table below.

Pipe Size	Maximum Velocity*
1"-2½"	1800 FPM
3"-10"	3000 FPM
12"-24"	4000 FPM
Greater than 24"	6500 FPM

* At Standard Conditions

G. All diffusers shall include an isolation ball valve type unless otherwise noted in the plans. Provide ball valves in accordance with Section 15104 – Ball Valves.

H. The air headers furnishing air to the diffusers shall be tapped and provided with a welded-in-horizontal run-out coupling at the location of each individual air diffuser. If the air header is hot dip galvanized, the couplings shall be welded-in prior to hot dip galvanizing for full protection. All threaded parts shall be retapped after galvanizing.

2.5 AIR DIFFUSERS

A. Each air diffuser shall be of one piece construction with no moving parts and shall consist of an air release tube and

deflector(s) with bubble shearing edges. The diffusers must be of proven structural design without inherent structural deficiencies or weaknesses.

B. The air release tube shall transport air flows from the drop pipe connection at the top of the diffuser, down through the deflector to the air release slots. The tube shall have an inside diameter equal to or greater than that of the drop pipe throughout its length and shall terminate with a full diameter opening. This is to allow positive cleaning of the airway of each diffuser by allowing a brush or rod inserted at the top end of the drop pipe to pass completely through the diffuser.

C. The bottom of the tube shall contain vertical slots at least ¼-inch (¼") wide to ensure the distribution of airflow.

D. The deflector portion of the diffuser shall break-up the coarse bubbles generated at the release tube slots into the fine bubbles required for efficient oxygen transfer. The shear edge shall provide sharp discontinuity in the air/water flow, generating high shear forces on the course bubbles causing bubble break-up.

2.7 AIR DIFFUSER ASSEMBLIES

An individual air diffusion drop (air feed pipe) shall be furnished for each air diffusion head. Furnish air drops and diffusers of the number and size at the location as shown on the drawings.

A. One-Inch (1") Diffuser Assemblies.
1. Each one-inch (1") diffuser assembly shall consist of a one-inch (1") diffuser, an individual drop pipe of Schedule 40 304 stainless steel, and a 304 stainless steel orifice/tee assembly. This assembly shall be fastened to the air supply header through a horizontal one-inch (1") Schedule 40 stainless steel threaded runout. The orifice/tee assembly shall consist of a one-inch (1") threaded 304 stainless steel tee with a reinforced nylon orifice insert. The orifice insert shall screw into the top of the stainless steel tee and shall be removable for positive cleaning of the drop pipe and diffuser.
2. Some of the one-inch (1") diffuser assemblies shall include a one-inch (1") 304 stainless steel union and a one-inch (1") 304 stainless steel ball valve as indicated on the drawings.
3. Each vertical drop pipe shall extend from the above-water orifice/tee assembly to the air diffuser located at the required air release elevation.
4. Each air drop pipe shall be rigidly secured in place by the top orifice/tee assembly and by a structural steel support furnished by the equipment manufacturer. The drop pipes shall be secured to the support with one-inch (1") polyethylene pipe clamps with 304 stainless steel hardware. Structural steel supports shall be constructed from 4" × 4" × ¼" structural steel angle. Provide stainless steel kwik bolts as necessary to connect supports together and to anchor them to the concrete floors. Fabrication drawings of structural support shall be included with submittal data for review by Engineer.

B. Two-Inch (2") Diffuser Assemblies. The two-inch (2") diffuser assemblies shall consist of a two-inch (2") diffuser, a two-inch (2") 304 stainless steel orifice/tee assembly, and a two-inch (2") Schedule 40 galvanized steel drop pipe. The orifice/tee assembly shall consist of a two-inch (2") Schedule 40 galvanized steel tee with a reinforced nylon orifice insert.
1. Each vertical drop pipe shall extend from the above-water orifice/tee assembly to the air diffuser located at the required air release elevation.
2. Each air drop pipe shall be rigidly secured in place by the top orifice/tee assembly and by a structural steel support furnished by the equipment manufacturer. The drop pipes shall be secured to the support with one-inch (1") polyethylene pipe clamps with 304 stainless steel hardware. Structural steel supports shall be constructed from 4" × 4" × ¼" structural steel angle. Provide stainless steel kwik bolts as necessary to connect supports together and to anchor them to the concrete floors. Fabrication drawings of structural support shall be included with submittal data for review by Engineer.

2.8 CORROSION PROTECTION

A. All headers, pipes, fittings, and supports which are not stainless steel shall be hot dipped galvanized unless otherwise noted on the plans.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that equipment has no defects on the structure or surface that will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the work to the Engineer.

3.2 INSTALLATION

A. Install aeration equipment at the location shown on the construction drawings and the manufacturer's installation drawings which have been reviewed by the Engineer.

3.3 FIELD TESTING

A. The Manufacturer's representative, with assistance from the Contractor, shall perform equipment tests in order to certify compliance with the herein specified performance requirements.

B. The Contractor shall provide all necessary test equipment. Contractor shall ensure there is sufficient volume in the basin to conduct test and that all downstream components are capable of receiving liquid. If there is no flow to the basin upon start up, the Contractor shall provide water for testing purposes. If downstream componentS are not in place, Contractor shall make provisions for recycling water and disposal.

C. Field tests shall consist of operating the equipment under normal and abnormal conditions.
   1. Operate each item of equipment through its entire performance range and through at least 3 full cycles. Adjust, balance, calibrate and verify that the equipment, controls, and process system are operating as intended.
   2. Test all purge assemblies.
   3. Should the tests indicate any malfunction, Contractor shall make any necessary repairs and adjustments, and then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

D. A copy of all information from functional tests, including data, worksheets, and other materials shall be turned over to the Owner at the completion of the testing program, and copies shall be included in Operation & Maintenance Manual for the project.

3.4 SERVICES BY MANUFACTURER

A. A factory trained representative of the manufacturer shall provide services for installation and supervision, start-up, test services, and operation and maintenance personnel training services.

B. Manufacturer's technical representative shall attend two (2) start-ups. The first start-up shall be a dry start-up and inspection, and the second shall be a wet start-up as part of the overall clear water test. The Contractor shall submit approved start-up forms signed by the manufacturer for each of the two (2) start-ups. Additionally, in conjunction with the two (2) start-ups, the manufacturer shall provide a representative for eight (8) on-site hours to inspect equipment after installation and supervise initial operation. Furnish the representative for the additional time required to correct or supervise correction of any defects or malfunctions related to the start-ups and overall system integration during the clear water test.

C. Manufacturer's representative shall perform on-site services according to the following schedule, excluding travel time:

Work	**Person Days**	**Trips**
Manufacturer's inspection and certification of installation	1	1
Pre-demonstration functional and performance testing	1	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ testing and pre-demonstration start up
Pre-demonstration start up	1	Can be combined w/ testing and pre-demonstration start up

D. Manufacturer shall provide a written start-up report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

E. Manufacturer shall operate the system during the field test in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. The representative shall revisit the site as often as necessary until all problems are corrected and the installation is entirely satisfactory. The Manufacturer shall provide a written report documenting the results of the field testing.

F. All costs, including travel, lodging, meals, and incidentals for additional visits shall be at no additional cost to the Owner.

G. Manufacturer will be back charged by the client for an unsuccessful field testing demonstration. Schedule the field testing a minimum of 48 hours following a successful start-up procedure.

END OF SECTION

SECTION 11311
COARSE BUBBLE WIDE BAND DIFFUSERS

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for furnishing the diffused aeration equipment. This section includes all air diffusion equipment and appurtenances with all related piping, support structures, valves and fittings.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Reference Standards:
1. Air Movement and Control Association International (AMCA)
2. American National Standards Institute (ANSI)
3. American Gear Manufacturers Association (AGMA)
4. American Society of Mechanical Engineers (ASME)
5. ASTM International (ASTM)
6. National Electrical Manufacturers Association (NEMA)
7. National Electric Code (NEC)
8. National Fire Protection Association (NFPA)
9. Occupational Safety and Health Administration (OSHA)

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples.

B. Diffusion System Data
1. Scope of supply including part numbers, quantity, location and manufacturer listed in table format.
2. Cut sheets, diffusion system basin layouts, air release elevations, construction materials, dimensions, weights, shop coatings, and anchor system details.
3. Supports.
4. Diffusion system performance characteristics.
5. Clean water transfer efficiency testing data.
6. Headloss calculations.

C. The Manufacturer shall provide the following certifications.
   a. The Manufacturer has examined the Contract Documents and agrees to the process performance guarantee and material specifications, warranty conditions, and other requirements of the Contract.
   b. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
   c. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel. (A written certification of a proper and correct installation and start-up shall be provided.)
   d. Owner's personnel have received sufficient training and are qualified to operate the equipment.

D. Record Drawings: Submit record drawings under provisions of Section 01720 - Project Record Documents.

E. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all curves, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

F. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

C. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

D. Coordinate all dimensions to ensure adequate clearances for maintenance, removal, or replacement of diffusers.

E. The requirements of this Section shall be considered the minimum limits of acceptability.

1.6 WARRANTY

A. For a period of 12 months from substantial completion of the plant, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Take proper measures to prevent rust and

corrosion.

C. Accept equipment on-site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs or caps installed to protect the equipment during shipment until the equipment is installed and permanent connections are made.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide single, wide band, coarse bubble diffusers which are specifically designed for the aeration application. Refer to the design conditions outlined in Section 2.2 Performance and Design Requirements.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Basin dimensions shown in the performance table below are for the expanded volume and do not include the existing basin dimensions.

Location	**Units**	Peak Shaving Basin (Expansion Only)
Static Volume	ft^3	11,200
Static Water Depth	ft	16.00
Static Submergence	ft	15.00
Minimum Mixing Air	$scfm/kft^3$	30
Maximum Top of Drop Leg Pressure	psig	7.01
Design Airflow	scfm	336
Basin Percent Solids	%	0.25

2.3 ACCEPTABLE MANUFACTURERS

A. Provide fine bubble disk membrane diffusion systems of one of the following:
requirements and system operating conditions.
1. EDI
2. Sanitaire

B. Listing as an acceptable manufacturer does not relieve the Manufacturer from conforming to these specifications.

2.4 AIR DIFFUSION EQUIPMENT

A. The air diffusion equipment must be capable of delivering the design air flow at average water depths without exceeding the top of dropleg pressure outlined in Section 2.2 Performance and Design Requirements.

B. The air diffusion equipment must generate a minimum orifice pressure loss to ensure adequate distribution at lower airflows.

C. The equipment manufacturer shall be solely responsible for proper design of the air diffusion orifices to provide:
1. Air distribution to suit Engineer's design requirements for both the fine bubble and coarse bubble diffusers.
2. Minimum pressure losses

D. No air diffusion equipment using underwater air orificing or restricting devices for air distribution shall be considered for the project. Individual air diffusers must be positively cleaned from above the water surface without being removed or the air supply interrupted.

E. The air diffuser supplied must have a clean history of efficient operation, free from clogging, back pressuring of structural failure when applied to service conditions similar to those indicated for this project.

2.5 AIR DISTRIBUTION PIPING AND EQUIPMENT

A. Droplegs and submerged air headers furnishing air to the diffusers shall be stainless steel pipe. Droplegs shall be minimum 10 gauge. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to AISI 304L and ASTM A-240-78a. Fabricate non-welded parts from sheets and plates of 304 stainless steel conforming to AISI 304 and ASTM A-240-78a. Dimensional tolerances shall conform to ASTM A-544-72 and ASTM A-530-72.

B. Furnish air distribution headers and connectors with the following minimum nominal wall thicknesses:
1. For mutually reinforced diffuser connectors and headers, wall thickness is 0.109 inches.
2. For non-mutually reinforced diffuser connectors and headers, wall thickness is Schedule 20.

C. Fabricate all applicable products and fittings conforming to ASTM A-774-80 and A-778-80.

D. All welding must be performed in the factory using shielded arc, inert gas, MIG or TIG method. Filler wire must be added to all welds. Fully penetrate butt welds to the interior surface and provide gas shielding to interior and exterior of joint. Interior weld beads shall be smooth, evenly distributed, and project not more than $^{1}/_{16}$-inch ($^{1}/_{16}$"). Field welding will not be permitted.

E. All stainless steel surfaces shall be passivated by pickling and neutralization in six percent (6%) nitric acid and three percent (3%) hydrofluoric acid for 15 minutes followed by immersion in a tri-sodium phosphate rinse.

F. All nuts, bolts, and washers, including anchor bolts, shall be 18-8 stainless steel.

G. Provide a dropleg from the air main connection as shown on the drawings.

H. Join header sections with joints that allow rotation for alignment during installation.

I. Furnish an expansion/contraction system for all headers to allow for 125°F temperature change. Expansion joints at quarter span points shall be provided on all continuous lengths of header between two (2) restraining points.

J. Furnish a minimum of two (2) stainless steel supports for each air header with 17 feet maximum spacing between supports. Each support shall resist a 550 inch-lbs. bending moment and 239 lbs. of uplift force. Supports shall be vertically adjustable by two inches with a 90-degrees cradle and a position locking mechanism.

K. Diffuser connectors shall resist a bending moment of 1,000 inch-lbs.

L. Air piping shall be sized so that the velocity of the air in the pipe at peak air flow is less than or equal to the values in the table below.

Pipe Size	Maximum Velocity*
1" - 2½"	1,800 FPM
3" - 10"	3,000 FPM
12" - 24"	4,000 FPM
Greater than 24"	6,500 FPM

* At Standard Conditions

2.6 AIR DIFFUSERS

A. Diffusers shall consist of cast end caps, air exit ports at two (2) levels, an orifice insert, and a full length opening near the bottom.

B. Diffusers shall release air uniformly along a minimum one-foot (1') band beyond the side of the air header. Air release shall be distributed along the 24-inch (24") perimeter uniformly at air rates up to 30 scfm.

C. Diffusers shall be fabricated from 304L stainless steel.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that the structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the work to the Engineer.

3.2 INSTALLATION

A. Install aeration equipment at the location shown on the construction drawings and the Manufacturer's installation drawings which have been reviewed by the Engineer.

3.3 FIELD TESTING

A. The Manufacturer’s representative, with assistance from the Contractor, shall perform equipment tests in order to certify compliance with the herein specified performance requirements.

B. The Contractor shall provide all necessary test equipment. Contractor shall ensure there is sufficient volume in the basin to conduct test and that all downstream components are capable of receiving liquid. If there is no flow to the basin upon start up, the Contractor shall provide water for testing purposes. If downstream components are not in place, Contractor shall make provisions for recycling water and disposal.

C. Field tests shall consist of operating the equipment under normal and abnormal conditions.
   1. Operate each item of equipment through its entire performance range and through at least 3 full cycles. Adjust, balance, calibrate and verify that the equipment, controls, and process system are operating as intended.
   2. Test all purge assemblies.
   3. Should the tests indicate any malfunction, Contractor shall make any necessary repairs and adjustments, and then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

D. A copy of all information from functional tests, including data, worksheets, and other materials shall be turned over to the Owner at the completion of the testing program, and copies shall be included in Operation & Maintenance Manual for the project.

3.4 MANUFACTURER'S REPRESENTATIVE

A. Manufacturer’s on-site services shall be provided via one or more qualified full-time factory employee(s), or service technician(s) with extensive experience in on-site installation and testing of equipment similar to that specified herein. The Manufacturer shall provide services for installation and supervision, start-up, test services, and operation and maintenance personnel training services.

B. Manufacturer’s technical representative shall attend two (2) start-ups. The first start-up shall be a dry start-up and inspection, and the second shall be a wet start-up as part of the overall clear water test. The Contractor shall submit approved start-up forms signed by the manufacturer for each of the two (2) start-ups. Additionally, in conjunction with the two (2) start-ups, the manufacturer shall provide a representative for eight (8) on-site hours to inspect equipment after installation and supervise initial operation. Furnish the representative for the additional time required to correct or supervise correction of any defects or malfunctions related to the start-ups and overall system integration during the clear water test.

C. Manufacturer’s representative shall perform on-site services according to the following schedule, excluding travel time:

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	1	1
Pre-demonstration functional and performance testing	1	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ testing and pre-demonstration start up
Pre-demonstration start up	1	Can be combined w/ testing and pre-demonstration start up
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

D. Manufacturer shall provide a written start-up report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

E. Manufacturer shall operate the system during the field test in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. The representative shall revisit the site as often as necessary until all problems are corrected and the installation is entirely satisfactory. The Manufacturer shall provide a written report documenting the results of the field testing.

F. All costs, including travel, lodging, meals, and incidentals for additional visits shall be at no additional cost to the Owner.

G. Manufacturer will be back charged by the client for an unsuccessful field testing demonstration. Schedule the field testing a minimum of 48 hours following a successful start-up procedure.

END OF SECTION

SECTION 11313
FINE BUBBLE DISK MEMBRANE DIFFUSION SYSTEM

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for furnishing a flexible membrane fine bubble aeration system for the aeration basins. This section includes all air diffusion equipment and appurtenances with all related piping, support structures, valves and fittings. Diffusers shall provide "full-floor" coverage of aeration basins.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Reference Standards:
1. Air Movement and Control Association International (AMCA)
2. American National Standards Institute (ANSI)
3. American Gear Manufacturers Association (AGMA)
4. American Society of Mechanical Engineers (ASME)
5. ASTM International (ASTM)
6. National Electrical Manufacturers Association (NEMA)
7. National Electric Code (NEC)
8. National Fire Protection Association (NFPA)
9. Occupational Safety and Health Administration (OSHA)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples.

B. Diffusion System Data
1. Scope of supply including part numbers, quantity, location and manufacturer listed in table format.
2. Cut sheets, diffusion system basin layouts, air release elevations, construction materials, dimensions, weights, shop coatings, and anchor system details.
3. Supports.
4. Diffusion system performance characteristics.
5. Clean water transfer efficiency testing data.
6. Headloss calculations.

C. The Manufacturer shall provide the following certifications.
   a. The Manufacturer has examined the Contract Documents and agrees to the process performance guarantee and material specifications, warranty conditions, and other requirements of the Contract.
   b. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
   c. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel. (A written certification of a proper and correct installation and start-up shall be provided.)
   d. Owner's personnel have received sufficient training and are qualified to operate the equipment.

D. Record Drawings: Submit record drawings under provisions of Section 01720 - Project Record Documents.

E. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all curves, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

F. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

C. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

D. Coordinate all dimensions to ensure adequate clearances for maintenance, removal, or replacement of diffusers.

E. The requirements of this Section shall be considered the minimum limits of acceptability.

1.6 WARRANTY

A. For a period of 12 months from substantial completion of the plant, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Take proper measures to prevent rust and corrosion.

C. Accept equipment on-site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs or caps installed to protect the equipment during shipment until the equipment is installed and permanent connections are made.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The air diffusion equipment must be capable of supplying maximum air flows within the maximum pressure limitations imposed by the air supply and distribution systems. The intent of these specifications requires that the air diffusion equipment must be capable of meeting the maximum pressure limitations for the lifetime of the project. The equipment manufacturer shall guarantee the integrity of the system including membrane holders and membrane slits for five (5) years of operation. If for any reason in this five (5) year period the membranes are found to have rips or slit enlargement the manufacturer shall provide replacement parts and labor to repair the system.

B. Before the aeration equipment is placed in continuous operation, the equipment manufacturer will determine an initial baseline pressure loss.

C. The equipment manufacturer shall be solely responsible for proper design of the air diffusion orifices to provide air distribution to suit Engineer's design requirements.

D. The air distribution and air diffusion equipment must be able to distribute the design and maximum airflows for the aerated basins. Air diffusion and piping systems must be capable of handling 150 percent (150%) of design airflows within the maximum pressure limits.

E. Allowable air pressure measured at the top of the drop pipe shall not exceed the pressures shown in Section 2.2 Performance and Design Requirements at the specified airflow rates.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

Location	**Units**	Aeration Basin No. 3
Static Volume	ft^3	46,060
Static Water Depth	ft	16.19
Static Submergence	ft	15.13
Membrane Diffuser Diameter	in	9
Design SOR	lbs. O_2/day	3,645
Target Dissolved Oxygen	mg/L	2.0
Minimum Mixing Air	scfm/ft^2	0.12
Maximum Top of Drop Leg Pressure(1)	psig	7.03
Minimum Required Airflow	scfm	1,008
Minimum Airflow Per Diffuser(2)	scfm	1.10
SOTE(3)	%	32.2
Basin Percent Solids	%	0.3 – 0.7

(1) The pressure is measured at the top of the drop leg.
(2) At Design airflow.
(3) Minimum Standard Clean Water Oxygen Transfer Efficiency. See section 2.5B.

2.3 ACCEPTIBLE MANUFACTURERS

A. Provide fine bubble disk membrane diffusion systems of one of the following:
requirements and system operating conditions.
1. EDI
2. Sanitaire

B. Listing as an acceptable manufacturer does not relieve the Manufacturer from conforming to these specifications.

2.4 AIR DISTRIBUTION PIPING

A. Arrange the diffusers for "full-floor" coverage to obtain adequate oxygen transfer, mixing, and prevention of solids deposition. Maximum distance between basin walls and adjacent diffusers shall not exceed three feet (3´). Header (lateral) spacing shall not exceed three feet (3´).

B. Provide droplegs with a loose follower flange from the top connection and a band coupling for the lower connection. Provide a thrust anchor on the header or manifold near the dropleg.

Droplegs shall be fabricated from sheets and plates of 316L stainless steel with a 2D finish conforming to AI SI 316L and ASTM A-240-78a for welded components and 316 stainless steel conforming to AISI 316 and ASTM A-240-78a for non-welded components. Dimensional tolerances shall conform to ASTM A-544-72 and ASTM A-530-72.

C. Manifold piping shall be minimum Schedule 40 PVC. Schedule 40 PVC material shall comply with ASTM specifications D1784, D178l5, and D2466. Header (lateral) piping shall be minimum 4-inch (4") diameter SDR 33.5 PVC. SDR 35 PVC material shall comply with ASTM specifications D3915 and D3034. PVC material shall include titanium dioxide, 2 percent by weight, for protection from degradation from ultraviolet light.

All solvent welded joints shall be made in the factory. No field solvent welding will be allowed.

D. All new stainless steel surfaces shall be passivated by pickling and neutralization in six percent (6%) nitric acid and three percent (3%) hydrofluoric acid for 15 minutes followed by immersion in a tri-sodium phosphate rinse.

E. All nuts, bolts, and washer, including anchor bolts, shall be 304 stainless steel.

F. Join header sections with joints that allow rotation for alignment during installation. Joint shall be positive fixed threaded union flange type joints to prevent blow apart. All underwater joints shall be positive locking type.

G. Furnish an expansion/contraction system for all headers to allow for 125 °F temperature change. Expansion joints shall be provided on all continuous lengths of header between two (2) restraining points.

H. Header joints to manifolds shall be minimum 4-inch (4") diameter fixed joint connections designed to resist thrust generated by expansion or contraction of the header.

I. Furnish a minimum of two (2) manifold supports for each manifold consisting of a two-inch (2") hold-down guide strap, anchor bolts, and supporting structure. Each support shall resist the maximum anticipated bending moment and uplift forces. All components shall be fabricated of 304 or 304L stainless steel. Header support shall allow for plus or minus two-inch (2") vertical adjustment in the field.

Furnish a minimum to two (2) header supports, similar to manifold supports, for each header with eight-feet (8´) maximum spacing between supports. Each support shall resist the maximum anticipated bending moment and uplift

forces. Supports shall allow for plus or minus two-inch (2") vertical adjustment in the field. Vertical adjustment shall allow for leveling of the diffuser assemblies to within 1/4-inch (1/4") of a common horizontal plain.

No worm gear clamps shall be used.

Attach supports to existing concrete tank floor with a minimum of two (2) stainless steel adhesive anchors to resist anticipated pull out force with a factor of safety of 4.

J. Diffuser element holders and their connections to the headers shall resist a point load of 200 pounds applied vertically at the outermost edge of the diffuser holder.

K. Air piping shall be sized so that the velocity of the air in the pipe at peak air flow is less than or equal to the values in the table below.

Piping Size	Maximum Velocity*
1" - 2-1/2"	1,800 FPM
3" - 10"	3,000 FPM
12" - 24"	4,000 FPM
Greater than 24"	6,500 FPM

* At Standard Conditions

L. Furnish a purge assembly, including piping, valve, fittings, and supports per manufacturer.

2.5 AIR DIFFUSERS

A. Diffusers shall be fine bubble, flexible membrane type. Diffuser assemblies shall include an EPDM diffuser membrane, PVC diffuser holder, air flow control orifice, and 304 stainless steel or PVC retaining device. Diffusers with ceramic or plastic type media shall not be used.

B. Minimum clean water oxygen transfer efficiency for the aeration basin at standard conditions (SOTE) at the submergence specified in 2.2.B shall be equal to or greater than the values specified in 2.2.B. Provide test results demonstrating compliance with SOTE requirements using a submergence of ± one-foot (1′) of the specified submergence in table 2.2.B and airflows per diffuser as given in 2.5.E below, and at the actual airflow proposed.

C. Diffusers must incorporate some method of backflow prevention to prevent entry of wastewater into the diffuser and piping when the air flow is off.

D. Cleaning of the diffuser must be possible without dewatering the tank. Air flexing of the diffuser is acceptable.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that the structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the work to the Engineer.

3.2 INSTALLATION

A. Install aeration equipment at the location shown on the construction drawings and the Manufacturer's installation drawings which have been reviewed by the Engineer.

3.3 FIELD TESTING

A. The Manufacturer’s representative, with assistance from the Contractor, shall perform equipment tests in order to certify compliance with the herein specified performance requirements.

B. The Contractor shall provide all necessary test equipment. Contractor shall ensure there is sufficient volume in the basin to conduct test and that all downstream components are capable of receiving liquid. If there is no flow to the basin upon start up, the Contractor shall provide water for testing purposes. If downstream componentS are not in place, Contractor shall make provisions for recycling water and disposal.

C. Field tests shall consist of operating the equipment under normal and abnormal conditions.
   1. Operate each item of equipment through its entire performance range and through at least 3 full cycles. Adjust, balance, calibrate and verify that the equipment, controls, and process system are operating as intended.
   2. Test all purge assemblies.
   3. Should the tests indicate any malfunction, Contractor shall make any necessary repairs and adjustments, and then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

D. A copy of all information from functional tests, including data, worksheets, and other materials shall be turned over to the Owner at the completion of the testing program, and copies shall be included in Operation & Maintenance Manual for the project.

3.4 MANUFACTURER'S REPRESENTATIVE

A. Manufacturer’s on-site services shall be provided via one or more qualified full-time factory employee(s), or service technician(s) with extensive experience in on-site installation and testing of equipment similar to that specified herein. The Manufacturer shall provide services for installation and supervision, start-up, test services, and operation and maintenance personnel training services.

B. Manufacturer’s technical representative shall attend two (2) start-ups. The first start-up shall be a dry start-up and inspection, and the second shall be a wet start-up as part of the overall clear water test. The Contractor shall submit approved start-up forms signed by the manufacturer for each of the two (2) start-ups. Additionally, in conjunction with the two (2) start-ups, the manufacturer shall provide a representative for eight (8) on-site hours to inspect equipment after installation and supervise initial operation. Furnish the representative for the additional time required to correct or supervise correction of any defects or malfunctions related to the start-ups and overall system integration during the clear water test.

C. Manufacturer’s representative shall perform on-site services according to the following schedule, excluding travel time:

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	1	1
Pre-demonstration functional and performance testing	1	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ testing and pre-demonstration start up
Pre-demonstration start up	1	Can be combined w/ testing and pre-demonstration start up
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

D. Manufacturer shall provide a written start-up report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

E. Manufacturer shall operate the system during the field test in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. The representative shall revisit the site as often as necessary until all problems are corrected and the installation is entirely satisfactory. The Manufacturer shall provide a written report documenting the results of the field testing.

F. All costs, including travel, lodging, meals, and incidentals for additional visits shall be at no additional cost to the Owner.

G. Manufacturer will be back charged by the client for an unsuccessful field testing demonstration. Schedule the field testing a minimum of 48 hours following a successful start-up procedure.

END OF SECTION

SECTION 11319
AIR LIFT PUMPS

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for furnishing air lift pumps and their related accessories, for a complete and operable system.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. Air Movement and Control Association International (AMCA)
2. American National Standards Institute (ANSI)
3. American Gear Manufacturers Association (AGMA)
4. American Society of Mechanical Engineers (ASME)
5. ASTM International (ASTM)
6. National Electrical Manufacturers Association (NEMA)
7. National Electric Code (NEC)
8. National Fire Protection Association (NFPA)
9. Occupational Safety and Health Administration (OSHA)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01300 – Submittals and Section 01340 – Shop Drawings, Product Data and Samples. Submit for review, detailed drawings, data, and descriptive literature on all equipment and accessories including the following, arranged to facilitate submittal review:
   1. Performance Characteristics. Performance curves for prototype pump shall be acceptable. Curves shall show output in GPM for various airflow rates and percent submergence.
   2. Dimensional drawings.
   3. Dry and operating weight.
   4. Materials of Construction.
   5. Assembly drawings, including supports.

B. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all curves, cut sheets, drawings, equipment lists, maintenance schedules, descriptions, etc. that are required to instruct operation and maintenance personnel.

1.5 QUALITY ASSURANCE

A. Pumps shall be provided by a single manufacturer.

B. All components shall be constructed of new materials.

1.6 WARRANTY

For a period of 12 months from substantial completion of the plant, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Crate and protect all equipment against damage during shipment. Exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

B. Store equipment off the ground in enclosed shelter. Store and maintain equipment in accordance with Manufacturer's recommendations and per provisions of the Contract.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide airlifts which are specifically designed for the application. Refer to the service design conditions outlined in Section 2.2 Performance Requirements.

B. Furnish air lifts of standard dimensions such that parts will be interchangeable between like units. Air Lift Pump Table Abbreviations:
   1. Material
      a. 304 SST: Type 304 Stainless Steel
      b. 316 SST: Type 316 Stainless Steel
      c. HDGS: Hot-Dipped Galvanized Steel
      d. PVC: Schedule 80 PVC
   2. Discharge Type
      a. Plain: Plain Outlet, 90° Elbow
      b. HBP: Headbox With Plain Outlet
      c. HDF: Headbox With Flanged Outlet
      d. HBFW: Headbox With Flume and Weir Box

2.2 PERFORMANCE REQUIREMENTS

A. The airlifts shall be capable of meeting the following pumping conditions:

Parameter	Units	AL-05-201, AL-05-202	AL-06-301	AL-13-301, AL-13-302
Service	-	RAS	SCUM	WAS
Location	-	RAS Pit No. 3	Scum Pit No. 3	Sludge Holding Tank
No. of Units	Each	2	1	2
Pump Output (Max.)	GPM	283	100	100
Min. Dynamic Submergence (At Max. Static Lift)	%	80	92	55
Static Lift (Max.)	Ft Above Water Surface	2.17	0.55	6.42
Max. Air Supply	SCFM	30	5	55
Inlet				
Type	Flanged/Open	Flanged	Flanged	Flanged
Dia.	Inches	8	6	6
Eductor Pipe Dia.	Inches	8	6	6
Max. Air Pipe Dia.	Inches	1	1	2
Material	-	304 SST	304 SST	304 SST
Discharge Type	-	Plain	Plain	Plain

B. Provide airlift pumps of the size and number shown on the drawings (the size shown is the minimum size). Construct the airlift pumps from schedule 40 galvanized steel. Stainless steel outer tubes (Schedule 10) are acceptable. Bolts and washers shall match the outer tube material.

C. Provide enclosed discharge head configurations for each airlift pump. A removable plate shall be provided at the top of the airlift for cleaning.

D. Provide **external air supply pipes** of stainless steel pipe. All valves shall be stainless steel. Air diffusion rings are not required. Air release points and center-line discharge elevations are shown on the drawings. The discharge shall be deflected down at a 45 degree angle.

E. Provide support plates and brackets of 304 stainless steel or galvanized steel. The support bracket material shall match the outer tube material and anchor bolts. Refer to construction drawings for additional details.

2.3 ACCEPTABLE MANUFACTURERS

A. Provide air lift pumps of one of the following or an approved equal:
   1. EDI
   2. Sanitaire

B. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.

2.4 CONSTRUCTION

A. Injector, inlet, tube/riser, discharge head, and supports shall all be constructed of the material specified.

B. All flanged bolts, nuts and washers shall be Type 316 stainless steel.

C. Injector shall have a flanged inlet and outlet connection. Air supply connection shall be a welded half-coupling for metallic injectors, or molded threaded connection for non-metallic injectors.

D. Tube / Riser shall be a straight section of pipe, with flanged ends, with neoprene gaskets.

E. An external air supply pipe constructed of stainless steel shall be provided, with integral supports attached to the tube/riser exterior or concrete wall as shown on the construction drawings. Air diffusion rings are not required. Air release points and center-line discharge elevations are shown. The pipe shall terminate at the top of the discharge, with a threaded connection.

F. Discharge
   1. Plain discharges shall be a 90-degree elbow, with a plain end open discharge and a removable plate at the top for cleaning.
   2. Head boxes shall be oversized for venting of air and include a removable cover plate bolted to the head box body, and with a threaded tap for a relief vent.
   3. Plain discharges shall be deflected down at a 45° angle.
   4. Flanged discharges shall have a flat faced flange, drilled for ANSI B16.1 requirements.
   5. Weir boxes shall be flanged, with a sharp crested weir outlet, and depth of flow markings on its body.

G. Supports - Provide support plates, angles, brackets, and U-bolts or straps, and adhesive anchor bolts, suitable for wall mounting on a concrete wall. All supports and brackets shall match tube/riser material.

H. See Section 13441 – Process Control Narratives for air lift control.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that equipment has no defects on the structure or surface that will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the work to the Engineer.

3.2 INSTALLATION

A. Install airlifts at the location shown on the construction drawings and the manufacturer's installation drawings which have been reviewed by the Engineer.

3.3 FIELD TESTING

A. All equipment shall be given running tests by the Contractor and Manufacturer at the site following installation of the equipment and controls.

B. The Contractor shall provide all necessary test equipment including all required incidentals.

C. Field Tests shall consist of operating the air lifts under all design conditions.

D. Should the tests indicate any malfunction, the Contractor shall make any necessary repairs and adjustments, then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately and is ready for permanent operation.

3.4 MANUFACTURER'S REPRESENTATIVE

A. Furnish the service of the manufacturer's technical representative for two (2) start-ups attended. The first start-up shall be a dry start-up and inspection, and the second shall be a wet start-up as part of the overall clear water test. The Contractor shall submit approved start-up forms signed by the manufacturer for each of the two (2) start-ups. Additionally, in conjunction with the two (2) start-ups, the manufacturer shall provide a representative for eight (8) on-site hours to inspect equipment after installation and supervise initial operation. Furnish the representative for the additional time required to correct or supervise correction of any defects or malfunctions related to the start-ups and overall system integration during the clear water test.

B. Manufacturer's representative shall perform on-site services according to the following schedule, excluding travel time:

Work	**Person Days**	**Trips**
Manufacturer's inspection and certification of installation	0.5	1
Pre-demonstration functional and performance testing	0.5	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ pre-demonstration start up
Pre-demonstration start up	0.5	1
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

END OF SECTION

SECTION 11320
CLARIFIERS (PIER-SUPPORTED)

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provisions of all labor, materials, and equipment to furnish and install a pier supported spiral blade clarifier. The clarifier shall include the center drive with torque alarms, access bridge, access platform, kick plates, handrails, center feed well, spiral rake arms, anchor bolts, scum skimmers, scum trough, v-notch weir, scum baffle, piping, valves, spray system, wiring, conduit, control panel and all other appurtenances required or shown on the drawings required including training and start-up to provide a complete and operating system.

1.2 RELATED WORK

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Gear Manufacturer's Association (AGMA)
1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. Anti-Friction Bearing Manufacturers Association (AFBMA)
4. Hydraulic Institute (HI)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. National Electric Code (NEC)
7. National Electrical Manufacturers Association (NEMA)
8. Steel Structures Painting Council (SSPC)
9. Underwriters Laboratories (UL)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples.

B. Clarifier Data
1. Submit certified data on motors, speed reducers, tip speed, torque capacities, and gear and detailed structural calculations signed and sealed by a Professional Engineer licensed in the State of Texas. Submit manufacturer's L-10 bearing life calculations for the mechanism. Submit manufacturers information on control panel and electrical schematics for the torque overload device.

C. Manufacturer's Certifications
1. Submit certification that the manufacturers of proposed electrical, mechanical, and structural systems affecting the performance of the rotating equipment have examined the Contract Documents and agree to the performance and material specifications, warranty conditions, and other requirements set forth herein.
    a. Submit manufacturer's certification that the equipment complies with the maximum power requirement.

b. Submit seal manufacturer's certification that the seal is designed for service and application specified and is installed and aligned properly.
c. Installation approved certification.

D. Record Drawings: Submit record drawings under provisions of Section 01720 - Project Record Documents.

E. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

F. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.5 QUALITY ASSURANCE

A. Use new materials of high grade, and with properties best suited to the work required.

B. Clarifier dimensions shall be coordinated with construction drawings.

1.6 WARRANTY

A. For a period of 12 months from substantial completion of the work, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer

1.7 DELIVERY, STORAGE AND HANDLING

A. Crate and protect all equipment against damage during shipment. Take proper measures to prevent rust and corrosion.

B. Store equipment off the ground in enclosed shelter. Store and maintain equipment in accordance with Manufacturer’s recommendations and per provisions of the Contract.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide one pier supported spiral blade style clarifier.

2.2 PERFORMANCE REQUIREMENTS

Design Conditions	Units	SC-06-301
Location		WWTP
Service		Mixed Liquor
Design Flow	MGD	0.5
Peak Flow	MGD	1.0
RAS Flow (max)	MGD	0.41
Inner Basin Diameter	ft	36
Weir Diameter	ft	31
SWD	ft	13.35
Basin Slope	ft/ft	1/12
Minimum Torque (100%)	LBF	2,592
Drive Diameter (min)	in	12
Drive Motor (max)	HP	1
Motor Speed	RPM	1,800
Feed Well Diameter (min)	ft	4
Flocculating Well Diameter (min)	ft	8
Center Pier Inner Diameter	in	12

1. Provide a clarifier capable of meeting all duty conditions.
2. Select equipment which is designed and built for continuous service.

2.3 ACCEPTABLE MANUFACTURERS

A. Provide clarifiers from one of the following:
1. Walker Process
2. Evoqua

B. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.

2.4 DRIVE UNIT

A. CAST IRON DRIVE
1. Provide a drive unit consisting of a primary gear reducer, an intermediate worm gear reducer and a final reduction unit.
2. The primary gear reducer shall be worm or helical gear heavy duty type. Bearings shall be of the anti-friction type, run in oil, grease style bearings will not be allowed. The gear reducer shall have a service factor of 1.25.

3. The motor shall not be less than 1/2 HP. A squirrel cage, induction type, totally enclosed, ball bearing unit with ample power for starting and operating the mechanism without loading basin 40° C ambient temperature, Class B insulation shall be supplied. All motor shall conform to NEMA specification AC motors and are to be suitable for operation on 460V, 3-Phase, 60 Hz current.
4. The primary reduction unit shall drive the intermediate reduction unit through a chain and sprocket arrangement.
5. The intermediate reduction gear shall be a heavy duty worm gear type speed reducer. The intermediate gear shall have oil lubricated bearings with a minimum L_{10} life of 20 years, based on continuous operation at the specified torque rating.
6. The intermediate reduction gear shall be supplied with an overload protection system which is actuated by the thrust from the work shaft. The overload protection system shall consist of an overload alarm and a shut-off micro switch totaling two micro switches. The overload system shall alarm at 100% of the specified torque, and stop the motor when the load reaches 120% of the specified torque. The micro switches shall be mounted in a NEMA 4X Type 304 stainless steel housing for observance of the dial position. A signal to open the motor circuit when an overload occurs shall be supplied. A shear pin overload device shall be provided to provide additional protection above the torque cut-off point.
7. The intermediate reduction gear shall be constructed of cast iron.
8. Provide a final gear reduction unit consisting of a pinion, anti-friction bearings assembly, and an internal split gear design. All bearing shall be oil lubricated with a minimum L_{10} life of 20 years, based on continue operation at the specified torque rating.
9. Provide an oil filing and level pipe along with a drain plug and sight glass mounted on the drive mechanism.

2.5 INFLUENT FEEDWELL WITH ENERGY DISSIPATING INLETS

A. Provide an influent feed well-constructed of minimum 3/16" steel plate sections supported from the center cage and bridge with steel stiffeners as necessary. The influent feed well plates shall be hot dipped galvanized steel.

B. Ports shall be cut into the influent well and baffled to provide a bi-directional or radial pattern to prevent short circuiting. Baffles shall be adjustable.

C. In Lieu of tube style EDI, flocculation baffles are acceptable. 5.Baffles shall bolt to center cage and well support beams. The baffles to be fabricated from minimum 3/16" thick A36 carbon steel plate. Maximum baffle exit velocity shall be less than 0.15 fps at peak influent flow. Hydraulic calculations shall be provided showing dimensional characteristics, port area, velocity, headloss, and mixing intensity.

2.6 FLOCCULATING WELL

A. Provide a flocculating well-constructed of minimum 3/16" steel plate sections supported from the center cage with steel stiffeners as necessary. The flocculating well shall be placed so that it surrounds the influent feed well and the energy dissipating inlets. The flocculating well plates shall be hot dipped galvanized steel.

2.7 SLUDGE COLLECTION MECHANISM

A. Provide two braced truss style structural steel rake arms supported by the drive cage. The truss arms shall be equipped with spiral steel blades. Plow blades shall be a hot dip galvanized with adjustable stainless-steel squeegees. Arms shall be vertically adjustable at the center cage to assure even grout thickness over the tank bottom.

B. Rake arms are to be constructed to withstand 150% of the specified torque rating without bending of being damaged.

C. Rake arms shall be configured so that the blades scrape the bottom of tank twice with each revolution of the mechanism.

D. Squeegees shall be constructed of 316 stainless-steel.

E. Ferrous metal members shall be hot dipped galvanized steel.

2.8 CENTER CAGE AND COLUMN

A. Provide steel drive cage and column constructed of a minimum 1/4" thick steel plate. The center drive cage and column shall be hot dipped galvanized steel.

B. The center column shall support the drive unit, access platform, access bridge, scum skimmer arm, and sludge collection mechanism. The drive shall be mounted, levels and grouted in place on top of the center column with non-shrink grout.

C. The center cage shall be bolted to the drive unit and shall be adjustable to allow proper alignment.

D. The center column shall serve as the influent pipe.

2.9 SKIMMING DEVICE AND COLLECTION

A. Provide two full radius scum skimming devices as part of the clarifier mechanism, arranged to sweep the surface of basin, automatically removing scum and floating material into a full radius scum trough.

B. The scum skimmer arm shall be mounted with a hinged wiper assemble on the outer end of the skimmer blade to form a pocket to trap scum. The skimmer arm and wiper assembly shall maintain continual contact and proper alignment between the scum blade, scum baffle and scum trough.

C. The scum trough shall be constructed of a minimum 1/4" thick steel plate and supported from the basin wall. The scum trough and skimmer shall be hot dipped galvanized.

D. The scum trough shall be provided with a flexible connection between the scum trough and scum pipe in the basin wall.

E. The scum trough shall be provided with an automatic flushing system utilizing water from the clarifier basin. The automatic flushing system shall be accessible from the platform or bridge.

2.10 ACCESS BRIDGE AND PLATFORM

A. Provide a welded structural steel access walkway extending to the center of each clarifier. The walkway shall be 4'-0" wide with aluminum grating, handrail, and kick plates on both sides of the walkway. The handrail shall be positioned and constructed as shown on the construction drawings. The handrail shall be 42" high and shall consists of double row 1-1/2" diameter horizontal pipe. The kick plate shall be 4" high. All handrails shall meet OSHA standards.

B. The bridge shall be designed to support the dead load and a live load of 150 pounds per liner foot with a deflection not exceeding exceed 1/360 when both dead loads and live loads are applied.

C. An 8’ x 8’ platform shall be provided with aluminum grating, handrail, and kick plates along sides of the platform. The handrail shall be positioned and constructed as shown on the construction drawings. The handrail be 42” high and shall consists of double row 1-1/2” diameter horizontal pipe. The kick plate shall be 4” high. All handrails shall meet OSHA standards. Provide two (2) hinged access hatches to facilitate cleaning the energy dissipating inlet and stilling well; access hatch opening shall be located with structural members designed to provide unencumbered access for cleaning.

D. Access bridge shall be hot dipped galvanized.

E. Lighting supports shall be provided and designed by the clarifier manufacturer for support and installation of the light at the location shown as shown on the construction drawings. Detailed structural calculations and design for the supports shall be signed and sealed by a Professional Engineer licensed in the State of Texas

F. The bridge shall be designed to support lighting, and stanchion loads at the locations shown in the construction drawings. Loads shall include wind loads based on the project location’s wind zone.

2.11 WEIRS AND SCUM BAFFLES

A. Furnish effluent weirs, scum baffle and related bolts and supports as shown on the drawings. Neoprene shall be provided between weirs and the contact surface. Weirs and the baffle shall be constructed out of hot dipped galvanized plates.

2.12 STRUCTURAL MEMBERS

A. All structural steel members shall conform to ASTM A36 or ASTM A992 for wide flange beams.

B. All structural steel components shall be a minimum 1/4” thick.

C. All welding shall conform to American Welding Society Standards AWS D1.1.

D. Maximum deflection in a span under combined live and dead loads shall not exceed L/360.

2.13 ANCHOR BOLTS AND FASTNERS

A. Bolts, studs and nuts: American National form right-hand machine cut threads in conformity with the current ANSI B1.1, Screw Threads, Coarse Thread Series, unless otherwise specified. Provide nuts and bolts with the standard hexagonal shape.

B. Finish for bolt heads and nuts: Semi-finished in conformity with ANSI B18.2, Wrench-Head Bolts and Nuts and Wrench Openings, Heavy Series, unless otherwise specified.

C. Anchor bolts, flange bolts, studs and nuts: Stainless steel in conformity with ASTM A 276.

D. Provide embedded anchors with the necessary hex nuts and washers to secure all parts of the mechanism. Epoxy or wedged anchor will not be allowed.

E. All anchorage, fasteners and other hardware shall be stainless steel. Anchors shall be designed and provided by the clarifier manufacturer and sealed by a Professional Engineer licensed in the State of Texas.

2.14 CLARIFIER CONTROLS

A. Control Panel
1. Enclosure
a. The local control panel shall be rated NEMA 4X, 316 stainless steel enclosure.
b. Control panel shall be furnished and installed as shown on the drawings.
c. Provide an inner door pocket that includes a copy of as-built drawings from the manufacturer as well as any other pertinent documentation necessary to properly operate the controls.
d. Control panel and local disconnect supports shall be provided and designed by the clarifier manufacturer for support and installation of the control panels and disconnects at the location as shown on the construction drawings. Supports shall be designed to withstand the panel loads in addition to wind loads based on the project location's wind zone. Detailed structural calculations and design for the supports shall be signed and sealed by a Professional Engineer licensed in the State of Texas
e. Control panel loads at the locations shown on the construction drawings shall be included by the clarifier manufacturer in the design of the access bridges. Top of control panel shall not exceed 6'-0" above clarifier bridge or platform.
2. Disconnects
a. All panels are to be provided with a main circuit breaker with lockable handle.
b. Individual feeder circuit breaker shall be required, fuses are not acceptable.
3. Surge Protection
a. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20µs impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground.
b. Provide surge protection for 480VAC power feeds into control panel. Surge arresters shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, Citel DS40 series, or equal.
4. Environmental Control
a. All panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditions units as required to prevent temperature buildup inside of the panel. The internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel.
5. Corrosion Control
a. Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity.
b. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.
6. Internal Electrical Wiring
a. All interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 Deg Celsius.
b. Power distribution wiring on the line side of disconnects shall be 12 AWG minimum. Control wiring on the secondary side of disconnections shall be 16 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulation for not less than 600 volts.
c. All wiring shall be neatly cabled, clearly tagged and color coded.

7. Operator Devices
    a. Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for manual operation of the filter.
    b. Transformer type pilot lights and illuminated pushbuttons shall be provided for indication of an operation status.
    c. All operator devices shall be UL Listed, NEMA Type 4X rated, oil and water-tight with finger safe-guards located on the contact blocks to prevent accidental contact with wire connections.
    d. Power on light
    e. Run indicating lights
    f. Alarm lights
    g. Alarm silence and reset push buttons
    h. ON-OFF selector switch
8. See construction drawings for classified area requirements.

B. Process Control Narratives.

Process Description:	One (1) new secondary clarifier will be constructed to separate clear water from solids. The clarifier will be operated continuously at a constant speed. The clarifier system will be vendor supplied and controlled by the vendor supplied control panel.
P&ID:	6-I-1 Secondary Clarifier No. 3 P&ID
Controlled Devices:	SC-06-301 – Secondary Clarifier
Instrumentation Devices:	Overload protection system shall be provided by the drive manufacturer per this specification section 2.4.A.6: • High Torque Alarm • High Torque Shutdown • Shear Pin Fail Shutdown
Local Functions:	The Clarifier's systems will be vendor supplied and controlled by the vendor supplied control panel. The vendor supplied panels shall provide at a minimum: • ON/OFF Switch: o Provides control of the secondary clarifier. • Phase Failure Bypass switch: o Allow operators to bypass Phase Fail relay. • White Pilot Light: o Control Power On status. • Red Pilot Light: o A red pilot light will indicate when the clarifier is running. • Amber Pilot Light: o Amber pilot lights will indicate: ▪ High Torque Alarm ▪ High Torque Shutdown ▪ Clarifier Overload ▪ Shear Pin Fail Shutdown. • Elapsed Time Meter: o An elapsed time meter will measure runtime. • Push Button: o An Alarm Test pushbutton will allow testing of panel and SCADA alarms. o A Clarifier Shutdown Reset pushbutton will reset any local panel alarms if the conditions are clear. o A Clarifier Overload Reset pushbutton will reset the solid-state overload on the clarifier motor contactor. In the ON position, the clarifier will operate if the interlocks for the clarifier listed in the INTERLOCKS section below are not active. In the Off position, the local control panel shall not call to engage the drive.
MCC Functions:	None

PLC/HMI Functions:	None
SCADA Functions:	See Specification Section – 13441 – Process Control Narratives
Interlocks:	Interlocks below are hardwired: CP-06-301 Phase Fail SC-06-301 Motor Overload SC-06-301 Motor Protection Relay SC-06-301 Shear Pin Fail Shutdown SC-06-301 High Torque Shutdown
Alarms and Indications:	Alarms Indicated on SCADA: CP-06-301 Control Power Fail CP-06-301 Phase Fail SC-06-301 Not Running SC-06-301 Shear Pin Fail Shutdown SC-06-301 High Torque Shutdown SC-06-301 Motor Overload SC-06-301 Motor Protection Relay

2.15 ACCESSORIES

A. Nameplate
1. Furnish each clarifier with a stainless-steel data plate containing the manufacturer's name, model number, serial number, and any other pertinent data.
2. Provide a duplicate plate for installation on the inside cover of the control panel.

2.16 COATING SYSTEM

A. Coating system for drive unit and any other ferrous metal that is not hot-dip galvanized or stainless steel shall be shop primed with an intermediate epoxy coat and polyurethane top coat. Coating systems shall be acceptable for wastewater applications.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the Work to Engineer.

3.2 INSTALLATION

1. Install products in accordance with manufacturer's written instructions.
2. Provide sufficient clearances for thermal expansion and contraction.

3.3 FIELD TESTING

A. All equipment will be given running tests by Contractor and Manufacturer's Representative at the Site following installation of the equipment and controls.

B. The Contractor shall provide all necessary testing equipment.

C. Contractor shall perform a dry start-up to ensure proper torque limits and rotation prior to conducting a clear water test. Upon completion of the dry start-up the Contraction shall provide water for testing purposes. Contractor shall make provisions for recycling pumped water and disposal.

D. Field tests shall consist of operating the clarifier under normal and abnormal conditions.

E. Should the tests indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments, and then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the ENGINEER, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

3.4 MANUFACTURER SERVICES

A. A factory trained representative of the Manufacturer shall provide services for installation supervision, start-up and test services, and operation and maintenance personnel training services.

B. Manufacturer's representative shall perform on-site services, including training of Owner's personnel, according to the following schedule, excluding travel time.

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	0.5	1
Pre-demonstration functional and performance testing	0.5	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ pre-demonstration start up
Pre-demonstration start up	0.5	1
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer's Representative shall provide a written report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

D. Manufacturer's Representative shall operate the system in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. The Representative shall revisit the site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. The Manufacturer's Representative shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the Owner.

END OF SECTION

SECTION 11340
CLOTH-MEDIA DISK FILTER

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provision of all labor, materials, and equipment to furnish and install automatically backwashing cloth media filtration equipment, and accessories, including training, start-up and field demonstration, for a complete and operable system.

B. Furnish, install, startup, and field test automatic backwashing, cloth media disk filtration system(s) and all appurtenances as shown on the Drawings and specified herein and as noted in Attachment No. 1.

C. Furnish all labor, materials, equipment, and incidentals required for complete installation, proper operation, and successful field testing.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, or Supplier, of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Gear Manufacturers Association (AGMA)
2. American National Standards Institute (ANSI)
3. American Welding Society (AWS)
4. Anti-Friction Bearing Manufacturer's Association (AFBMA)
5. ASTM International (ASTM)
6. Hydraulic Institute (HI)
7. Institute of Electrical and Electronic Engineers (IEEE)
8. Manufacturers Standardization Society (MSS)
9. National Electric Code (NEC)
10. National Electrical Manufacturers Association (NEMA)
11. National Fire Protection Association (NFPA)
12. Occupational Safety and Health Administration (OSHA)

1.4 SUBMITTALS

A. Submit shop drawings, product data, samples, and descriptive literature as specified in Sections 01300 and 01340. Include the following arranged to facilitate submittal review.

1. Cut sheets, construction materials, dimensions, weights, shop coatings, and scope of supply, including part numbers, quantity, location, and manufacturer listed in table format.
2. Dimensioned drawings showing all required clearances, control valves, and piping connections.
3. Product data on valves, motorized valve actuators, gaskets, motors, and flexible couplings.

B. Provide the following certifications:

1. The final installation is as specified here in, as intended by the Manufacturer and suitable for continued operation by Owner's personnel.
2. Field test results are satisfactory.
3. The manufacturer can provide a complete stock of spare parts within 48 hours of request.

C. Submit updated Operation and Maintenance (O&M) manuals specifically for this installation. Include all cut sheets, drawings, equipment lists, descriptions, and materials, necessary to instruct the Owner's personnel. Include signed start-up and field-testing reports.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponent obtained from the OEM during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacture and warranted by the Manufacturer.

B. Equipment shall be designed and rated for their intended service environments and area classifications.

C. Use only new materials matching manufacturer standard parts.

D. All welding shall be done at the Manufacturer's factory. Field welding shall not be permitted without the Engineer's express written approval.

E. Coatings shall be factory-applied. Field coating is not acceptable other than touchup coating.

F. Manufacturer's on-site services shall be provided via one or more qualified full-time factory employee(s) or service technician(s) with extensive experience in on-site installation and testing of equipment similar to that specified herein.

1.6 WARRANTY

A. For a period of 12 months from installation and startup, the Manufacturer shall warrant that the equipment shall be free of defects in material and workmanship. The Manufacturer shall repair or replace any defective equipment or components. The Owner shall not be responsible for any related costs, such as removal, shipping, or reinstallation. Contractor shall coordinate delivery to ensure equipment is installed and start up occurs no more than 6 months after delivery.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver and store equipment as per manufacturer's recommendation at a minimum.

B. Crate and protect all equipment against damage during shipment. Exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

C. Ship packaged systems intact to the extent feasible.

D. Accept units on-site. Inspect for damage upon delivery.

E. Store equipment off the ground in a secured, enclosed shelter where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations.

F. Do not remove shipping blocks, plugs, or caps installed to protect the equipment during shipment until the equipment is installed and permanent connections are made.

PART 2 - PRODUCTS

2.1 GENERAL

A. The filter equipment shall be designed specifically for installation in the concrete basin shown in the construction drawings.

B. Each unit will include:
1. Cloth Media Disks
2. Automatic Backwash and Solids Removal System
3. Automatic Valves

C. All motors, pumps, and bearings shall be designed for continuous duty and long operating life in a high humidity atmosphere.

2.2 PERFORMANCE REQUIREMENTS

Table 1: Filter Performance Requirements. Proposed disks will be installed at existing filters **DF-07-101** and **DF-07-201**.

Design Conditions (Per Filter Basin)	Units	Existing	Proposed
Location		Tertiary Filter Basin	Tertiary Filter Basin
Average Daily Flow	MGD	1.0	1.5
Peak Two Hour Flow	MGD	2.0	3.0
Minimum Filtration Area	S.F.	215.3	322.9
Total No. of Filtration Disks	-	4	6
Max Flux Rate through Effective Area	gpm/sf	6.5	6.5
Minimum Backwash Flux Rate	gpm/sf	6	6
Average Influent TSS (at ADF)	mg/l	10	10
Influent TSS (at ADF)	mg/l	15	15
Effluent TSS	mg/l	<5	<5
Effluent Turbidity	NTU	<3	<3

2.3 ACCEPTABLE MANUFACTURERS

A. Provide disk filter systems as manufactured by:
1. Aqua-Aerobic Systems, Inc., of Illinois

2.4 BASIN MOUNTING BRACKETS AND HARDWARE

A. Brackets are existing and shall be utilized to install proposed equipment.

2.5 CENTER TUBE ASSEMBLY

A. The existing center tube assembly shall be re-utilized. The proposed cloth media filter disk assemblies shall be connected to the existing center tube assembly.

2.6 CLOTH MEDIA FILTER DISK ASSEMBLIES

A. Each filter shall include cloth filter assemblies, each consisting of a pile cloth media sock supported by an injection molded polyethylene frame. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the center tube, without special tools, to allow for removal and replacement of the cloth at the point of installation.

B. Cloths shall be constructed of a microfiber pile cloth material with a normal filtration rating of 5 micron. The cloth shall be resistant to continual exposure to free chlorine residuals of 3-5 mg/L. Short duration spike residuals lasting 2-4 hours with concentrations of 8 mg/L shall have no deleterious effects on the cloth. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss.

C. During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for removal with the cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path may be from the outside of the filter assembly to the inside.

2.6 DRIVE ASSEMBLY

A. The drive assembly shall remain.

2.7 BACKWASH AND SOLIDS REMOVAL SYSTEM / BACKWASH PUMPS

A. The backwash function shall incorporate an existing pump that draws filter effluent through the cloth and into a stationary or rotating shoe thereby removing accumulated solids from the cloth surface. Each filter element shall be cleaned by at least two shoes, one on each side. Heavy duty springs shall be used to tension the shoes against rotating cloth assemblies.

B. Each filter basin backwash/sludge discharge installation includes existing externally mounted backwash pumps (2 per basin plus 1 on-the-shelf spare) that shall be re-utilized in this phase.

C. Backwashing for the proposed filters shall occur in the same manner as the existing, with an additional backwash sequence being included for the two proposed filters for each basin. The Operator shall have the ability to specify the backwash time interval elapses through the operator interface. Backwash shall also be enabled by tank water level, time or manual initiation. The backwash water shall be pressurized by the filter's backwash pump for discharging from the filter system.

D. Filtering shall not be interrupted during normal backwashing and sludge discharge.

E. Each filter shall include one new backwash valve. Valve shall be a two (2) piece, flanged end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, with a 115 volt, single phase, 60 Hz, open / close service electrical actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.

F. Existing solid waste valves shall remain, to be utilized with the expanded filter system.

G. Existing crossover valve shall remain, to be utilized with the expanded filter system.

H. Existing sludge removal system perforated manifold shall remain, to be utilized with the expanded filter system.

2.8 CONTROL SYSTEM

A. Two (2) filter control panels exist on-site and are equipped to handle the controls for the expanded filter disks, backwashing valves, and other associated appurtenances included in the scope of work. All control wiring and setup for the proposed filter disks and equipment shall be handled through the existing control panel that corresponds to the basin the equipment is installed in.

B. Control setup shall include but may not necessarily be limited to the proposed filter disks, backwash valves, and setup of an additional backwashing cycle for each pair of proposed filter disks. Existing method of operations shall remain for the existing filter disks and valves. The existing control panel has been outfitted with all necessary wiring and devices for the proposed equipment; the panel manufacturer's instructions are to be followed concerning the installation of additional control wiring and implementation of program updates to the system.

1. The existing control panel is sized for the proposed load.
2. All control panel wire shall be 14 AWG multi-strand machine tool wire minimum with MTW insulation.
3. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing.
4. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122º F. Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.
5. All control components shall be mounted internal to the enclosure and be mounted with stainless steel hardware. The enclosure and internal control components must be clearly identified with plastic engraved name tags secured to the panel with stainless steel self-tapping screws.

F. PLC tag database was provided to PCSS and/or Owner for incorporating into top end SCADA for Monitoring and Controls. At minimum the following shall be provided:

1. The following statuses shall be monitored at the plant SCADA (Note: SCADA monitoring is not part of AASI scope of work):
   a. All motor Hand/Off/Auto
   b. All motor running status
   c. All available VFD fault alarms
   d. All available VFD speeds and status
   e. All valve statuses
   f. All pressure statuses
   g. All levels and alarms
   h. All flows and totalized flows

Process Description:	Two (2) cloth-media disks will be provided alongside the four (4) existing cloth-media disks in each of two (2) existing tertiary filtration basins to filter the clarified effluent from the clarifiers before discharging to the disinfection basin. Two (2) existing backwash pumps per basin will clean the filter disks and pump the backwash waste back to the head of the plant. Two existing control panels (one per basin) will control their corresponding backwash valves and backwash pumps. The backwash sequence will be initiated once the water level reaches the manufacturer defined backwash level set-point. The solids removal process shall remain as currently programmed. An existing submersible transducer in each filter basin will measure the liquid level in the filter basin. An existing float provides a backup to the transducers.
P&ID:	7-I-1 Tertiary Filters P&ID
Controlled Devices:	<u>Existing:</u> DF-07-101 – Basin No. 1 Drive SPP-07-101 – Basin No. 1 Backwash Pump No. 1 SPP-07-102 – Basin No. 1 Backwash Pump No. 2 BV-07-101 – Basin No. 1 Solids Waste Valve No. 2 BV-07-105 – Basin No. 1 Solids Waste Valve No. 1 BV-07-103 – Basin No. 1 Backwash Valve No. 2 BV-07-104 – Basin No. 1 Backwash Valve No. 1 BV-07-102 – Basin No. 1 Backwash Crossover Valve BV-07-106 – Basin No. 1 Backwash Pump No. 1 Suction Valve BV-07-107 – Basin No. 1 Backwash Pump No. 1 Discharge Valve BV-07-109 – Basin No. 1 Backwash Pump No. 2 Suction Valve BV-07-110 – Basin No. 1 Backwash Pump No. 2 Discharge Valve PSP-07-101 – Basin No. 1 Turbidimeter Pump DF-07-201 – Basin No. 2 Drive SPP-07-201 – Basin No. 2 Backwash Pump No. 1 SPP-07-202 – Basin No. 2 Backwash Pump No. 2 BV-07-201 – Basin No. 2 Solids Waste Valve No. 2 BV-07-205 – Basin No. 2 Solids Waste Valve No. 1 BV-07-203 – Basin No. 2 Backwash Valve No. 2 BV-07-204 – Basin No. 2 Backwash Valve No. 1 BV-07-202 – Basin No. 2 Backwash Crossover Valve BV-07-206 – Basin No. 2 Backwash Pump No. 1 Suction Valve BV-07-207 – Basin No. 2 Backwash Pump No. 1 Discharge Valve BV-07-209 – Basin No. 2 Backwash Pump No. 2 Suction Valve BV-07-210 – Basin No. 2 Backwash Pump No. 2 Discharge Valve PSP-07-201 – Basin No. 2 Turbidimeter Pump <u>Proposed:</u> BV-07-120 - Basin No. 1 Backwash Valve No. 3 BV-07-220 - Basin No. 2 Backwash Valve No. 3
Instrumentation Devices:	<u>Existing:</u> LE-07-101 – Basin No. 1 Level Transducer LSH-07-101 – Basin No. 1 High-Level Float PIT-07-101 – Basin No. 1 Backwash Pump No. 1 Suction Vacuum Transmitter PIT-07-102 – Basin No. 1 Backwash Pump No. 1 Discharge Vacuum Transmitter PIT-07-103 – Basin No. 1 Backwash Pump No. 2 Suction Vacuum Transmitter

	PIT-07-104 – Basin No. 1 Backwash Pump No. 2 Discharge Vacuum Transmitter PSH-07-101 – Basin No. 1 Turbidimeter Pump High Pressure Switch AE-07-101 – Basin No. 1 Turbidity Sensor AIT-07-101 – Basin No. 1 Turbidity Transmitter FIT-07-101 – Basin No. 1 Backwash System Flow Transmitter LE-07-201 – Basin No. 2 Level Transducer LSH-07-201 – Basin No. 2 High-Level Float PIT-07-201 – Basin No. 2 Backwash Pump No. 1 Vacuum Transmitter PIT-07-202 – Basin No. 2 Backwash Pump No. 1 Pressure Transmitter PIT-07-203 – Basin No. 2 Backwash Pump No. 2 Vacuum Transmitter PIT-07-204 – Basin No. 2 Backwash Pump No. 2 Pressure Transmitter PSH-07-201 – Basin No. 2 Turbidimeter Pump High Pressure Switch AE-07-201 – Basin No. 2 Turbidity Sensor AIT-07-201 – Basin No.2 Turbidity Transmitter FIT-07-201 – Basin No. 2 Backwash System Flow Transmitter
Local Functions:	In the HAND position, the drive and backwash pumps will operate if the interlocks for the pump listed in the INTERLOCKS section below are not active.
MCC Functions:	None
HMI Functions:	Vendor Supplied Local Control Panel.
PLC Functions:	The Tertiary Filter system will be vendor supplied and controlled by the two (2) existing vendor supplied control panels.
SCADA Functions:	Refer to IO list for a list of indications and alarms. PCSS shall coordinate with the Vendor regarding Tag database and IP addresses for data to show on SCADA.
Alarms and Indications:	<u>Alarms Indicated on SCADA:</u> Basin No. 1 Fail Basin No. 1 Backwash Pump No. 1 Fail Basin No. 1 Backwash Pump No. 2 Fail Basin No. 1 High Level Alarm Basin No. 1 Turbidimeter High Pressure Alarm Basin No. 2 Fail Basin No. 2 Backwash Pump Fail Basin No. 2 Backwash Pump No. 1 Fail Basin No. 2 Backwash Pump No. 2 Fail Basin No. 2 High Level Alarm Basin No. 2 Turbidimeter High Pressure Alarm

PART 3 – EXECUTION

3.1 INSPECTION

A. Contractor shall Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Contractor shall Inspect and verify the function of all existing and proposed equipment prior to installation.

C. Contractor shall Promptly report defects which may affect the work to Engineer.

D. Contractor shall Inspect and verify the functionality of all equipment, existing and proposed, after installation is complete. If any equipment does not function properly after the modification as part of this scope of work is completed, it will be the responsibility of the contractor to ensure the equipment is restored to working order.

3.2 INSTALLATION

A. Install and adjust equipment in accordance with the Drawings, approved shop drawings, and the manufacturer's instructions

B. Do not operate the equipment until the installation is approved by the Manufacturer’s on-site representative.

C. Remove temporary bracing supports and other construction debris that may damage equipment.

D. Remove any temporary oils used for protection during shipment.

E. Check equipment for correct operation and freedom of moving parts.

F. Align equipment to Manufacturer's tolerances. Adjust clearances and torques.

3.3 FIELD TESTING

A. Prior to startup, the Manufacturer’s representative, shall inspect new equipment for proper assembly, alignment, and proper operation.

B. Equipment shall be checked for proper alignment to avoid imbalance and excessive vibration. Any misalignment of greater than ¼” shall be remedied by the contractor prior to demonstration period.

C. Place the system into operation. All components shall continue to operate without alarms or shut downs, except as intended, for eight consecutive hours to be considered ready for startup.

D. Field tests shall consist of operating the equipment under normal conditions.

3.4 MANUFACTURER SERVICES

A. A factory trained representative of the manufacturer shall provide services for installation supervision, start-up and field testing services and operation and maintenance personnel training services.

B. Manufacturer's representative shall perform on-site services, according to the following schedule, excluding travel time:

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	2	1 (One per basin)
Pre-demonstration functional and performance testing	2	1 (One per basin)
Pre-demonstration onsite training of owner personnel	0	N/A
Pre-demonstration start	1	Can be combined with functional and performance testing

C Manufacturer shall provide a written report certifying that the installation has been checked and that the equipment is ready to be placed into service.

D. Manufacturer shall operate the system in the presence of the Engineer and verify that the equipment meets the specified requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is satisfactory. The Manufacturer's Representative shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

F. The Contractor will be back charged by the Client for an unsuccessful field testing demonstration. Schedule the field demonstration a minimum of 48 hours following a successful startup procedure.

END OF SECTION

SECTION 11450
VOLUTE PRESS

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for furnishing and installing all labor, materials, equipment, controls, and appurtenances to provide and install a six-drum volute press, including dosing and flocculation tanks, dewatering drums, drive units, solenoid valves, controls, and control panels; including training and start-up, for a complete and operable system.

B. The volute press shall be provided with the screw conveyor as a package.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer from complying with the requirements therein.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
1. American National Standards Institute (ANSI).
2. American Society for Testing and Materials (ASTM).
3. American Bearings Manufacturers Association (ABMA).
4. American Gear Manufacturers' Association (AGMA).
5. Institute of Electrical and Electronics Engineers (IEEE).
6. National Electrical Code (NEC).
7. National Electrical Manufacturers' Association (NEMA).
8. Steel Structures Painting Council (SSPC).
9. Underwriters Laboratories (UL).

1.4 SUBMITTALS

A. Provide submittal data, manuals, and drawings as specified in Section 01340 – Shop Drawings, Product Data, and Samples. **Coordinate the submittal of the volute press with the submittal of the screw conveyor system as specified in Section 11733 – Screw Conveyor.**

B. Volute Press Data
1. Certified shop and installation drawings showing details of construction, weight, impact loads, dimensions, and anchor bolt locations
2. Manufacturer’s specification
3. Descriptive literature, bulletins and/or catalogs of the equipment
4. Catalog data sheets for major components, i.e. drive, motor, etc.
5. Complete bill of materials for all equipment with materials of construction
6. Descriptive literature on surface preparation and shop coating
7. Factory performance test results and certifications
8. Performance test results with permanent installation and vibration analysis
9. Anchorage bolt sizing calcs, **signed and sealed by a Texas Professional Engineer.**
10. Flow rate and pressure requirements for spray water system
11. Control system information including electrical schematic and interconnection wiring diagrams
12. L-10 bearing life calculations for dewatering drums and drives

13. Spare parts list
14. Submit start-up and manufacturer field services schedule

C. Motor Data
1. Horsepower
2. Electrical characteristics
3. Bearing life ratings
4. Insulation ratings
5. Weight
7. Wiring Diagram
9. Dimensions
10. Nameplate data

D. Instruction Books
1. Service and maintenance manual
2. Service parts list
3. Outline drawing

E. Manufacturer's Certifications
1. Submit manufacturer's certification that Contract Documents have been examined by the manufacturer for proposed electrical, mechanical, and structural systems affecting performance of the equipment.
2. Submit manufacturer's certification that the maximum power requirement, if used, shall not exceed the motor rating under operating conditions.
3. Submit sealed manufacturer's certification that the equipment is designed for service and application specified and is installed and aligned properly.

F. Record Drawings
1. Submit record drawings under provisions of Section 01720 – Project Record Documents.

G. Operation and Maintenance Instructions
1. Submit operation and maintenance data under provisions of Section 01300- Submittals. Operation and maintenance manuals shall be prepared specifically for this installation and shall include, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance.

1.5 QUALITY ASSURANCE

A. The volute press shall be manufactured by a company with proven experience, with at least 10 installations in operation for at least 1 year in the United States, with at least 1 operating system dewatering municipal WAS in Texas.

B. The volute press shall be assembled at the Manufacturer's facility and delivered to the site as a complete unit.

C. Use new materials of high grade and with properties best suited to the work required.

D. The volute press shall be field tested and acceptable to the Engineer prior to achieving substantial completion. Field testing includes operating the volute press and all ancillary equipment under all design conditions. Field testing shall include operating the press for a minimum of 7 hrs/day, with a minimum influent dry solids concentration of 0.75% yielding a minimum of 16.5% dry solids cake concentration, utilizing no more than 21 lb/ton of dry solids of active polymer emulsion.

E. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component Manufacturer from a single equipment Manufacturer.
   2. The equipment Manufacturer shall review and approve or shall prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by volute press equipment Manufacturer.

1.6 WARRANTY

A. For a period of 12 months from substantial completion, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the Engineer.

1.7 GUARANTEE

A. The Manufacturer shall guarantee the volute press meets the performance requirements as specified herein within 60 days of system start-up. Should the volute press not meet the Manufacturer's guarantee the Manufacturer shall incur a monetary penalty equivalent to the cost of third party dewatering for the amount of sludge inadequately dewatered, or the incremental cost of additional polymer, incremental cost of transport of disposal, or the Owner may require the volute press Manufacturer to replace all equipment with new equipment that can meet the specified performance requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide one volute press system complete with a drive system, dewatering drums, volute press base, cake outlet chutes, dosing tank, flocculation tanks, flocculation tank mixers, valves, gauges, transmitters, wiring, controls and control panel.

B. Provide a volute press capable of meeting all design duty conditions.

C. Select equipment which is designed and built for the specified operating duty cycle without disruption in service.

2.2 PERFORMANCE REQUIREMENTS

Design Conditions	Units	VP-14D-101
Type of Sludge	-	Municipal WAS
Feed Sludge Solids	%	0.75-1.75
Max. Hydraulic Loading	gpm	260 (0.75% TS)
Max. Solids Loading	lbs/hr	1,500
Operation Duty Cycle	hr/day	7 hr/day (5 day/week)
Maximum Drive Size Per Drum	HP	3
Minimum Dried Cake Produced	% Solids	16.5
Number of Drums	-	6
Number of Mixers	-	2
Maximum Drive Size Per Mixer	HP	3
Maximum Cationic Polymer Dose	lb dry polymer/ton dry sludge	20.9

2.3 ACCEPTABLE MANUFACTURERS

A. Provide dewatering volute press of one of the following Manufacturers. No others will be allowed:
1. PWTech

B. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.

2.4 MATERIALS

A. All materials utilized in the construction of the volute press equipment shall be entirely suitable in every respect for the service required. All metals in contact with polymer or sludge, and all other components other than those specified in the table below shall be stainless steel, type 304 or 316, or plastic.

B. No carbon steel shall be used for any part of the volute press.

C. The following table indicates the materials and coatings that shall be provided for the volute press and related components unless specified otherwise herein:

Equipment	Material
Tanks and Support Frame	Type AISI 304 Stainless Steel
Flocculation Tanks	Type AISI 304 Stainless Steel
Flash Mixing Tank	Type AISI 304 Stainless Steel
Plumbing and Spray Bars	Type AISI 304 Stainless Steel
Dewatering Drums	Type AISI 304 Stainless Steel
Dewatering Drum Screw	Type AISI 304 Stainless Steel w/ Flame Coating 10Co-4Cr
Gear Motors	Die Cast Aluminum and Type 304 Stainless Steel
Gear Motor Coating	Acrylic Paint
Spray Nozzles	Polypropylene
Electrical Enclosure	Type AISI 304 Stainless Steel
Electrical Wiring Housing	Non-metallic flexible liquid-tight conduit and fittings
Valves	Stainless Steel, EPDM Seating

D. The structural support frame shall be fabricated of type 304 stainless steel. It shall be a rigid structure, adequately braced to withstand intended loads without excessive vibration or deflection.

E. The framework shall be of welded and/or bolted construction. The structure shall be designed for installation on a prepared concrete foundation and secured with anchor bolts. The Contractor shall verify the location of the concrete foundation with the Manufacturer's submittal and ensure the concrete foundations are installed to allow for proper anchoring in accordance with the anchoring calculations provided by the Manufacturer and signed and sealed by a Professional Engineer licensed in the State of Texas.

2.5 FLOCCULATION AND DOSING TANKS

A. The volute press shall have a mixing system which consists of two flash mixing tanks and a flocculation tank, each equipped with an electric mixer.

B. Flash mixing and flocculation tanks shall be a minimum 20 gauge (1mm). Tanks and spill containment trays will be fully welded internally and externally.

C. Design and manufacture of tanks and spill trays must ensure no leakage or spillage of fluids under normal working conditions. Tank design will minimize the possibility of any short circuiting of flow. Tank size will allow for sufficient residence time for flocculation to occur

D. The flocculation tanks shall be equipped with a polymer inlet and a drainage outlet with a normally closed plug valve.

E. Flocculation tank dimensions and design shall ensure adequate residence time and mixing conditions to reach complete flocculation and satisfactory dewatering performance. Tank design shall minimize the possibility of any short circuiting of flow.

F. The flash mixing tank shall have a high level switch and the flocculation tanks shall be equipped with a level sensor.

G. The flash mixing tank and flocculation tanks shall be pre-assembled on a common coated, fabricated stainless steel base frame.

2.6 DEWATERING DRUMS

A. All circular components will be laser cut to ensure maximum evenness of wear and therefore operating life.

B. Assembly will be undertaken in such a way that all fixed rings are concentric and parallel. All fixed rings will be equally spaced apart for each section of the dewatering drum. When mounted on the retaining rods and installed, all moving rings will move freely between the fixed rings.

C. Each dewatering drum shall be equipped with individual spray bars. Each spray bar shall consist of a spray pipe fitted with spray nozzles, located above the dewatering drum. The spray pipe and spray nozzle assembly shall be readily removable. Nozzle spacing and spray pattern shall be such that the sprays from adjacent nozzles overlap one another on the dewatering drum surface. The sprays will operate periodically and will remove solids built up externally on the drum such that over time no significant buildup of solids occurs on the drum. The Manufacturer shall provide one solenoid valve for each dewatering drum. The valves may be shipped loose and installed by the Contractor as shown on the drawings.

D. Each dewatering drum will have a drive motor:
   1. The dewatering drum drive motor will be a close coupled gearmotor. Gearmotors will be hollow shaft design designed to drive the dewatering drum screws with no additional couplings or joints. Motors will be

filled with grease on assembly and sealed for life. Screw rotational speed shall be obtained through a hypoid reduction gear. Input power to the dewatering drum drive shall be supplied through an A.C. variable frequency drive unit. **See Section 2.7 – Motors in this specification for detailed motor information.**

F. The dewatering volute press shall be totally enclosed including covers for the individual drums.

2.7 MOTORS

A. Each dewatering drum and mixer shall have a drive motor. Each motor shall be a one-piece gearmotor. Gearmotor shall be hollow shaft type, designed to drive the drums/mixer with no additional couplings or joints. Motors shall be filled with grease on assembly and sealed for life. Motor shall be mill and chemical duty, TEFC severe duty rated and NEMA premium efficient. Motor shall also follow all requirements of Section 16013 – Electric Motors. Input power to each motor shall be supplied through an AC variable frequency drive unit. All motors shall be inverter ready.
1. Mixer rotational speed shall be obtained through a hypoid reduction gear.
2. Screw rotational speed shall be obtained through a reduction gear.

B. Gearmotor Data:

1.	Motor Power Requirements:	480 VAC, 3-phase, 60 Hz
2.	No Load Motor Speed:	1,730 rpm
3.	Mixer Motor Gear Reduction:	342:1
4.	Mixer Motor Output Shaft Speed:	42 rpm @ 60 Hz
5.	Drum Motor Gear Reduction:	342:1
6.	Drum Motor Output Shaft Speed:	2.1 rpm @ 60 Hz
7.	Insulation Class:	NEMA 4X
8.	Enclosure:	TEFC
9.	Enclosure Material:	304 Stainless Steel
10.	Speed Type:	Inverter Ready

2.8 CAKE DISCHARGE OUTLET

A. Cake Outlet Chutes:
1. Provide a SS304 cake outlet chute for each three-drum unit connected to the conveyor.

B. The contractor is responsible for coordinating shop drawings between volute press and conveyor manufacturer in order to provide a complete and operable system.

2.9 VALVES

A. Wash-water inlet: The manufacturer shall provide 1” 316SS solenoid valves for the wash water system. Refer to P&IDs.

B. Flocculation tank drain: The manufacturer shall provide a manually actuated 6” plug valve for the flocculation tank drain. Refer to P&IDs. The plug valve shall be provided by the Contractor in accordance with Section 15103 - Plug Valves.

C. Polymer inlet: The manufacturer shall provide a manually actuated 2” 316 SST swing check valve for the polymer solution inlet at the flocculation tank. Refer to P&IDs.

2.9 BOLTS AND NUTS

A. All bolts, nuts, and other screwed components shall be of Type 316 stainless steel. Permanently installed fasteners not subject to removal for routine maintenance or adjustment, may be of galvanized carbon steel if adequately coated with corrosion resistant paints or other approved coatings.

2.10 CONTROLS

A. Provide a UL listed control panel (VP-14D-101) and remote-control Start/Stop stations that will allow for safe, simple and automated operation of the unit. Control panel shall have an integrated electrical and control system capable of operating the equipment as described below. All electrical work, motors and drives will comply with any relevant NEMA standards. The electrical control system will be able to accept remote start and stop signals, and will have outputs for unit in operation, and unit alarms to an external SCADA system. Dewatering volute press system shall operate off 480VAC, 3-phase, 60 Hz service fed from Dewatering Control Panel (CP-14D-101).

B. Control panel and remote-control interface shall be provided by equipment manufacturer and must meet requirements in Section 13330 – Control Panel Enclosures and Panel Equipment.

C. Volute Press Control Panel shall conform to all Division 13 Specifications. All PLCs, Touchscreen HMIs, Ethernet Switches, and Control Panel hardware shall match plant systems. Programs must be unlocked with all required add-ons. All Firmware shall be the latest release at the time of submittal.

D. The Automatic Controls for operation of the Volute Press shall be furnished fully assembled, wired and pre-programmed, ready for field mounting and wiring in a UL certified NEMA 4X enclosure. The control system shall include a through door operated main disconnect that can be locked in the OFF position. The external door shall also provide an emergency stop button which shall be a mushroom head style pushbutton that when depressed shall immediately de energize all moving equipment in the system.

E. Main control components shall consist of; variable frequency drive controllers with short-circuit and overload protection, and motor starters with short circuit and overload protection. Other components include control power transformer, programmable logic controller, control relays, and terminal points for interconnection with ancillary equipment. Door mounted components shall consist of an operator interface terminal (OIT), pushbuttons, selector switches and pilot light for system control power.

F. Variable frequency drives (VFD) shall be provided for the dewatering drum drive and mixing and flocculation tank agitators as well as any feed pumps. The VFDs shall be UL listed and shall be manufactured by Eaton, Square D or approved equal. VFDs shall have Modbus/TCP, and Ethernet/IP (DLR) capability. Refer to Section 16175 – Variable Frequency Drive for VFD specification requirements.

G. Motor starters shall be full voltage, non-reversing, IEC style across the line units. Coils shall be 120 volts ac. Siemens type Sirius 3RT10 or equivalent.

H. Provide a PLC in accordance with 13311 PLC Hardware and Software.

I. Control relays shall be general purpose type with a 10 amp contact rating minimum, miniature square base, and internal on status pilot light. Relays shall be Allen Bradley Type 700-HF Series or approved equal.

J. Control panel shall provide a network switch with an Ethernet/IP port for SCADA system connection. Control panel manufacturer shall provide Ethernet/IP tag list for all I/O. IP address will be assigned by the PCSS and/or Owner during construction.

K. Remote Operator Interface Terminal (OIT) shall be included for control and monitoring of the Volute Press System. Provide Ethernet/IP connection from OIT and control panel. Connections shall be provided for the control of the sludge pumps, the NPW booster pumps, screw conveyors, and polymer system.

L. The control panels and all other electrical equipment installed in the control panel shall comply with Division 13 and Division 16 specifications unless specified herein.

M. All power wiring shall be 14 AWG multi-strand machine tool wire minimum with SIS insulation. Control wiring shall be 250 volt, type SIS insulation stranded copper and shall be sized for the required load, 18 AWG minimum.

N. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing.

O. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122º F. Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.

P. Circuit breakers for the main disconnect shall be thermal magnetic molded case units. Circuit breakers shall be Square D, Class 650, Type FAL or equivalent

Q. All control components shall be mounted internal to the enclosure and be mounted with stainless steel hardware. The enclosure and internal control components must be clearly identified with plastic engraved name tags secured to the panel with stainless steel self-tapping screws.

R. PLC tag database shall be provided to PCSS and/or Owner for incorporating into top end SCADA for Monitoring and Controls. At minimum the following shall be provided:

a. The following statuses shall be monitored at the plant SCADA:
   i. All motor Hand/Off/Auto
   ii. All motor running status
   iii. All available VFD fault alarms
   iv. All available VFD speeds and status
   v. All pressure statuses
   vi. All levels and alarms
   vii. Flow & totalized flow

S. The following statuses shall be sent to the local control panel:

1. Sludge Holding Tank Low Level Lock Out
2. Dewatering Press Feed Pump Running Status
3. Dewatering Press Feed Pump Fail Status

T. When a fault occurs at the dewatering equipment an alarm at the dewatering control panel will notify operator and stop dewatering operation as described below.

U. Provide “pull-cord” emergency stop switches for the volute press VP-14D-101 and the screw conveyors SCC-14D-101 and SCC-14D-102 that will provide an immediate equipment shutdown when activated. Any e-stop shall shut down all dewatering equipment. See Specification Section 11733 – Screw Conveyor.

V. Emergency Stop Pushbuttons and Pull Cord Emergency Stop Switches shall be hard-wired. When any E-stop is pressed or if a fault occurs in either conveyor then all dewatering equipment shall immediately stop as described below.

W. Process Control Narrative:

Process Description:	One Volute Press will be installed in the Dewatering facility. The Volute Press will be utilized to dewater sludge from the existing Sludge Holding Tank. Dewatering Press Feed Pumps will pump Waste Activated Sludge (WAS) from the Sludge Holding Tank to the Volute Press flocculation tank. A VFD will control the speed of the pump. In the event of a pump overload or a VFD fault, the dewatering systems will shut down and alarm. The Volute Press control panel (CP-14D-101) will send and receive signals from the Dewatering Press Feed Pump control panel (CP-14A-001). WAS flow will be monitored via flow meter at the Dewatering Press Feed Pumps Station. The operator will be able to set the desired flow, and the Dewatering Press Feed Pump will operate to maintain that flow via a PID control loop. Any variations from the preset flow will cause the dewatering system to shut down and an alarm to occur. Dewatering NPW Booster Pumps shall begin startup following the initiation of start operations on the Dewatering Press Feed Pumps. The Dewatering NPW Booster Pumps shall be stopped following the Dewatering Press Feed Pumps being stopped. Polymer solution will be injected into the Volute Press flocculation tank from two (2) Polymer Blending Units (one duty, one spare) at a rate based on the WAS flow rate. Operators shall set desired Polymer feed from the Dewatering Control Panel. Manual adjustment of the speed control for the polymer dilution mixing chamber will be made from the Dewatering control panel's operator interface terminal (OIT). The Dewatering control panel will also monitor the Polymer Blending Unit for faults due to low water pressure, or no polymer flow and shut the dewatering system down and alarm should this occur. Whenever the dewatering system is operating three (3) motorized mixers, controlled by VFD, shall operate continuously, stirring the contents of the flocculation tank. A high level switch and level sensors shall detect any high level in the flocculation tanks and shut the dewatering system down and trigger an alarm should this occur. Variable speed mixers in the flocculation tanks can be adjusted from the dewatering control panel OIT. Flocculated WAS shall discharge directly into the Volute Press for dewatering. Dewatering Drums shall operate when the operator begins the startup sequence from the Dewatering control panel OIT. The motor is controlled by a single VFD. When the plant shuts down the dewatering drum shall continue to operate for a pre-set time before they shut down. Sprays shall open to operate at user adjustable frequency and duration while dewatering drum is operating. The frequency and duration of the spray are adjustable from the Dewatering panel OIT. Screw Conveyors shall operate whenever the dewatering drums are operating and shall shut down following a pre-set delay following the shut down of the dewatering drums. Any E-stop or no-motion sensor on the conveyors shall shut down the dewatering system and cause an alarm in the event they are activated. The conveyors shall also shut down the system and cause an alarm on over torque alarm. The Volute Press forms part of the dewatering PCS system. See Specification Section 11152 – Double Disc Diaphragm Pump, Section 11144 – Multi-Stage Vertical Turbine Pump, and Section 11540 – Liquid Polymer Blending Unit for process control narrative.

P&ID:	14D-I-1 Volute Dewatering Press P&ID
Controlled Devices:	VP-14D-101 Volute Press No. 1 FCT-14D-101 Flocculation Tank Mixer No. 1 FCT-14D-102 Flocculation Tank Mixer No. 2 FCT-14D-103 Flocculation Tank Mixer No. 3 SCC-14D-101 Screw Conveyor No. 1 SCC-14D-102 Screw Conveyor No. 2 PCP-14A-101 Dewatering Press Feed Pump No. 1 PCP-14A-201 Dewatering Press Feed Pump No. 2 VMP-14B-101 Dewatering NPW Booster Pump No. 1 VMP-14B-201 Dewatering NPW Booster Pump No. 2 PBU-14C-101 Polymer Blending Unit No. 1 PBU-14C-201 Polymer Blending Unit No. 2
Instrumentation Devices:	FIT-14A-101 Sludge Flow LSH-14D-101 Flocculation Tank Level Switch High LT-14D-102 Flocculation Tank No. 1 Level Transmitter LT-14D-103 Flocculation Tank No. 2 Level Transmitter MS-14D-101A Volute Press No. 1 Motion Sensor No. 1 MS-14D-101B Volute Press No. 1 Motion Sensor No. 2 MS-14D-101C Volute Press No. 1 Motion Sensor No. 3 MS-14D-101D Volute Press No. 1 Motion Sensor No. 4 MS-14D-101E Volute Press No. 1 Motion Sensor No. 5 MS-14D-101F Volute Press No. 1 Motion Sensor No. 6 ES-14D-100 Volute Press No. 1 E-Stop ES-14D-101 Screw Conveyor No. 1 E-Stop ES-14D-201 Screw Conveyor No. 2 E-Stop SV-14D-101 Solenoid Valve SV-14D-102 Solenoid Valve SV-14D-103 Solenoid Valve SV-14D-104 Solenoid Valve SV-14D-105 Solenoid Valve SV-14D-106 Solenoid Valve
Local Functions:	<u>Local Control Panel:</u> The local control panel shall at minimum contain the following for each pump: • H-O-A Switch • A white light to indicate power status • A green light to indicate the Dewatering system running status • A red light to indicate the Dewatering system on UPS power • E-Stop Push Button • Operator Interface Terminal When set to HAND (Manual) operation, all items may be switched on and off manually at the control panel by the switches on the OIT Manual Operation Screen. When set to Off, no items shall work whether switched on or off either at the control panel or anywhere else.
MCC Functions:	None
HMI Functions:	Vendor provided panel, at a minimum shall have the following data shown:

	• Polymer Dose Rate • FM-14A-101 Instantaneous Flow • FM-14A-101 Totalized Flow • Flocculation Tank Level • Motion Sensor Alarms • Emergency Stops • Screw Conveyor Status
PLC Functions:	In AUTO mode, PLC shall provide for the operational control of all components of the Volute Press- system including the ability to set times and operating speeds for any Dewatering Press Feed Pump or Dewatering NPW Booster Pump installed, solids conveyor, dewatering drums, mixers, polymer dosing system and wash-down sprays. PLC shall allow suitably qualified operators to adjust operating parameters such as delay timers for fault alarms and system calibration constants. PLC shall allow the operator to inspect the operation of all the components including indicators such as output frequency, current draw, thermal condition, elapsed operating times, and any faults present. Operator shall be able to view approximated readouts of all operational speeds and flowrates relevant to the operation of the system. Operator shall be able to manually operate each item of equipment from the OIT for inspection and maintenance reasons. Operator shall be able to set the unit to operate at a specific time or on specific days with no operators present. When set to AUTO, all items of equipment shall work as per the following descriptions. • Clock Operation o The clock function shall be controlled by the PLC in the control panel. Two clock functions shall be allowed for in the program. The clock may be set to either “On” or “Auto/timer” via the OIT. ▪ If the clock is set to “On” the plant shall run for as long as the main switch is set to “Auto”. ▪ When the clock is set to “Auto/Timer” the plant shall operate in accordance with the clock settings. o Clock function settings shall allow the operator to set the dewatering press and all associated equipment to switch on and off, at pre-designated times on pre-designated days with no operators being present. o A minimum of two (2) different “clock programs” shall be allowed for in the PLC program. Control Sequence: 1. In AUTO, Operation of the volute press shall be initiated by engaging the following sequence: a. Run Permissives enable automatic control b. Prompt input of desired sludge feed rate and polymer dose. c. Sequence Start 1. System shall begin sequence start by OIT pushbutton 2. System Time Clock scheduled sequence start 3. SCADA run signal d. System shall begin Auto Start Delay Timer e. Volute press shall initiate system start operations (Optional start delay timers for all equipment): 1. Dewatering Press Feed Pumps shall be started 2. Polymer Blending Unit shall be started

	3. Dewatering NPW Booster Pumps shall be started 4. Flocculation Mixers shall be started 5. Dewatering Drums shall be started 6. Screw Conveyors shall be started a. Conveyor No. 2 shall be started and rotation confirmed. b. Conveyors No. 1 shall be started and rotation confirmed. f. System Stop shall be initiated by 1. Run Flow Total Stop On a. System shall begin stop operation when Totalizer setpoint is achieved 2. Run Flow Total Stop Off a. Runs Continuously until the system receives a system stop signal initiated by any of the following: i. Local operator pushbutton from the control panel OIT ii. Local Time Clock stop setpoint iii. Remote stop signal from the operator over SCADA iv. Alarm shutdown shall occur for any enabled fault status, refer to manufacturer documentation for Alarm Shutdown Table 2. Stopping the dewatering operation shall initiate the following sequence (Optional stop timers for all equipment): a. Normal or Extended stop timers shall be started b. Dewatering Press Feed Pump(s) shall be turned off. c. Polymer blending unit shall be stopped. d. Drum equipment shall initiate system stop. 1. All drum sprays shall operate on a separate cycle timer e. Conveyor No. 1 shall run for 60 seconds and then stop. Zero rotation shall be confirmed. f. Conveyor No. 2 shall run for 60 seconds and the stop. Zero rotation shall be confirmed. g. Dewatering NPW Booster Pumps shall be stopped. h. Some Optional Timers shall be bypassed by certain alarm groups, refer to manufacturer documentation for Alarm Shutdown Table. i. E-Stops are hard-wired and shall shut off ALL equipment immediately and alarm SCADA.
SCADA Functions	See specification 13441 – Process Control Narratives.
Interlocks:	<u>All interlocks below are hardwired:</u> FIT-14A-101 Low Sludge Flow LSL-13-001 Sludge Holding Tank Low Level Alarm LSL-13-002 Sludge Holding Tank Low Level Alarm ES-14D-100 E-Stop Activated ES-14D-101 E-Stop Activated

	ES-14D-102 E-Stop Activated <u>All interlocks below are programmed:</u> FIT-14A-101 Low Sludge Flow PBU-14C-101 Polymer Blend Unit No. 1 Fail PBU-14C-201 Polymer Blend Unit No. 2 Fail PBU-14D-101 Polymer Blend Unit No. 1 Low Flow PBU-14D-201 Polymer Blend Unit No. 2 Low Flow PBU-14D-101 Polymer Blend Unit No. 1 Low Pressure PBU-14D-201 Polymer Blend Unit No. 2 Low Pressure VP-14D-101 Volute Press No. 1 System Fail MS-14D-101A Volute Press No. 1 Motion Sensor No. 1 Alarm MS-14D-101B Volute Press No. 1 Motion Sensor No. 2 Alarm MS-14D-101C Volute Press No. 1 Motion Sensor No. 3 Alarm MS-14D-101D Volute Press No. 1 Motion Sensor No. 4 Alarm MS-14D-101E Volute Press No. 1 Motion Sensor No. 5 Alarm MS-14D-101F Volute Press No. 1 Motion Sensor No. 6 Alarm DDP-14A-101 Dewatering Press Feed Pump No. 1 Fail DDP-14A-201 Dewatering Press Feed Pump No. 2 Fail DDP-14A-101 Dewatering Press Feed Pump No. 1 Low Pressure DDP-14A-201 Dewatering Press Feed Pump No. 2 Low Pressure VMP-14B-101 Dewatering NPW Booster Pump No. 1 Fail VMP-14B-201 Dewatering NPW Booster Pump No. 2 Fail VMP-14B-101 Dewatering NPW Booster Pump No. 1 Low Pressure VMP-14B-201 Dewatering NPW Booster Pump No. 2 Low Pressure FCT-14D-101 Flocculation Tank Mixer No. 1 Fail FCT-14D-102 Flocculation Tank Mixer No. 2 Fail LSH-14D-102 High Flocculation Tank No. 1 Level LT-14D-101 High Flocculation Tank No. 2 Level LT-14D-102 High Flocculation Tank No. 3 Level SCC-14D-101 Screw Conveyor No. 1 Fail SCC-14D-102 Screw Conveyor No. 2 Fail SCC-14D-101 Screw Conveyor No. 1 Zero Speed Sensor SCC-14D-102 Screw Conveyor No. 2 Zero Speed Sensor LSL-13-001 Sludge Holding Tank Low Level Alarm LSL-13-002 Sludge Holding Tank Low Level Alarm ES-14D-100 E-Stop Activated ES-14D-101 E-Stop Activated ES-14D-102 E-Stop Activated
Alarms and Indications:	<u>Alarms Indicated on SCADA:</u> See Specification Section 13441 – Process Control Narratives and Attachment 13311A - IO list for a complete list of alarms and status indications.

2.12 SPARE PARTS

A. Provide one set of the following spare parts:
   1. Spray wash system solenoid valve

PART 3 – EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. Crate and protect all equipment against damage during shipment. Exposed connections shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

B. Store equipment off the ground in enclosed shelter. Store and maintain equipment in accordance with Manufacturer's recommendations.

C. Contractor shall be response for all wiring and piping between the local junction box, local control panel, dosing/flocculation tank, and dewatering drum.

3.2 INSPECTION

A. Inspect and verify that equipment has no defects on the structure or surface that will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the work to the Engineer.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's written instructions. Contractor shall coordinate the submittal of the volute press with the submittal of the screw conveyor system as specified in Section 11733 – Screw Conveyor.

B. Provide sufficient clearances for proper operation.

3.4 FIELD START-UP

A. All equipment shall be given running tests by the Contractor and Manufacturer at the site following installation of the equipment and controls.

B. The Contractor shall provide all necessary test equipment including water, temporary piping, and other required incidentals.

C. Field Tests shall consist of operating the volute press under all design conditions. Field test shall also consists of influent and output % solids, polymer dosing, and total suspended solids of filtrate. Field test shall operate at 2 hours at a WAS concentration of 0.5, 1.5, 2.5 each at 3 speed settings for each.

D. Should the tests indicate any malfunction, the Contractor shall make any necessary repairs and adjustments, then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

E. **The volute press form part of the dewatering PCS system and therefore should be tested as part of the dewatering system to achieve acceptance.**

3.5 SERVICES BY MANUFACTURER

A. A factory trained representative of the Manufacturer shall provide services for installation supervision, start-up and test services and operation and maintenance personnel training services.

B. Manufacturer's representative shall perform on-site services according to the following schedule, excluding travel time:

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	2	1
Pre-demonstration functional and performance testing	2	1
Pre-demonstration onsite training of owner personnel	2	Can be combined w/ testing and pre-demonstration start up
Pre-demonstration start up	2	Can be combined w/ testing and pre-demonstration start up
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer shall provide a written report certifying that the installation has been checked, is adequate for the intended purpose, all power connections has bene checked, all controls are functional, and that the equipment is ready to be placed into service.

D. Manufacturer shall start-up and operate the system in the presence of the Engineer, and conduct the field performance test to verify that the equipment meets or exceeds the specified requirements. Manufacturer shall revisit the site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. The Manufacturer shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the Owner.

F. Manufacturer will be back charged by the client for additional services of its staff and the Engineer for a re-test in the event of an unsuccessful field testing demonstration.

3.6 FINAL ACCEPTANCE

A. Final acceptance use will not occur until after the following activities have been performed and accepted by the Engineer.
1. Training the Owner's operating and maintenance personnel by the Manufacturer's Representative.
2. Satisfactory completion of the Demonstrative Period under the Owner's control.

END OF SECTION

SECTION 11540
LIQUID POLYMER BLENDING UNIT

PART 1 – GENERAL

1.1 SCOPE

A. This section of the specifications covers furnishing all labor, equipment, materials, controls, and appurtenances for integrated emulsion polymer dilution and feed systems, including training and start-up for a complete and operable system.

B. Contractor shall coordinate with the dewatering press manufacturer to integrate all liquid polymer blending unit controls into the dewatering press control panel. The liquid polymer blending units shall be provided by the dewatering press manufacturer as part of complete system responsibility.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer from complying with the requirements therein.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
1. American National Standards Institute (ANSI).
2. American Society for Testing and Materials (ASTM).
3. American Bearings Manufacturers Association (ABMA).
4. American Gear Manufacturers' Association (AGMA).
5. Institute of Electrical and Electronics Engineers (IEEE).
6. National Electrical Code (NEC).
7. National Electrical Manufacturers' Association (NEMA).
8. Steel Structures Painting Council (SSPC).
9. Underwriters Laboratories (UL).

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data, and Samples.

B. Polymer Blending Unit Data
1. Certified shop and installation drawings showing details of construction, weight, dimensions, and anchor bolt locations.
2. Manufacturer’s specification.
3. Descriptive literature, bulletins and/or catalogs of the equipment.
4. Catalog data sheets for major components (e.g. drive, motor, etc.).
5. Complete bill of materials for all equipment with materials of construction.
6. Descriptive literature on surface preparation and shop coating.
7. Factory performance test results and certifications.
8. Performance test results.
9. Flow rate and pressure requirements for dilution water.

10. Control system information including electrical schematic and interconnection wiring diagrams.
11. Spare parts list.
12. Motor data for all motors including horsepower, electrical characteristics, bearing life ratings, insulation ratings, and nameplate data.

C. The Manufacturer shall provide the following certifications.
   a. The Manufacturer has examined the Contract Documents and agrees to the process performance guarantee and material specifications, warranty conditions, and other requirements of the Contract.
   b. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
   c. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel. (A written certification of a proper and correct installation and start-up shall be provided.)
   d. Owner's personnel have received sufficient training and are qualified to operate the equipment.

D. Record Drawings: Submit record drawings under provisions of Section 01720 - Project Record Documents.

E. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all curves, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

F. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

C. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

D. The requirements of this Section shall be considered the minimum limits of acceptability.

1.6 WARRANTY

A. For a period of 12 months from project substantial completion, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Take proper measures to prevent rust and corrosion.

C. Accept equipment on-site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs or caps installed to protect the equipment during shipment until the equipment is installed and permanent connections are made.

PART 2 – PRODUCTS

2.1 GENERAL

A. An integrated equipment package shall be provided to automatically meter, dilute, completely activate and feed liquid polymer and water. Blending units shall produce a solution free of unblended polymer using a two-stage activation system, combining polymer dispersion/wetting with a separate motorized activation chamber. Units shall have automatic flushing upon shutdown. Units shall also have a secondary dilution system which allows for independent variation of carrier water flow from dilution flow.

B. Provide polymer blending units which are specifically designed for conditioning aerobically digested waste activated municipal sludge. Systems using solely hydraulic mixing are not allowed.

D. Furnish units of standard dimensions such that parts will be interchangeable between like units.

E. Neat polymer flow shall automatically vary based on sludge feed flow.

2.2 PERFORMANCE REQUIREMENTS

A. Performance Table:

Design Conditions	**Units**	**PBU-14C-101, PBU-14C-201**
System Dedication	N/A	Dewatering Press
Type of Polymer	N/A	Emulsion
Specific Gravity	N/A	1.04
Polymer/Water Solution Output	% Polymer	0.25
Design Polymer Input Flow Rate	gph	2.63
Min. Dilution Water Input Capacity	gpm	4.34
Max. Dilution Water Input Capacity	gpm	17.51
Minimum Dilution Water Pressure	psi	60
Polymer Solution Output Capacity	gpm	5 - 20
Duty Rating	N/A	Continuous 24/7
Voltage/Phase/Hz	V/ø/Hz	230/460V/single-phase/60 Hz

2.3 ACCEPTABLE MANUFACTURERS

A. Provide polymer blending unit of one of the following Manufacturers. No others will be allowed:
1. Velodyne, USA

B. Listing as an acceptable manufacturer does not relieve the Manufacturer from conforming to these specifications.

2.4 POLYMER BLEND UNIT

A. Frame
1. Each unit shall be furnished on a common open frame including metering pump, mixing equipment, piping and valves, and local control panel.
2. Polymer system frame shall be 304 stainless steel construction and affixed to a stainless steel table. The skid shall be minimum 3/16-inch 304 stainless steel. The frame shall be minimum 3/16-inch angle or structural stainless steel tubing. The plate supporting the control panel shall be minimum 12 gage. All pipe supports shall be stainless steel. The table must have holes for floor mounting to concrete and designed for lifting by a fork lift.

B. Metering Pump
1. System shall include a variable speed, positive displacement, progressive cavity-type metering pump.
2. Pump shall have 316 stainless steel rotor and Viton stator.
3. Motor shall be TEFC, severe duty rated.

4. Metering pump shall be capable of pumping solution or emulsion-type polymers of anionic, non-anionic or cationic types with apparent viscosities of up to 3,500 cps.
   Metering pump shall be mounted to the polymer system frame at height of no more than 14 inches higher than the base for ideal suction conditions. Pump should be easily accessible for servicing.
6. Metering pump calibration column shall be graduated in increments of 0.1 gallons/10 mL and sized to provide a one-minute drawdown at 100% pump capacity. Calibration column must be supported by the system frame.

C. Mixer
1. Mixer shall have variable speed capability.
2. Mixing energy shall be provided by a multi-bladed turbine rotating on a 304 stainless steel shaft with 304 stainless steel bearings and seals.
3. When rotating, the turbine shall occupy a minimum of 30% of the mixing chamber volume.
4. Mixing chamber shall be constructed of clear PVC or Polycarbonate with stainless steel flanges.
5. Mixing chamber shall have a minimum pressure rating of 100 psi.

D. Dilution Water System
1. System shall be provided with a self-adjusting valve to automatically adjust the dilution water to maintain a polymer blend concentration utilizing a flow meter to determine actual flow through the system.
2. System shall have a NEMA 4X solenoid valve for on-off control of dilution water supply.
3. System shall have a pressure switch on the on the inlet side of the mixing chamber.
4. System shall have a stainless steel liquid filled dilution water inlet pressure gauge.
5. Water supply connection, fittings, piping, and solenoid valves shall be 1-inch FNPT; stock solution connection, fittings, piping, and valves shall be 1-inch FNPT.

2.5 SPARE PARTS AND ACCESSORIES

A. Each polymer blending unit shall be provided with the following spare parts in a lockable toolbox:
1. One complete set of tools required for normal operation and maintenance.
2. One set of gaskets and o-rings for all gasketed covers and connections.
3. One polymer injection valve.
4. One pump rotor, stator, and mechanical seal.
5. One repair kit for wear parts not specified.

2.6 CONTROLS

A. A NEMA 4X Junction Box shall be provided by the polymer system manufacturer and affixed to the frame. Terminal blocks shall be provided for interconnecting all skid-mounted electrical devices and all remote input and output signals.

B. Polymer Blending Units are controlled and powered by the Dewatering Press Control Panel (CP-14D-101). Outputs from the Dewatering System Control Panel to the Polymer Blending Units shall include power, start and stop signals, and flow paced variable speed control for the polymer feed pumps. Inputs to the Dewatering System Control Panel shall include Dilution Water Pressure and Polymer Flow. All electrical work, motors and drives will comply with any relevant NEMA standards. Polymer system shall operate off 480VAC, 3-phase, 60 Hz service fed from Dewatering Control Panel (CP-14D-101).

D. The Automatic Controls for operation of the Polymer Blending Unit shall be furnished fully assembled, wired and pre-programmed, as part of the Dewatering System Control Panel (CP-14D-101).

E. Variable frequency drives (VFD) shall be provided for the polymer feed pumps. The VFDs shall be UL listed and shall be Altivar series as manufactured by Schneider Electric. VFDs shall have Modbus/TCP, and Ethernet/IP (DLR) capability.

F. All electrical equipment installed in the control panel shall comply with Division 13 and Division 16 specifications unless specified herein.

G. All power wiring shall be 14 AWG multi-strand machine tool wire minimum with SIS insulation. Control wiring shall be 250 volt, type SIS insulation stranded copper and shall be sized for the required load, 18 AWG minimum.

H. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing.

I. Process Control Narrative:

Process Description:	Two (2) Polymer Blending Units (one duty, one spare) shall be provided for the proposed Volute Press. The polymer blending units shall startup following the initiation of start operations on the Dewatering Press Feed Pumps. The Polymer Blending Unit shall be stopped following the Dewatering Press Feed Pumps being stopped. The Dewatering Press Feed Pumps shall pump WAS from the existing sludge holding tank to proposed Volute Press, based on control signals from the Dewatering Control Panel (CP-14D-101). The Polymer Blending Unit shall receive the feed start signal and flow pacing speed signals from the Dewatering Control Panel. Dewatering Control panel OIT allows operator input of desired sludge feed rate and polymer dose. The polymer blending units form part of the dewatering PCS system. See Section 11445 – Volute Press for process control narrative
P&ID:	14C-I-1 Polymer System P&ID
Controlled Devices:	PBU-14C-101 Polymer Blending Unit No. 1 PBU-14C-201 Polymer Blending Unit No. 2
Instrumentation Devices:	Control system is part of vendor supplied package
Local Functions:	In HAND (Manual), manual adjustment of the speed control for the polymer dilution mixing chamber can be made from the control panel OIT.
MCC Functions:	None
HMI Functions:	Polymer Blending Unit system shall be vendor supplied and controlled by the vendor supplied Dewatering System Control Panel (CP-14D-101).
PLC Functions:	In AUTO (remote), Polymer feed to the dewatering system is achieved by the integral polymer preparation system connected to the dewatering system. These units are controlled and powered by the Dewatering Press Control Panel (CP-14D-101). Outputs from the Dewatering System Control Panel to the Polymer Blending Units shall include power, start and stop signals, general fail alarms, and flow paced variable speed control for the polymer feed pumps. Each Polymer Blending Unit shall alternate which unit is the being called upon each successive call to run. Polymer Blending Units are called as part of the Dewatering sequence. Polymer Blend Unit Metering pumps go to standby mode and signal an alarm when low dilution water pressure occurs. The pumps automatically restart when pressure is returned.
SCADA Functions:	See specification 13441 – Process Control Narratives.
Interlocks:	No external interlocks
Alarms and Indications:	<u>Alarms Indicated on SCADA:</u> PBU-14C-101 Fail PBU-14C-201 Fail PBU-14C-101 Loss of Dilution Water Flow Alarm PBU-14C-201 Loss of Dilution Water Flow Alarm PSL-14C-101 Low Water Pressure

	PSL-14C-201 Low Water Pressure

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect all equipment prior to installation.

B. Promptly report defects which may affect the work to the Engineer.

3.2 INSTALLATION

A. Install equipment at the location shown on the construction drawings and the Manufacturer's installation drawings which have been reviewed by the Engineer.

B. Provide sufficient clearances for proper operation.

3.3 FIELD TESTING

A. The Manufacturer’s representative, with assistance from the Contractor, shall perform equipment tests in order to certify compliance with the herein specified performance requirements.

B. The Contractor shall provide all necessary test equipment. Contractor shall ensure there is sufficient dilution water to conduct test and that all downstream components are capable of receiving liquid. If there is no dilution water upon start up, the Contractor shall provide water for testing purposes. If downstream components are not in place, Contractor shall make provisions for recycling water and disposal.

C. Field tests shall consist of operating the equipment under normal and abnormal conditions.
1. Operate each item of equipment through its entire performance range and through at least 3 full cycles. Adjust, balance, calibrate and verify that the equipment, controls, and process system are operating as intended.
2. Metering pumps shall be calibrated and tested at a minimum of 5 different system speeds.
3. Should the tests indicate any malfunction, Contractor shall make any necessary repairs and adjustments, and then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

D. A copy of all information from functional tests, including data, worksheets, and other materials shall be turned over to the Owner at the completion of the testing program, and copies shall be included in Operation & Maintenance Manual for the project.

E. The polymer blending units form part of the dewatering PCS system and therefore should be tested as part of the dewatering system to achieve acceptance.

3.4 MANUFACTURER'S REPRESENTATIVE

A. Manufacturer’s on-site services shall be provided via one or more qualified full-time factory employee(s), or service technician(s) with extensive experience in on-site installation and testing of equipment similar to that specified

herein. The Manufacturer shall provide services for installation and supervision, start-up, test services, and operation and maintenance personnel training services.

B. Manufacturer's representative shall perform on-site services according to the following schedule, excluding travel time:

Work	**Person Days**	**Trips**
Manufacturer's inspection and certification of installation	1	1
Pre-demonstration functional and performance testing	1	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ testing and pre-demonstration start up
Pre-demonstration start up	1	Can be combined w/ testing and pre-demonstration start up
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer shall provide a written start-up report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

D. Manufacturer shall operate the system during the field test in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. The representative shall revisit the site as often as necessary until all problems are corrected and the installation is entirely satisfactory. The Manufacturer shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals, and incidentals for additional visits shall be at no additional cost to the Owner.

F. Manufacturer will be back charged by the client for an unsuccessful field testing demonstration. Schedule the field testing a minimum of 48 hours following a successful start-up procedure.

END OF SECTION

SECTION 11700
SCREENINGS WASHER COMPACTOR

PART 1 - GENERAL

1.1 SCOPE

A. This section includes provisions of all labor, materials, and equipment to furnish and install a washer compactor system. The washer compactor system shall include the washer compactor equipment, piping, valves, spray system, wiring, conduit, motors, gear boxes, control panel and all other appurtenances required or shown on the drawings required, including training and start-up, to provide a complete and operating system.

B. The washer compactor shall be provided with the perforated plate screens as a package. The Manufacturer for the perforated plate screens and the washer compactor shall be the same.

1.2 RELATED WORK

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Reference Standards:
1. American Gear Manufacturers Association (AGMA)
2. American National Standards Institute (ANSI)
3. American Welding Society (AWS)
4. National Electric Code (NEC)
5. National Electrical Manufacturers Association (NEMA)
6. National Institute for Occupational Safety and Health (NIOSH)
7. Occupational Safety and Health Act/Administration (OSHA)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples. **Coordinate the submittal of the washer compactor system with the submittal of the perforated plate screens as specified in Section 11221 – Perforated Plate Screen.**

B. Washer Compactor Data
1. Scope of supply, including list of materials shipped loose and complete bill of materials for all equipment.
2. Descriptive literature, bulletins and/or catalog data sheets of the equipment and major components (e.g. drive, motor, instrumentation, etc.)
3. Certified shop and installation drawings showing all details of construction, dimensions, required clearances, motors, control panels, attachments, supports, connections, couplings, and panel layouts.
4. Structural details for anchoring, frames, enclosures, mounts, or stands, including material properties, classifications, dimensions, and thicknesses.
5. Detailed process and instrumentation (P&ID) diagrams, electrical wiring diagrams, and control narratives.
6. Complete wiring diagrams and control schematics.

7. Information for all surface preparation and shop coatings.
8. Certified shop test results.
9. Performance characteristics.
10. Calculations of bearing life (L-10), drive size, and screenings removal capacity.

C. The Manufacturer shall provide the following certifications.
1. The Manufacturers of proposed electrical, mechanical, and structural systems affecting the performance of the equipment have examined the Contract Documents and agree to the performance and material specifications, warranty conditions, and other requirements set forth herein.
2. The maximum power required of any motor will not exceed the motor rating.
3. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
4. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel. (A written certification of a proper and correct installation and start-up, including all set points and calibrations, shall be provided.)
5. Owner's personnel have received sufficient training and are qualified to operate the equipment.

D. Record Drawings: Submit record drawings under provisions of Section 01720 - Project Record Documents.

E. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

F. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

C. The equipment shall be designed, constructed, and installed in accordance with the Manufacturer's best practices and methods. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

D. Manufacturer and Contractor shall coordinate all dimensions to ensure adequate clearances for equipment maintenance, or removal, or replacement.

E. All welding shall be done at the Manufacturer's factory. Field welding shall not be permitted without the Engineer's express written approval.

F. The requirements of this Section shall be considered the minimum limits of acceptability.

1.6 WARRANTY

A. A single supplier shall take system responsibility for the perforated plate screen and washer compactor system controls and shall ensure that the components of the system are properly integrated to form a complete and operating system.

B. For a period of 12 months from substantial completion of the project, the Manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the Manufacturer and found defective after inspection by the Manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Exposed flanges shall be covered and sealed with shrink wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

C. Accept units on site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter, where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs, or caps installed to protect equipment during shipment until the equipment is installed and permanent connections made.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide a self-contained washer compactor system to collect, compact, and convey debris from the screens to the dumpster.

B. The unit shall be designed to accept screenings and wash and compress them into an inclined dewatering zone which allows excess water to drain into a collection and drain pan.

2.2 PERFORMANCE REQUIREMENTS

A. Performance Table:

Design Conditions	Units	WC-03-001
Location	-	Headworks
Type of Screw Conveyor	-	Shaftless Spiral
Loading Capacity (min)	ft^3/hr	70
Number of Inlet Hoppers	-	3
Number of Discharge Openings	-	1
Cover	-	Yes
Wash Water Pressure Requirement (min)	psi	40-60
Wash Water Flow Requirement (min)	gpm	8
Drive Size (max)	HP	2
Motor Type	-	Explosion-proof
Duty Rating	-	Inverter-Duty
Drive Direction	-	Push

2.3 WASHER COMPACTOR EQUIPMENT

A. All wetted and structural components shall be constructed of Type 316 stainless steel.

B. Screw Conveyor.
1. Screw conveyor shall be comprised of a drained inlet chamber, washing and compaction-dewatering zones, screw auger, drive assembly and gear, and discharge piping.
2. Screw conveyor housing shall include inlet hoppers as noted on the performance requirements, vertically and horizontally aligned with the screening discharge at the screens. Additionally, include inlet hopper at the manual screen location as shown on the drawings.
3. Provide a brush attached to the screw conveyor shaft for cleaning.
4. Wear bars shall be located in the screw conveyor housing to support the screw and shall be constructed of stainless steel or UHMWPE.
5. Contractor shall construct the conveyor utilizing the existing discharge chute.

C. Drive Assembly.
1. Motors shall conform to the requirements of Section 16013, Electric Motors.
2. Motors shall be UL rated for operation in Class 1, Division 2, Groups C and D.
3. The unit shall be powered by a 460 Volt, 3 Phase, 60 HZ, 1800 RPM, 1.15 service factor, NEMA design B type motor with NEMA MG-1, Class “F” insulation, severe duty rated TEFC enclosure and AGMA class 2 gear reduction assembly with 94% efficiency.
4. The gear reducer shall have 13,900 inch-pounds of torque, shaft mounted, 2.0 sf and an output speed of 14 RPM.
5. Manufacturer shall install motor as a vertical motor to provide adequate room for Operations in Headworks.

D. Discharge Piping.
1. The washer compactor shall be furnished with discharge piping and elbows of sufficient length and appropriate arrangement to transport the pressed screenings to the existing discharge chute and dumpster pad as shown on the drawings.

2. The discharge piping assembly shall be designed to allow for proper compacting and transport of screenings, field erection, ease of maintenance, disassembly and clean out, if required.
3. Individual sections and any additional elbows not welded shall have a flange connection on each end.
4. The discharge piping shall be schedule 5, Type 316 stainless steel.
5. Provide a rise in the discharge piping before vertical drop as required by the manufacturer.

E. Collection and Drain Pan.

1. The collection pan shall direct excess water to a minimum three-inch (3") drain connection, which is extended below the headworks grating to discharge. The collection pan shall be removable or have a convenient port to allow cleaning of debris.

F. Wash Water System.

1. Connect the non-potable water system to the wash water spray system solenoid valves using flexible hosses and ball valves. Provide the minimum number of Manufacturer required solenoid valves for the wash water system.
2. Solenoid valves shall be 115 Volt, 60 Hz, explosion proof, and housed in NEMA 8 enclosures. Valves shall have 18" long integral leads and shall have ½" NPT conduit connection.

G. Wash Press Emergency Stop Local Push Button Station. A NEMA 8 stainless steel emergency stop push button shall be mounted to the end flange and shall have a ½" NPT conduit connection. The emergency stop shall be explosion proof.

H. Provide "pull-cord" emergency stop switches for the mechanical bar screen MFS-03-301 and Screenings Wash Compactor WC-03-001 that will provide an immediate equipment shutdown when activated. Any e-stop shall shut down all headworks equipment.

2.4 ACCEPTABLE MANUFACTURERS

A. Provide washer compactors of one of the following, no others shall be allowed:

1. SAVÉCO North America, Inc.

B. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.

2.5 ANCHOR BOLTS AND FASTENERS

A. Anchor Bolts: All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 316 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.

B. Fasteners: All fasteners shall be type 316 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

C. Provide embedded anchors with the necessary hex nuts and washers to secure all parts of the mechanism. Wedged anchors will not be allowed.

2.6 CONTROLS

A. A common primary control panel will be provided to control the perforated plate screens and washer compactor. Refer to Section 11221 – Perforated Plate Screen for details on the controls for the system.

2.7 ACCESSORIES

A. Nameplate
1. Furnish each washer compactor with a stainless-steel data plate containing the Manufacturer's name, model number, serial number, and any other pertinent data.
2. Provide a duplicate plate for installation on the inside cover of the control panel.

2.8 COATING SYSTEM

G. The coating system for the drive unit and any other non-submerged, ferrous metal that is not hot-dip galvanized or stainless steel shall be shop primed with an intermediate epoxy coat and polyurethane top coat. Coating systems shall be acceptable for wastewater applications.

H. Field painting shall conform to the requirements of Section 09921 – Protective Coatings.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the Work to Engineer.

3.2 INSTALLATION

A. Install products in accordance with Manufacturer's written instructions. Contractor shall coordinate installation with the perforated plate bar screens specified in Section 11221 – Perforated Plate Screen.

B. Contractor shall carefully examine existing headworks structure and roughing in to verify actual locations of washer compactor before installation.

C. Provide sufficient clearances for proper operation.

D. Mount duplicate pump nameplate(s) inside front panel of control panel, using stainless steel fasteners.

3.3 FIELD TESTING

A. All equipment shall be given operational tests by the Contractor and Manufacturer's Representative at the site following installation of the equipment and controls.

B. The Contractor shall provide all necessary test equipment including water, temporary piping, and other required incidentals.

C. Field tests shall consist of operating the washer compactor system under normal and anormal conditions. This includes operating the system concurrently with the screen system.

D. Should the tests indicate any malfunction, the Contractor shall make any necessary repairs and adjustments, then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

3.4 MANUFACTURER SERVICES

A. A factory trained Representative of the Manufacturer shall provide services for installation supervision, start-up and test services, and operation and maintenance personnel training services.

B. Manufacturer's Representative shall perform on-site services, including training of Owner's personnel, according to the following schedule, excluding travel time.

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	1	1
Pre-demonstration functional and performance testing	1	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ pre-demonstration start up
Pre-demonstration start up	0.5	1
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer's Representative shall provide a written start-up report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

D. Manufacturer's Representative shall operate the system during the field test in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. The representative shall revisit the site as often as necessary until all problems are corrected and the installation is entirely satisfactory. The Manufacturer's Representative shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals, and incidentals for additional visits shall be at no additional cost to the Owner.

END OF SECTION

SECTION 11720
WINCHES

PART 1 – GENERAL

1.1 SCOPE

A. This work includes furnishing all labor, materials, equipment, controls, and appurtenances for a winch pulling system, including training and start-up for a complete and operable system. Items under this section shall be provided by one manufacturer.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer from complying with the requirements therein.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:

1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. American Bearing Manufacturers Association (ABMA)
4. American Gear Manufacturers' Association (AGMA)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. National Electric Code (NEC)
7. National Electrical Manufacturers Association (NEMA)
8. Underwriters Laboratories (UL)

1.4 SUBMITTALS

A. Provide submittal data, manuals, and drawings as specified in Section 01340 – Shop Drawings, Product Data, and Samples.

B. Winch Data
1. Certified shop and installation drawings showing details of construction, weight, dimensions, and anchor bolt locations
2. Manufacturer's specification
3. Descriptive literature, bulletins and/or catalogs of the equipment
4. Complete bill of materials for all equipment with materials of construction
5. Performance data
6. Anchorage calculations and details
7. L-10 bearing lift calculations
8. Spare parts list

9. Start-up and manufacturer field services schedule

C. Wire Rope Data
1. Submit wire rope material and material type, diameter (in inches), strand construction, minimum break strength (in pounds), approximate weight per 100 feet of material (in pounds), and qualifying specification.

D. Electric Controller
1. Provide a wireless (two-button minimum) remote for winch operation. Wireless remote must come with charger or battery replacements.

E. Manufacturer's Certifications
1. Submit manufacturer's certification that Contract Documents have been examined by the manufacturer for proposed electrical, mechanical, and structural systems affecting performance of the equipment.
2. Submit manufacturer's certification that the maximum power requirement, if used, shall not exceed the motor rating under operating conditions.

F. Motor Data
1. Horsepower
2. Electrical characteristics
3. Other data to provide a complete description

G. Instruction Books
1. Service and maintenance manual
2. Service parts list
3. Outline drawing

H. Operation and Maintenance Instructions
1. Submit operation and maintenance data under provisions of Section 01720 – Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance.

1.5 QUALITY ASSURANCE

A. The winch system shall be assembled at the manufacturer's facility and delivered to the site as a complete unit.

B. Use new materials of high grade and with properties best suited to the work required.

C. The winch shall be field tested and accepted prior to achieving substantial completion. Field testing includes operating the winch and all ancillary equipment under all design conditions.

D. Component Supply and Compatibility:
1. Obtain all equipment included in this Section regardless of the component manufacturer from a single manufacturer.
2. The equipment manufacturer shall review and approve or shall prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the winch equipment manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Take proper measures to prevent rust and corrosion.

C. Accept equipment on-site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs or caps installed to protect the equipment during shipment until the equipment is installed and permanent connections are made.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide one winch, complete with electric motor and gearbox.

2.2 PERFORMANCE REQUIREMENTS

Design Conditions	Units	WCH-14D-101
Location	-	Dewatering Building (Outdoors, Under Canopy)
Winch Pull Rating (Minimum)	Tons	6.5
Wire Pull Rating (Minimum)	Tons	19.5
Line Speed (Minimum for First Layer Wrap)	fpm	24
Motor Size (Maximum)	HP	7.5

A. Provide a winch capable of meeting all design conditions.

B. Select equipment which is designed and built for the specified operating cycle without disruption in service.

2.3 ACCEPTABLE MANUFACTURERS

A. Provide winch of one of the following, no others will be allowed:
1. Columbia Winches and Hoists
2. Ingersoll Rand
3. Thern

B. Listing as an acceptable manufacturer does not relieve the Manufacturer from conforming to these specifications.

2.4 WINCH

A. Provide a skid mounted winch complete with electric motor and gearbox. Select motor and gearbox combination on overall line pull and line speed capacities.

B. Braking System

1. Provide a braking system which will automatically engage against the load any time the unit is stopped. Provide a manual release on the motor/brake assembly which will disengage the brake in emergency situations.

C. Winch and wire shall be sized such that the dumpster can be pulled when placed at the end of the dumpster tracks, as shown on the drawings.

2.2 WIRE ROPE

a. Description. Wire rope shall be stainless steel with a minimum pay out length of 60-feet (60'). Strand type and diameter shall conform to manufacturer's recommendation based on motor and gearbox combination. The wire rope shall have a minimum pull rating of 30-tons.

2.3 CONTROLS

A. Wireless Control Pendant and Local Control Panel

1. Provide one (1) NEMA 4X control box and one (1) wireless remote-control pendant in a NEMA 4X housing with each winch. The remote-control pendant will have a minimum of two (2) spring loaded buttons for winch operation. When depressed, one button will cause the wire rope to wind off the drum and the second button will cause the wire rope to wind on the drum. Each button will automatically return to the "OFF" position when released. The wireless remote must come with charger or battery replacements.
2. Vendor shall supply control box, remote-control and wall-mounting hardware. See construction drawings for location and proposed winch and controls. Vendor shall provide sufficient wire length to make installation.
3. A NEMA 4X stainless steel control panel shall be provided and installed separate from the winch motor as shown in the Construction Drawings. The control panel shall include the following:
    a. Reversing starter controls.
    b. FORWARD and REVERSE momentary contacts on the face of the panel.
    c. Emergency Stop push button on the face of the panel.
    d. Circuit breaker disconnect.

2.4 ANCHOR BOLTS

A. See structural sheets for anchor bolt requirements. Verify dimensions and placement location with winch manufacturer prior to ordering winch or constructing the equipment pad for the winch.

2.5 SPARE PARTS AND ACCESSORIES

A. Provide spare parts as recommended by the winch manufacturer.

2.6 MOTORS

Provide each winch motor with a standard nameplate securely affixed in a conspicuous place showing serial number and name of the manufacturer.

A. Winch Nameplate. Each winch nameplate will show the line pull capacity in pounds, the corresponding line speed in feet per minute, and the corresponding wire rope diameter. The line pull capacity will be provided for the first layer, mean drum, and full drum.
pulling capacity in lbs.

B. Winch Motor. See Electric Motor section in Division 16.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that equipment has no defects on the structure or surface that will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the work to the Engineer.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's written instructions.

B. Provide sufficient clearances for proper operation.

3.3 FIELD START-UP

A. All equipment shall be given running tests by the Contractor and Manufacturer at the site following installation of the equipment and controls.

B. The Contractor shall provide all necessary test equipment, and other required incidentals.

C. Field Tests shall consist of pulling the Owner's dumpster for a field demonstration.

D. Testing will be conducted as follows:
1. The dumpster will be set on the embed plates at the dewatering building loading bay, at the furthest point from the winch.
2. The winch will pull the dumpster to the curb via the control panel and then the remote station.
3. If the dumpster reaches the wheel stop curbs before both control methods can be adequately tested, the Contractor shall disengage the winch from the dumpster and pull the dumpster back to the starting point and reattach the winch to continue testing.
4. After the manufacturer's representative, Engineer, and Operator are satisfied with the test, the Contractor shall disengage the winch from the dumpster, pull the dumpster back to a location determined by the Operator, and reattach the winch.

E. Should the tests indicate any malfunction, the Contractor shall make any necessary repairs and adjustments, then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

3.4 SERVICES BY MANUFACTURER

A. A factory trained Representative of the Manufacturer shall provide services for installation supervision, start-up and test services, and operation and maintenance personnel training services.

B. Manufacturer's Representative shall perform on-site services, including training of Owner's personnel, according to the following schedule, excluding travel time.

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	0.5	1
Pre-demonstration functional and performance testing	0.5	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ pre-demonstration start up
Pre-demonstration start up	0.5	1
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer's Representative shall provide a written start-up report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

D. Manufacturer's Representative shall operate the system during the field test in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. The representative shall revisit the site as often as necessary until all problems are corrected and the installation is entirely satisfactory. The Manufacturer's Representative shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals, and incidentals for additional visits shall be at no additional cost to the Owner.

END OF SECTION

SECTION 11733
SHAFTLESS SCREW CONVEYOR

PART 1 – GENERAL

1.1 SCOPE

A. This section of the specifications covers furnishing all labor, equipment, structural supports, materials, controls, and appurtenances for screw conveyors, including training and start-up for a complete and operable system for the conveyance of dewatered sludge.

B. The shaftless screw conveyor shall be provided with the volute press as a package.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer from complying with the requirements therein.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
1. American National Standards Institute (ANSI)
2. American Iron and Steel Institute (AISI)
3. American Society for Testing and Materials (ASTM)
4. American Bearings Manufacturers Association (ABMA)
5. American Gear Manufacturers' Association (AGMA)
6. National Electrical Code (NEC)
7. National Electrical Manufacturers' Association (NEMA)
8. National Fire Protection Association (NFPA)
9. Underwriters Laboratories (UL)
10. American Welding Society Code (WSC)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data, and Samples. **Coordinate the submittal of the screw conveyor with the submittal of the volute press system as specified in Section 11445 – Volute Press.**

B. Conveyor Data
1. Certified shop and installation drawings showing details of construction, weight, dimensions, and anchor bolt locations.
2. Manufacturer’s specification
3. Descriptive literature, bulletins and/or catalogs of the equipment
4. Catalog data sheets for major components, i.e. drive, motor, etc.
5. Complete bill of materials for all equipment with materials of construction
6. Descriptive literature on surface preparation and shop coating
7. Factory performance test results and certifications
8. Performance test results with permanent installation and vibration analysis

9. Anchorage calculations with supports and details **signed and sealed by a licensed Professional Engineer in the State of Texas**
10. Control system information including electrical schematic and interconnection wiring diagrams.
11. L-10 bearing life calculations
12. Spare parts list
13. Submit start-up and manufacturer field services schedule

C. Motor Data
1. Horsepower
2. Electrical characteristics
3. Bearing life ratings
4. Insulation ratings
5. Weight
6. Thrust Bearing
7. Wiring Diagram
9. Dimensions
10. Nameplate data

D. Instruction Books
1. Service and maintenance manual
2. Service parts list
3. Outline drawing

E. Manufacturer's Certifications
1. Submit manufacturer's certification that Contract Documents have been examined by the manufacturer for proposed electrical, mechanical, and structural systems affecting performance of the equipment.
2. Submit manufacturer's certification that the maximum power requirement, if used, shall not exceed the motor rating under operating conditions.
3. Submit seal manufacturer's certification that the seal is designed for service and application specified and is installed and aligned properly.

F. Record Drawings
1. Submit record drawings under provisions of Section 01720 – Project Record Documents.

G. Operation and Maintenance Instructions
1. Submit operation and maintenance data under provisions of Section 01720 – Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Use new materials of high grade and with properties best suited to the work required.

B. All conveyors shall be factory tested and accepted prior to installation.

C. All conveyors shall be field tested and accepted prior to achieving substantial completion.

D. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single manufacturer.
2. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the conveyor manufacturer.

1.6 WARANTY

A. For a period of 12 months from project substantial completion, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide a direct driven screw conveyor system without intermediate bearings to convey the material specified in an enclosed and lined trough.

B. Screw Conveyor SCC-14-101 shall discharge into Screw Conveyor SCC-14-102 as shown on the drawings.

2.2 PERFORMANCE REQUIREMENTS

A. Performance Table:

Design Conditions	Units	SCC-14-101	SCC-14-102
Type of Screw Conveyor	-	Shaftless	Inclined Shaftless
Material	-	Municipal Wastewater Cake	Municipal Wastewater Cake
Maximum Solids Composition	% Solids	20	20
Material Density	lbs/ft^3	70	70
Minimum Loading	ft^3/hr	560	560
Maximum Drive Size	HP	5	5
Drive Direction	-	Push	Push
Incline	Degrees	See Drawings	See Drawings
Screw Diameter	in	7	7
Maximum Speed	RPM	20	20
Maximum Trough Fill	%	50	50
Duty Rating	-	Continuous, 24/7	Continuous, 24/7
Cover	-	Yes	Yes
Number of Receiving Openings in Cover	-	2	1
Number of Discharge Openings	-	1	1

2.3 ACCEPTABLE MANUFACTURERS

A. Provide screw conveyor of one of the following, no others will be allowed:
1. JDV Equipment

2.4 CONVEYOR

A. Trough
1. The trough shall conform to all CEMA standards and shall have a 1/16-inch thick neoprene or rubber gasket at each trough flange and between the trough top and cover. The trough shall be manufactured in maximum of 20-foot segments. The trough shall be equipped with a flanged fitting connection to be interconnected with other equipment.
2. The trough shall be fabricated of 304 stainless steel with a minimum thickness of 3/16-inch.
3. The trough shall have a wear liner of 1/4-inch minimum thickness and of ultra-high molecular weight (UHMW) polyethylene, ASTM D4020. Liner shall be attached to trough with 304 stainless steel clip with 1/4-inch minimum thickness.
4. Fasteners shall be 304 stainless steel, ASTM A193/ASTM A193M.
5. Provide a drain outlet, welded to the screw conveyor per the construction drawings. Outlet shall be 2-inch diameter, 304 stainless steel connection.
6. Conveyor troughs shall be integrated as shown in the construction drawings.

B. Cover
1. Covers shall be provided in no more than 48-inch segments.
2. Covers shall be fabricated of AISI 304 stainless steel with a minimum 14 gage thickness.
3. Covers shall be bolted to the flanges of the trough.
4. The supplier shall supply an inlet tray made of 304 stainless steel, which allows the first screw conveyor to catch the dewatered sludge as it is discharged from the volute press.

C. Shaftless Spiral Screw
1. The spiral screw shall be designed to convey material. Minimum thickness of spiral shall be ¾ inch and minimum height shall be 2.5 inches.
2. Spiral flights shall have full penetration welds at splice connections.
3. Spiral flights shall be welded to a 4-inch pipe with flanged disc end for connection to the end drive shaft..

D. Supports
1. The equipment shall be furnished with stainless steel supports suitable for mounting as shown on the drawings and as required by the equipment manufacturer. The supports shall be labeled for easy installation. Provide a support at the inlet end and supports every 10 feet on center inside the volute press building. Provide a support on the exterior of the dewatering building wall in the loading bay as shown on the construction drawings. **Supports shall be signed and sealed by a licensed Professional Engineer in the State of Texas.**
2. Each conveyor shall have a minimum of two (2) supports.
3. The conveyors shall not have any detectable vibration. If vibration is detected add additional supports at no additional cost to the Owner.
4. The conveyor supports shall be fabricated of 304 stainless steel with a minimum thickness of 1/4-inch.
5. Fasteners shall be 304 stainless steel, ASTM A193/ASTM A193M.

E. Drive

1. The motor shall be 460V, 3 Phase, 60 Hz TEFC severe duty, mill and chemical rated motor and gear reduction assembly. Motor shall be by NEMA design code B. The drive system shall be supplied with a trip current relay for torque overload protection. Gearbox and motors shall be factory assembled on the conveyor and tested prior to shipping.
2. Drive must be capable of starting conveyor with a completely full trough.
3. End plates shall be heat-treated alloy steel AISI, Grade 4150, of uniform diameter.
4. Drive bearings shall be high capacity roller bearings located in reducing drive housing with an L-10 life rating of 100,000 hours.
5. Drive end seals shall consist of a compression packing gland between drive shaft and sleeve.
6. Provide a stuffing box to prevent leakage of product out of conveyor. Stuffing box shall be cast iron or galvanized steel, with nominal ½-inch by ½-inch Teflon-impregnated packing, packing ring adjustment to tighten packing onto shaft, and packing ring housing bolted to screw conveyor trough end plate. Packing glands shall incorporate a stainless steel grease fitting with lantern ring set in middle of packing rings, with at least two rings of packing on product side of lantern ring. Provide at least one ring on non-product side of lantern.
7. Gear reducer shall be sized based on input power to each gear reducer, with resulting torque calculated at output shaft rpm, with a safety factor of 1.5 time this calculated torque. Nominal rated output torque shall be greater than or equal to the calculated output torque and its safety factors.

2.5 ELECTRICAL DEVICES AND CONTROLS

A. The screw conveyors form part of the dewatering PCS system. See Section 11445 – Volute Press for process control narrative.

B. Motion Failure Alarm Unit.

1. Each conveyor drive unit shall be equipped with a motion failure alarm unit.
2. The location and mounting details shall be as recommended by the conveyor manufacturer.
3. Motion sensors shall be the non-contacting type using a self-contained probe with circuit board.
4. Unit shall operate on 120 volt, single phase, 60 Hz power supply, and shall be housed in a NEMA 4X enclosure.
5. A 0 to 60 second time delay shall be provided for startup of the conveyor.

C Emergency Shutdown.

1. Each conveyor shall be furnished with an emergency trip cord and safety switch.
2. The cord shall run the full length of each conveyor.
3. The trip switch shall immediately stop the entire dewatering system including all conveyors when the switch is actuated.
4. Switch shall be double acting if cord is pulled or cut, except for explosion proof applications.

PART 3 – EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. Crate and protect all equipment against damage during shipment. Exposed connections shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

B. Store equipment off the ground in enclosed shelter. Store and maintain equipment in accordance with Manufacturer's recommendations.

3.2 INSPECTION

A. Inspect all equipment prior to installation and verify that equipment has no defects on the structure or surface that will adversely affect installation.

B. Promptly report defects which may affect the work to the Engineer.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's written instructions.

B. Provide sufficient clearances for proper operation.

C. Install screw conveyors with Type 316L stainless steel anchor bolts drilled and epoxied into concrete floors.

3.4 FIELD TESTING

A. All equipment shall be given operational tests by the Contractor and Manufacturer at the site following installation of the equipment and controls.

B. The Contractor shall provide all necessary test equipment including water, temporary piping, and other required incidentals.

C. Field tests shall consist of operating the screw conveyors under all operating conditions.

D. Should the tests indicate any malfunction, the Contractor shall make any necessary repairs and adjustments, then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

E. **The screw conveyors form part of the dewatering PCS system and therefore should be tested as part of the dewatering system to achieve acceptance.**

3.5 SERVICES BY MANUFACTURER

A. A factory trained representative of the Manufacturer shall provide services for installation supervision, start-up and test services and operation and maintenance personnel training services.

B. Manufacturer's representative shall perform on-site services according to the following schedule, excluding travel time:

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	1	1
Pre-demonstration functional and performance testing	1	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ testing and pre-demonstration start up
Pre-demonstration start up	1	Can be combined w/ testing and pre-demonstration start up
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer shall provide a written report certifying that the installation has been checked, is adequate for the intended purpose, all power connections has bene checked, all controls are functional, and that the equipment is ready to be placed into service.

D. Manufacturer shall start-up and operate the system in the presence of the Engineer, and conduct the field performance test to verify that the equipment meets or exceeds the specified requirements. Manufacturer shall revisit the site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. The Manufacturer shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the Owner.

F. Manufacturer will be back charged by the client for an unsuccessful field testing demonstration. Schedule the field demonstration a minimum of 48 hours following a successful start-up procedure.

3.5 FINAL ACCEPTANCE

A. Final acceptance use will not occur until after the following activities have been performed and accepted by the Engineer.
   1. Training the Owner's operating and maintenance personnel by the Manufacturer's Representative.
   2. Satisfactory completion of the Demonstrative Period under the Owner's control.

END OF SECTION

SECTION 13300
INSTRUMENTATION AND CONTROLS - GENERAL PROVISIONS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall procure the services of a Process Control System Supplier (PCSS) to furnish and install all materials, equipment, labor and services, required to achieve a fully integrated and operational system as specified herein, in the Specification Sections listed below, and in related drawings, except for those services and materials specifically noted.

1.

Section No	Title
13302	Testing
13303	Training
13306	Application Engineering Services
13310	Computer System Hardware
13311	PLC Hardware and Software
13315	HMI System Software
13320	Control and Data Network Equipment
13321	Fiber Optic Cabling and Equipment
13330	Control Panels and Panel Mounted Equipment
13335	Uninterruptible Power Supply (1 Phase)
13340	Instruments
13441	Process Control Narrative

B. 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, shall be included whether they are shown on the Drawings or not.

C. All equipment and installations shall satisfy applicable Federal, State and local codes.

D. Use the equipment, instrument, and loop numbering scheme shown on the Drawings and specifications in the development of the submittals. Do not deviate from or modify the numbering scheme without the Engineer's approval.

E. An Application Engineer System Supplier (AESS) shall be selected by the Owner to provide all PLC and HMI software programming and engineering not provided by equipment vendors. The AESS shall be a different entity than the PCSS and shall be responsible for all application engineering services. The PCSS, and not the AESS, shall procure all required PLC and HMI hardware, software and licenses.

1.2 RELATED WORK

A. Fiber optic cabling is specified in Section 13321.

B. Relevant equipment Sections in Divisions 11, 13, and 15.

C. For the migration of the chemical system controls, the PCSS shall coordinate with the owner to ensure chemical dosage based on the plant's effluent flow is not disturbed but is continued through the project's construction phase. This could be executed using temporary controls, the existing control cabinet IO signals or by using devices such as 4-20mA splitters.

1.3 SUBMITTALS

1. General Requirements:
   2. Refer to [Section 01300] for general submittal requirements.
   3. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the equipment as manufactured and delivered.
   4. Submittals shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature shall not be acceptable.
   5. Substitutions on functions or type of equipment specified shall not be acceptable unless specifically noted.
   6. Separate submittals shall be made for each submittal listed below.
   7. In case of specified equipment being discontinued within eighteen (18) months of submittal, notify and submit manufacturer suggested equivalent replacement.

B. Qualifications Submittal:
   1. Submit, within 30 calendar days after Notice to Proceed, detailed information on staff and organization to show compliance with the Quality Assurance requirements of this Section. The Qualifications submittal shall be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements shall be grounds for rejection as a PCSS. The Qualifications Submittal shall, as a minimum, contain the following:
   2. Copies of ISA CCST Level 1 certificates for all field technicians or resumes demonstrating field experience.
   3. Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.
   4. Copy of UL-508 certificate for panel fabrication facilities.
   5. Project references for water or wastewater projects as defined in the Quality Assurance paragraphs.
   6. 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.

C. Project Plan, Deviation List, and Schedule Submittal:
   1. Submit, within 45 calendar days after Notice to Proceed, a Project plan. The Project Plan shall be submitted and approved before further submittals shall be accepted. The Project Plan shall, at a minimum, contain the following:
   2. 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. A discussion of startup, replacement of existing equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications shall be included as applicable.
   3. Preliminary list of HMI software, 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. Review and approval of software and hardware systems as part of this Project Plan stage shall 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 approval.

4. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each 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.
5. 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, and I/O wiring diagrams.
6. Exceptions to the Specifications or Drawings shall be clearly defined in a Deviation List. The Deviation List shall consist 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 the Engineer. If no exceptions are taken to the specifications or drawings the PCSS shall make a statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.
7. Project schedule shall be prepared in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule must be based on the General Contractor schedule and must meet all field installation, testing, and start-up milestones in that schedule. The project schedule shall illustrate I&C related major project milestones including the following:
    a. Schedule for all subsequent project submittals. Include the time required for Contractor 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 and HMI server/workstation provided under this Contract.
    i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
    j. Incorporate time constraints for AESS activities as defined in [Section 13306].

D. Input/Output (I/O) List Submittal:
1. Submit, within 60 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
2. I/O list shall be based on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.
3. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
4. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O as required in the specifications.
5. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet shall include the following information:
    TAG NUMBER(S): As indicated on the Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out to allow for sorting by loop.
    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.
    PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
    Physical POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.

I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points are "1."
ENGINEERING UNITS: The engineering units associated with the Analog I/O.
ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
P&ID - the 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.

6. The I/O list shall be sorted in order by:
   Physical location.
   I/O Type.
   Loop Number.
   Device Tag.
7. Once the I/O list is approved, the PLC I/O addresses shall not be modified without approval by the Engineer.
8. For I/O layout requirements, see the PLC Section 13311.

E. Field Instruments Submittal:
1. Refer to the Instruments section for submittal requirements.

F. Hardware and Software Packages Submittal:
1. Refer to the sections below for specific Hardware and Software Packages submittal requirements:
   a. 13311 - PLC Hardware and Software.
   b. 13315 - HMI System Software.
   c. 13320 - Control and Data Network Equipment.
   d. 13321 - Fiber Optic Cabling and Equipment.
   e. 13330 - Control Panels and Panel Mounted Equipment.
2. For each hardware and software packages component specified in the sections above, submit a cover page that lists, at a minimum, 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.
3. The purpose of this submittal is to review the control panel and wiring diagrams. This could be combined with other submittals like the "Hardware and Software Submittal" if project is small enough.

G. Panel Layout Drawings and Wiring Diagrams Submittal:
1. Refer to the Control Panels section for submittal requirements.

H. Testing Plan Submittals:
1. Refer to Section 13302 - Testing for specific testing submittal requirements.

I. Training Plan Submittals:
1. Refer to Section 13303 for specific training requirements.

J. Spares, Expendables, and Test Equipment Lists Submittal:
1. Submit a list of, and descriptive literature for, spares, expendables, and test equipment.
2. Submit a list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the manufacturer.
3. Submit unit and total costs for the additional spare items specified or recommended for each subsystem.

K. Operations and Maintenance (O&M) Manuals:

1. Submit in accordance with Section 01300.
2. Furnish O&M manuals as specified herein. If the PCSS is performing the AE work, provide AE Manuals as specified in Section 13306.
3. The operations and maintenance manuals shall, at a minimum, contain the following information:
    a. Table of Contents:
        i. A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.
    b. Instrument and Equipment Lists:
        i. The following lists shall be developed in Microsoft Excel format and provided not only as a hardcopy in O&M but also electronically on a CD.
        ii. An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
        iii. An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial 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:
        i. ISA-TR20.00.01-2001(updated in 2004-2006) data sheets shall be provided 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.
        ii. Vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project, or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages that do not apply at all to the specific model supplied shall be removed.
        iii. Provide the record documentation of the system audit as specified in Section 13302 - Testing.
        iv. Include the calibration forms developed as specified in Section 13302 - Testing.
    d. As-Built Drawings:
        i. Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS.
        ii. As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.
    e. Original Licensed Software:
        i. Submit original software diskettes or CD-ROMs of 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. All software provided under this Contract shall be licensed to the Owner at the time of purchase. Provide media in software sleeves within O&M manual.

f. Electronic O&M Information:
   i. 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 CDROM or DVD. Electronic documents shall be supplied in Adobe Acrobat format.
   ii. Provide electronic files for all custom-developed manuals including training manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.
   iii. Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
   iv. Each computer system hardware device shall be backed up onto CDROM or DVD after Substantial Completion and shall be turned over to the Owner.
   v. If specified in the training section, provide digital copies of all training videos. Videos shall be in a format that is readable by standard DVD players and by standard PC DVD drives. Format shall be a minimum of 800 by 600 pixels and shall include sound.

4. The cover and edge of each volume shall contain the information as specified in Section [01340].

1.4 COORDINATION MEETINGS

A. Schedule the mandatory coordination meetings as described herein. The meetings shall be held at the Owner's designated location and shall include attendance by the Owner, the Engineer, the Contractor, the PCSS's Project Engineer, and the AESS Project Engineer, if applicable. Other Division 13 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Meeting shall be scheduled a minimum of one week before the requested meeting date.
   1. A project kickoff coordination meeting shall be held within two weeks after submitting the Project Plan. The purpose of the meeting shall be 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.
   2. A submittal review coordination meeting shall be held 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 shall be 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.
   3. Regular on-site meetings when the PCSS staff is at the plant site.

1.5 REFERENCE STANDARDS

A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.

B. International Society of Automation (ISA):
   1. ISA S5.2, Binary Logic Diagrams for Process Operations.
   2. ISA S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
   3. ISA S5.4, Instrument Loop Diagrams.
   4. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

5. ISA RP60.3, Human Engineering for Control Centers.
6. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers.
7. ISA-99, Industrial Automation and Control Systems Security.

C. National Electrical Manufacturers Association (NEMA).

D. National Fire Protection Agency (NFPA):
1. NFPA 70, National Electrical Code (NEC).
2. NFPA 79, Industrial Control Equipment.

E. Underwriters Laboratories, Inc. (UL):
1. UL 508 - Industrial Control Equipment - for custom fabricated equipment.
2. A nationally recognized testing laboratory, as approved by the Authority having jurisdiction, may substitute for UL listing on commercial off the shelf products.

1.6 QUALITY ASSURANCE

A. The Process Control System Supplier (PCSS) shall be a "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" shall be interpreted to mean an organization that complies with all of the following criteria:
1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall 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 shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be 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.

B. The PCSS shall maintain a permanent, fully staffed and equipped service facility within 200 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled start up to two months after startup completion.

C. PCSS shall hold a valid UL-508 certification for their panel fabrication facility.

D. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.

E. The selected PCSS shall be one of the following:
1. Prime Controls
2. Ace Controls
3. Texas Industrial Controls Manufacturing (TCIM)
4. ControlPanels USA
5. Weimar Manufacturing

6. or equal. If not listed, the contractor is required to submit the qualifications submittal for consideration.

F. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage, and handling shall be in accordance with Section [01600].

B. Shipping Precautions:
1. After completion of shop assembly, factory test and approval of all equipment, cabinets, panels and consoles shall be packed in protective crates and enclosed in heavy duty (5 mil) polyethylene envelopes or secured sheeting to provide protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.
2. Manufacturer's special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.
3. None of the HMI control and monitoring equipment shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity. Have qualified personnel accept the equipment on delivery and supervise unloading within the control room areas.
4. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the Owner.

1.8 NOMENCLATURE AND IDENTIFICATION

A. Field Instrument Tags:
1. See Section 13340.

B. Panel Nameplates:
1. See Section 13330.

1.9 WARRANTY

A. Provide warranty per Warranties and Bonds, and as specified herein.

1.10 MAINTENANCE CONTRACT

A. A written proposal for a maintenance contract executed by the PCSS shall be provided to the Owner for on-site preventive maintenance services related to the Instrumentation and Control system. The cost of this maintenance contract shall not be included in the Contract Price.

B. This proposal shall be provided within 30 days after final acceptance for the purpose of entering a contract for annual maintenance subsequent to the first year of maintenance. Standard per diem rates for providing breakdown service shall be set forth in the contract. Such rates shall be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted shall be firm for a minimum of 90 days from date of issue.

C. This maintenance contract shall include all labor, parts, and emergency calls providing on-site response within 24 hours, to provide complete system maintenance for a period of one year after the date of Substantial Completion of the system for all equipment and software provided as part of the PCSS scope of work.

D. Provide software updates throughout the maintenance contract period. Provide latest official released version for all software provided under this Contract. Owner shall have the latest software releases at the end of the maintenance contract period.

E. The maintenance contract shall also include a minimum of 4 preventive maintenance visits by qualified service personnel of the Supplier who is familiar with the type of equipment provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning and lubrication of system equipment and verification of correct operation.

F. Visits to the sites to correct deficiencies under warranty shall not be included in this preventive maintenance service contract.

G. Emergency maintenance procedures or plant visits may coincide with a preventive maintenance visit, however, they shall not replace the work intended to be performed during a preventive maintenance visit. The Supplier shall have full responsibility for the system hardware preventive and corrective maintenance.

H. During the one-year maintenance period, observation of maintenance operations by plant personnel and the instruction of said personnel in the details of the maintenance work being performed, shall be provided.

1.11 PROJECT/SITE REQUIREMENTS

A. Environmental Requirements. Refer to Section [16000] and Electrical Drawings for specific environmental and hazardous area classifications.

B. Elevation: Equipment shall be designed to operate at the project ground elevation.

C. Temperature:
1. Outdoor areas' equipment shall operate between -30 to 50 C degrees ambient.
2. Equipment located in indoor locations shall operate between 10 to 35 C degrees ambient minimum.
3. Storage temperatures shall range from 0 to 50 C degrees ambient minimum.
4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.

D. Relative Humidity. Air conditioned area equipment shall operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between 5 to 100 percent relative, condensing humidity.

PART 2 – PRODUCTS

2.1 GENERAL

A. All instrumentation and electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture and fungus. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.

B. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either

hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X on the Drawings or as defined under Division 16. Provide minimum size anchor of 3/8-inch.

C. All indicators shall be linear in process units, unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.

D. All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

E. All electronic/digital equipment shall be provided with radio frequency interference protection.

F. Electrical:
1. Equipment shall operate 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 shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
2. With the exception for field device network connected devices, all electronic instrumentation shall utilize 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, shall 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 shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.
5. Switches and/or signals indicating an alarm, failure or upset condition shall be wired in a fail-safe manner. A fail-safe condition is an open circuit when in an alarm state.
6. Materials and equipment shall be UL approved whenever such approved equipment and materials are available.
7. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory, and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.

2.2 ELECTRICAL SURGE PROTECTION

A. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20µs impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground.

B. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate NEMA 4X stainless steel enclosure (plastic is not acceptable) or conduit mounted, and shall be Phoenix Contact PT Series, MTL Surge Technologies (Telematic) TP48, Citel TSP-10 series, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an

instrument is acceptable. Protection devices in control panels shall be MTL Surge Technologies (Telematic) SD Series, Phoenix Contact PT Series, Citel DLA series, or equal.

C. Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment. Surge arresters shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, Citel DS40 series, or equal.

D. Non-Fiber Based Data Highway or Communications Circuits - Provide protection on all communication and data highway circuits that leave a building or are routed external to a building. Circuit protection shall be provided at both ends of the line. Surge protection devices shall be Phoenix Contact PlugTrab Series, Transtector FSP Series, MTL Surge Technologies (Telematic) NP Series, Citel DLA series or MJ8 series, or equal.

E. RF Coaxial Cable - Provide protection on communication cables between radios and antennas, mounted either inside the panel, or in the wall of the enclosure in accordance with NEMA and UL standards. Surge protection devices shall be Citel P8AX series, Polyphaser, or equal.

F. Inductive Loads - Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.

G. Telephone Circuits - At a minimum, provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.

2.3 SPARE PARTS

A. All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's contact information (address and phone number), part name, part number, part ordering information, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Owner or Engineer.

B. Furnish one of each type of installed Surge protection devices.

C. Other spare parts are specified in each section. An overview follows:
1. Devices within Control Panels - See the control panels section.
2. Computer Hardware and Software spare parts - See the Computer System Hardware section.
3. PLC spare parts - See the PLC section.
4. Network and Communications System - See the Control and Data Network Equipment section.
5. Instrument related Spare Parts - see the Instrument section(s).

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with manufacturer instructions. The indicated locations of equipment, transmitters, alarms and similar devices indicated are approximate only. Exact locations of all devices shall be as approved by the Engineer during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of interference with other work, proceed as

directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the Owner.

B. Provide brackets and hangers required for mounting of equipment.

C. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.

D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. Provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. Certify that field wiring associated with the equipment is installed in accordance with best industry practice. Coordinate work under this Section with that of the electrical work specified under applicable sections of Division 16.

E. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare and ultraviolet exposure on digital readouts.

3.2 TESTING

A. Refer to Section 13302.

3.3 TRAINING

A. Refer to Section 13303.

3.4 PROCESS CONTROLLER INPUT/OUTPUT (I/O) SCHEDULE

A. See attachment 13300A.

END OF SECTION

APPENDIX 13300-A

CONTROL SYSTEM INPUT/OUTPUT (I/O) SCHEDULE

This I/O Schedule is included for reference only. The determination of the exact number and type of I/O points shall be the responsibility of the PCSS based on the Drawings, the Specifications, Process Control Loop Descriptions (Section [13341]), auxiliary device requirements, and spare requirements.

Lift Station PLC Panel (CP-02-001)

Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
02	LIT-02-001 Lift Station Wet Well Level	AI	-	-	-	476.75	ft.	-	-	LOW/HIGH	From Ultrasonic Transducer
02	SP-02-101 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From H-O-A Switch
02	SP-02-101 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From H-O-A Switch
02	SP-02-101 Seal Fail Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Pump Protection Module
02	SP-02-101 Over Temp Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Pump Protection Module
02	SP-02-101 Overload Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From MCC - Motor Starter
02	SP-02-101 Running	DI	-	-	-	-	-	OFF	RUNNING	-	From MCC - Motor Starter
02	SP-02-201 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From H-O-A Switch
02	SP-02-201 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From H-O-A Switch
02	SP-02-201 Seal Fail Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Pump Protection Module
02	SP-02-201 Over Temp Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Pump Protection Module
02	SP-02-201 Overload Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From MCC - Motor Starter
02	SP-02-201 Running	DI	-	-	-	-	-	OFF	RUNNING	-	From MCC - Motor Starter
02	SP-02-301 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From H-O-A Switch
02	SP-02-301 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From H-O-A Switch
02	SP-02-301 Seal Fail Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Pump Protection Module
02	SP-02-301 Over Temp Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Pump Protection Module
02	SP-02-301 Overload Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From MCC - Motor Starter
02	SP-02-301 Running	DI	-	-	-	-	-	OFF	RUNNING	-	From MCC - Motor Starter
02	SP-02-401 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From H-O-A Switch
02	SP-02-401 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From H-O-A Switch
02	SP-02-401 Seal Fail Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Pump Protection Module
02	SP-02-401 Over Temp Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Pump Protection Module
02	SP-02-401 Overload Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From MCC - Motor Starter
02	SP-02-401 Running	DI	-	-	-	-	-	OFF	RUNNING	-	From MCC - Motor Starter
02	CP-02-001 Lift Station Wet Well High Level Alarm	DI	-	-	-	476.75	ft.	NORMAL	FAILURE	HIGH	From Float Switch System
02	CP-02-001 Lift Station Wet Well Low Level Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	LOW	From Float Switch System
02	CP-02-001 Pumps On Backup Control	DI	-	-	-	-	-	OFF	ON	BACKUP	From Existing Lift Station Local Panel
02	LSH-04-001 Peak High Level	DI	-	-	-	-	-	NORMAL	HIGH	HIGH	From Peak Shaving Basin Control Panel (CP-04-001)
02	LSL-02-001 Low Float (All Pumps Off)	DI	-	-	-	-	-	NORMAL	LOW	LOW	From Existing Lift Station Local Panel
02	LS-02-001 Lead Float	DI	-	-	-	-	-	NORMAL	CALL	-	From Existing Lift Station Local Panel
02	LS-02-001 Lag 1 Float	DI	-	-	-	-	-	NORMAL	CALL	-	From Existing Lift Station Local Panel
02	LS-02-001 Lag 2 Float (Peak Shaving)	DI	-	-	-	-	-	NORMAL	CALL	-	From Existing Lift Station Local Panel
02	LS-02-001 Lag 3 Float	DI	-	-	-	-	-	NORMAL	CALL	-	From Existing Lift Station Local Panel
02	LSH-02-001 High Float (Transducer Fail)	DI	-	-	-	-	-	NORMAL	HIGH	HIGH	From Existing Lift Station Local Panel
02	CP-02-001 Phase Fail	DI	-	-	-	-	-	FAILURE	NORMAL	OFF	From Existing Lift Station Local Panel
02	CP-02-001 Control Power Fail	DI	-	-	-	-	-	FAILURE	NORMAL	OFF	From Existing Lift Station Local Panel
02	CP-02-001 Common Spare Peak Shaving Basin Selector Switch Status	DI	-	-	-	-	-	HEADWORKS	PEAK SHAVING	-	From Selector Switch
02	CP-02-001 Headworks/Peak Shaving Basin Valve Selector	DI	-	-	-	-	-	HEADWORKS	PEAK SHAVING	-	From CR77
02	CP-02-001 PLC Fail (Watchdog)	DO	-	-	-	-	-	FAILURE	NORMAL	OFF	To Existing Lift Station Local Panel
02	SP-02-101 Call	DO	-	-	-	-	-	OFF	CALL	-	To Existing Lift Station Control Panel
02	SP-02-201 Call	DO	-	-	-	-	-	OFF	CALL	-	To Existing Lift Station Control Panel
02	SP-02-301 Call	DO	-	-	-	-	-	OFF	CALL	-	To Existing Lift Station Control Panel
02	SP-02-401 Call	DO	-	-	-	-	-	OFF	CALL	-	To Existing Lift Station Control Panel
02	SP-02-101 Fail	DO	-	-	-	-	-	NORMAL	FAILURE	ON	To SCADA
02	SP-02-201 Fail	DO	-	-	-	-	-	NORMAL	FAILURE	ON	To SCADA
02	SP-02-301 Fail	DO	-	-	-	-	-	NORMAL	FAILURE	ON	To SCADA
02	SP-02-401 Fail	DO	-	-	-	-	-	NORMAL	FAILURE	ON	To SCADA

Secondary Headworks Control Panels (CP-03-001, CP-03-002)

Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
03	MFS-03-101 Upstream Level	AI	-	-	-	-	in.	-	-	HIGH	From CP-03-002, To Level Transmitter (LIT-03-101)
03	MFS-03-101 Downstream Level	AI	-	-	-	-	in.	-	-	HIGH	From CP-03-002, To Level Transmitter (LIT-03-101)
03	MFS-03-301 Upstream Level	AI	-	-	-	-	in.	-	-	HIGH	From CP-03-001, To Level Transmitter (LIT-03-302)
03	MFS-03-301 Downstream Level	AI	-	-	-	-	in.	-	-	HIGH	From CP-03-001, To Level Transmitter (LIT-03-302)
03	CP-03-001 Control Panel Power	DI	-	-	-	-	-	FAILURE	NORMAL	OFF	From CP-03-001
03	CP-03-001 Phase Fail	DI	-	-	-	-	-	FAILURE	NORMAL	OFF	From CP-03-001
03	CP-03-001 System Reset	DI	-	-	-	-	-	FAILURE	RESET	-	From CP-03-001
03	CP-03-002 Control Panel Power	DI	-	-	-	-	-	FAILURE	NORMAL	OFF	From CP-03-002
03	CP-03-002 Phase Fail	DI	-	-	-	-	-	FAILURE	NORMAL	OFF	From CP-03-002
03	CP-03-002 System Reset	DI	-	-	-	-	-	FAILURE	RESET	-	From CP-03-002
03	LSH-03-001 Headworks High Level Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	HIGH	From Level Switch (LSH-03-001)
03	LSH-03-301 Headworks High Level Alarm	DI	-	-	-	-	-	NORMAL	FAILURE	HIGH	From Level Switch (LSH-03-301)
03	MFS-03-101 Screen/Brush in HAND	DI	-	-	-	-	-	OFF	HAND	-	From CP-03-001 H-O-A Switch HS-03-101
03	MFS-03-101 Screen/Brush in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From CP-03-001 H-O-A Switch HS-03-101
03	MFS-03-101 Screen Running	DI	-	-	-	-	-	OFF	RUNNING	-	From CP-03-001
03	MFS-03-101 Brush Running	DI	-	-	-	-	-	OFF	RUNNING	-	From CP-03-001
03	MFS-03-101 Screen Fail	DI	-	-	-	-	-	NORMAL	FAIL	ON	From CP-03-001
03	MFS-03-101 Brush Fail	DI	-	-	-	-	-	NORMAL	FAIL	ON	From CP-03-001
03	MFS-03-101 Screen Spray in HAND	DI	-	-	-	-	-	OFF	HAND	-	From CP-03-001
03	MFS-03-101 Screen Spray in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From CP-03-001
03	MFS-03-301 Screen/Brush in HAND	DI	-	-	-	-	-	OFF	HAND	-	From CP-03-002 H-O-A Switch HS-03-301B
03	MFS-03-301 Screen/Brush in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From CP-03-002 H-O-A Switch HS-03-301B
03	MFS-03-301 Screen Running	DI	-	-	-	-	-	OFF	RUNNING	-	From CP-03-002
03	MFS-03-301 Brush Running	DI	-	-	-	-	-	OFF	RUNNING	-	From CP-03-002
03	MFS-03-301 Screen Fail	DI	-	-	-	-	-	NORMAL	FAIL	ON	From CP-03-002
03	MFS-03-301 Brush Fail	DI	-	-	-	-	-	NORMAL	FAIL	ON	From CP-03-002
03	MFS-03-301 Screen Spray in HAND	DI	-	-	-	-	-	OFF	HAND	-	From CP-03-002
03	MFS-03-301 Screen Spray in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From CP-03-002
03	VMP-03-001 Booster Pump in HAND	DI	-	-	-	-	-	NORMAL	HAND	-	From CP-03-001 H-O-A Switch HS-03-001D
03	VMP-03-001 Booster Pump in AUTO	DI	-	-	-	-	-	NORMAL	AUTO	-	From CP-03-001 H-O-A Switch HS-03-001D
03	VMP-03-001 Booster Pump Running	DI	-	-	-	-	-	OFF	RUNNING	-	From CP-03-001
03	VMP-03-001 Booster Pump Fail	DI	-	-	-	-	-	NORMAL	FAIL	ON	From CP-03-001
03	WC-03-101 Compactor in HAND	DI	-	-	-	-	-	OFF	HAND	-	From CP-03-001 H-O-A Switch HS-03-001B
03	WC-03-101 Compactor in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From CP-03-001 H-O-A Switch HS-03-001B
03	WC-03-101 Compactor in FWD	DI	-	-	-	-	-	OFF	FORWARD	-	From CP-03-001
03	WC-03-101 Compactor in REV	DI	-	-	-	-	-	OFF	REVERSE	-	From CP-03-001
03	WC-03-101 Compactor Running	DI	-	-	-	-	-	OFF	RUNNING	-	From CP-03-001
03	WC-03-001 Compactor Fail	DI	-	-	-	-	-	NORMAL	FAIL	ON	From CP-03-001
03	WC-03-101 Comp Spray in HAND	DI	-	-	-	-	-	OFF	HAND	-	From CP-03-001
03	WC-03-101 Comp Spray in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From CP-03-001
03	WC-03-001 E-Stop Switch	DI	-	-	-	-	-	NORMAL	E-STOP	ESTOP	From E-Stop Switch (PB-03-001)
03	MFS-03-101 E-Stop Switch	DI	-	-	-	-	-	NORMAL	E-STOP	ESTOP	From E-Stop Switch (PB-03-101)
03	MFS-03-101 E-Stop Switch	DI	-	-	-	-	-	NORMAL	E-STOP	ESTOP	From E-Stop Switch (PB-03-101A)
03	MFS-03-301 E-Stop Switch	DI	-	-	-	-	-	NORMAL	E-STOP	ESTOP	From E-Stop Switch (PB-03-301)
03	MFS-03-101 Screen/Brush Call	DO	-	-	-	-	-	OFF	CALLED	-	From CP-03-001
03	MFS-03-301 Screen/Brush Call	DO	-	-	-	-	-	OFF	CALLED	-	From CP-03-001
03	MFS-03-301 Screen Spray Call to Open	DO	-	-	-	-	-	CLOSE	OPEN	-	From CP-03-002
03	VMP-03-001 Booster Pump Call	DO	-	-	-	-	-	OFF	CALL	-	From CP-03-001
03	WC-03-101 Compactor Call FWD	DO	-	-	-	-	-	OFF	CALL FWD	-	From CP-03-001
03	WC-03-101 Compactor Call REV	DO	-	-	-	-	-	OFF	CALL REV	-	From CP-03-001
03	WC-03-301 Comp Spray Call to Open	DO	-	-	-	-	-	CLOSE	OPEN	-	From CP-03-002
03	SV-03-101 Solenoid Valve No. 1 Open/Close	DO	-	-	-	-	-	CLOSE	OPEN	-	CP-03-001, To Solenoid Valve No. 1 (SV-03-101)
03	SV-03-001 Solenoid Valve No. 1 Open/Close	DO	-	-	-	-	-	CLOSE	OPEN	-	CP-03-002, To Solenoid Valve No. 1 (SV-03-001)
03	SV-03-302 Solenoid Valve No. 2 Open/Close	DO	-	-	-	-	-	CLOSE	OPEN	-	CP-03-002, To Solenoid Valve No. 2 (SV-03-302)

Perforated Plate Screen Control Panels are vendor provided. The PCSS shall coordinate with the vendor for additional I/O tags and IP addresses.

Peak Shaving Basin Control Panel (CP-04-001)											
Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
04	CP-04-001 Control Power Fail	DI	-	-	-	-	-	FAILURE	NORMAL	OFF	From CP-04-001 Control Power Relay
04	CP-04-001 Phase Fail	DI	-	-	-	-	-	FAILURE	NORMAL	OFF	From CP-04-001 Phase Fail Relay
04	CP-04-001 Pumps on Backup	DI	-	-	-	-	-	PRIMARY	BACKUP	BACKUP	From CP-04-001 Backup Control Relay
04	CP-04-001 System Reset	DI	-	-	-	-	-	FAILURE	RESET	-	To CP-04-001 Reset Relay
04	LSL-04-001 Peak Shaving Basin Low Level	DI	-	-	-	-	-	NORMAL	LOW	LOW	From Low Level Float Switch
04	SPP-04-101 Running	DI	-	-	-	-	-	OFF	RUNNING	-	From CP-04-001 Motor Starter Aux
04	SPP-04-101 Overload	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From CP-04-001 Motor Starter OL
04	SPP-04-101 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From CP-04-001, HS-04-101 H-O-A Switch
04	SPP-04-101 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From CP-04-001, HS-04-101 H-O-A Switch
04	SPP-04-201 Running	DI	-	-	-	-	-	OFF	RUNNING	-	From CP-04-001 Motor Starter Aux
04	SPP-04-201 Overload	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From CP-04-001 Motor Starter OL
04	SPP-04-201 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From CP-04-001, HS-04-201 H-O-A Switch
04	SPP-04-201 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From CP-04-001, HS-04-201 H-O-A Switch
04	SPP-04-301 Running	DI	-	-	-	-	-	OFF	RUNNING	-	From CP-04-001 Motor Starter Aux
04	SPP-04-301 Overload	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From CP-04-001 Motor Starter OL
04	SPP-04-301 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From CP-04-001, HS-04-301 H-O-A Switch
04	SPP-04-301 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From CP-04-001, HS-04-301 H-O-A Switch
04	CP-04-001 PLC Fail (Watchdog)	DO	-	-	-	-	-	FAILURE	NORMAL	OFF	From PLC -04-001
04	SPP-04-101 Call	DO	-	-	-	-	-	OFF	CALL	-	To CP-04-001 Motor Starter Coil
04	SPP-04-201 Call	DO	-	-	-	-	-	OFF	CALL	-	To CP-04-001 Motor Starter Coil
04	SPP-04-301 Call	DO	-	-	-	-	-	OFF	CALL	-	To CP-04-001 Motor Starter Coil

Aeration Basin to Central Plant PLC (CP-12-001)											
Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
05	FIT-05-101 RAS Air Lift Flow	AI	-	-	-	-	SCFM	-	-	LOW/HIGH	From Train No. 1 RAS Air Lift Flow No. 1
05	FIT-05-102 RAS Air Lift Flow	AI	-	-	-	-	SCFM	-	-	LOW/HIGH	From Train No. 1 RAS Air Lift Flow No. 2
05	FIT-05-201 RAS Air Lift Flow	AI	-	-	-	-	SCFM	-	-	LOW/HIGH	From Train No. 2 RAS Air Lift Flow No. 1
05	FIT-05-202 RAS Air Lift Flow	AI	-	-	-	-	SCFM	-	-	LOW/HIGH	From Train No. 2 RAS Air Lift Flow No. 2
05	FIT-05-301 RAS Air Lift Flow	AI	-	-	-	-	SCFM	-	-	LOW/HIGH	From Train No. 3 RAS Air Lift Flow No. 1
05	FIT-05-302 RAS Air Lift Flow	AI	-	-	-	-	SCFM	-	-	LOW/HIGH	From Train No. 3 RAS Air Lift Flow No. 2
05	AIT-05-101 Analytic Transmitter	AI	-	-	-	-	-	-	-	LOW/HIGH	From Train No. 1 Analalytic Transmitter
05	AE-05-101 Dissolved Oxygen Probe	-	-	-	-	-	mg/L	-	-		
05	AE-05-102 Mixed Liquor Suspended Solids Probe	-	-	-	-	-	mg/L	-	-		
05	AIT-05-201 Analytic Transmitter	AI	-	-	-	-	-	-	-	LOW/HIGH	From Train No. 2 Analalytic Transmitter
05	AE-05-201 Dissolved Oxygen Probe	-	-	-	-	-	mg/L	-	-		
05	AE-05-202 Mixed Liquor Suspended Solids Probe	-	-	-	-	-	mg/L	-	-		
05	AIT-05-301 Analytic Transmitter	AI	-	-	-	-	-	-	-	LOW/HIGH	From Train No. 3 Analalytic Transmitter
05	AE-05-301 Dissolved Oxygen Probe	-	-	-	-	-	mg/L	-	-		
05	AE-05-302 Mixed Liquor Suspended Solids Probe	-	-	-	-	-	mg/L	-	-		
05											
05											
05											
05											
05											
05											

Clarifier No. 3 Control Panel (CP-06-301) to Central Plant PLC (CP-12-101)									
Area Code	Description	Type	Low Limit	High Limit	Engr Unit	Off State	On State	ALarm State	Comments
06	CP-06-101 Control Power Fail	DI	-	-	-	NORMAL	FAILURE	OFF	From CP-06-101 Control Power Fail Relay
06	CP-06-101 Phase Fail	DI	-	-	-	NORMAL	FAILURE	OFF	From CP-06-101 Phase Fail Relay
06	SC-06-101 Running	DI	-	-	-	OFF	RUNNING	OFF	From CP-06-101 Motor Starter Aux
06	SC-06-101 Shear Pin Fail Shutdown	DI	-	-	-	NORMAL	FAILURE	ON	From SC-06-101 Torque Limit Sensor
06	SC-06-101 High Torque Alarm	DI	-	-	-	NORMAL	FAILURE	ON	From SC-06-101 Torque Limit Sensor
06	SC-06-101 High Torque Shutdown	DI	-	-	-	NORMAL	FAILURE	ON	From SC-06-101 Torque Limit Sensor
06	SC-06-101 Motor Overload	DI	-	-	-	NORMAL	FAILURE	ON	From CP-06-101 Motor Starter OL
06	SC-06-101 Motor Protection Relay	DI	-	-	-	NORMAL	FAILURE	ON	From CP-06-101 Motor Protection Relay
06	CP-06-201 Control Power Fail	DI	-	-	-	NORMAL	FAILURE	OFF	From CP-06-201 Control Power Fail Relay
06	CP-06-201 Phase Fail	DI	-	-	-	NORMAL	FAILURE	OFF	From CP-06-201 Phase Fail Relay
06	SC-06-201 Running	DI	-	-	-	OFF	RUNNING	OFF	From CP-06-201 Motor Starter Aux
06	SC-06-201 Shear Pin Fail Shutdown	DI	-	-	-	NORMAL	FAILURE	ON	From SC-06-201 Torque Limit Sensor
06	SC-06-201 High Torque Alarm	DI	-	-	-	NORMAL	FAILURE	ON	From SC-06-201 Torque Limit Sensor
06	SC-06-201 High Torque Shutdown	DI	-	-	-	NORMAL	FAILURE	ON	From SC-06-201 Torque Limit Sensor
06	SC-06-201 Motor Overload	DI	-	-	-	NORMAL	FAILURE	ON	From CP-06-201 Motor Starter OL
06	SC-06-201 Motor Protection Relay	DI	-	-	-	NORMAL	FAILURE	ON	From CP-06-201 Motor Protection Relay
06	CP-06-301 Control Power Fail	DI	-	-	-	NORMAL	FAILURE	OFF	From CP-06-301 Control Power Fail Relay
06	CP-06-301 Phase Fail	DI	-	-	-	NORMAL	FAILURE	OFF	From CP-06-301 Phase Fail Relay
06	SC-06-301 Running	DI	-	-	-	OFF	RUNNING	OFF	From CP-06-301 Motor Starter Aux
06	SC-06-301 Shear Pin Fail Shutdown	DI	-	-	-	NORMAL	FAILURE	ON	From SC-06-301 Torque Limit Sensor
06	SC-06-301 High Torque Alarm	DI	-	-	-	NORMAL	FAILURE	ON	From SC-06-301 Torque Limit Sensor
06	SC-06-301 High Torque Shutdown	DI	-	-	-	NORMAL	FAILURE	ON	From SC-06-301 Torque Limit Sensor
06	SC-06-301 Motor Overload	DI	-	-	-	NORMAL	FAILURE	ON	From CP-06-301 Motor Starter OL
06	SC-06-301 Motor Protection Relay	DI	-	-	-	NORMAL	FAILURE	ON	From CP-06-301 Motor Protection Relay

Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
Tertiary Filter Basin No. 1 Control Panel (CP-07-001)											
07	AIT-07-101 Analytic Transmitter	AI					NTU	-	-		Basin No. 1 Turbidity Level
07	FIT-07-101 Flow	AI					GPM	-	-		Basin No. 1 Backwash System Flow
07	LE-07-101 Level Sensor	AI					ft.	-	-		Basin No. 1 Tank Level
07	PIT-07-101 Pressure	AI					PSIA	-	-		Basin No. 1 Backwash Pump No. 1 Suction Vaccum Pressure
07	PIT-07-102 Pressure	AI					PSIA	-	-		Basin No. 1 Backwash Pump No. 1 Discharge Vacuum Sensor
07	PIT-07-103 Pressure	AI					PSIA	-	-		Basin No. 1 Backwash Pump No. 2 Suction Vacuum Pressure
07	PIT-07-104 Pressure	AI					PSIA	-	-		Basin No. 1 Backwash Pump No. 2 Discharge Vacuum Pressure
07	PSH-07-101 High Pressure Alarm	AI					PSIA	-	-		Basin No. 1 Turbidimeter Pump No. High Discharge Pressure
07	SPP-07-101 Speed Command	AO			-	-	Hz	-	-	-	Basin No. 1 Backwash/Waste Pump No. 1 Speed Command
07	SPP-07-102 Speed Command	AO			-	-	Hz	-	-	-	Basin No. 1 Backwash/Waste Pump No. 2 Speed Command
07	CP-07-101 Control Power On	DI	-	-	-	-	-	FAILURE	NORMAL	OFF	Basin No. 1 Control Power Okay
07	CP-07-101 Phase Fail	DI	-	-	-	-	-	FAILURE	NORMAL	OFF	Basin No. 1 Phase Fail Relay
07	DF-07-101 in Hand	DI	-	-	-	-	-	OFF	HAND	-	Basin No. 1 in Hand
07	DF-07-101 in Auto	DI	-	-	-	-	-	OFF	AUTO	-	Basin No. 1 in Auto
07	DF-07-101 Running	DI	-	-	-	-	-	STOPPED	RUNNING	-	Basin No. 1 Status
07	DF-07-101 Fail	DI						NORMAL	FAILURE	ON	Basin No. 1 Fault Status
07	SPP-07-101 in Hand	DI	-	-	-	-	-	OFF	HAND	-	Basin No. 1 Backwash Pump No. 1 in Hand
07	SPP-07-101 in Auto	DI	-	-	-	-	-	OFF	AUTO	-	Basin No. 1 Backwash Pump No. 1 in Auto
07	SPP-07-101 Running	DI	-	-	-	-	-	STOPPED	RUNNING	-	Basin No. 1 Backwash Pump No. 1 Status
07	SPP-07-101 Fail	DI						NORMAL	FAILURE	ON	Basin No. 1 Backwash Pump No. 1 Fault Status
07	SPP-07-102 in Hand	DI	-	-	-	-	-	OFF	HAND	-	Basin No. 1 Backwash Pump No. 2 in Hand
07	SPP-07-102 in Auto	DI	-	-	-	-	-	OFF	AUTO	-	Basin No. 1 Backwash Pump No. 2 in Auto
07	SPP-07-102 Running	DI	-	-	-	-	-	STOPPED	RUNNING	-	Basin No. 1 Backwash Pump No. 2 Status
07	SPP-07-102 Fail	DI						NORMAL	FAILURE	ON	Basin No. 1 Backwash Pump No. 2 Fault Status
07	LSH-07-101 High Level Alarm	DI	-	-	-	-	-	NORMAL	HIGH	HIGH	Basin No. 1 High Level Alarm
07	BV-07-101 Open Status	DI	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Solids Waste Valve No. 2
07	BV-07-101 Close Status	DI	-	-	-	-	-	OPEN	CLOSED	-	Basin No. 1 Backwash Solids Waste Valve No. 2
07	BV-07-102 Open Status	DI	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Crossover Valve
07	BV-07-102 Close Status	DI	-	-	-	-	-	OPEN	CLOSED	-	Basin No. 1 Backwash Crossover Valve
07	BV-07-103 Open Status	DI	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Valve No. 2
07	BV-07-103 Close Status	DI	-	-	-	-	-	OPEN	CLOSED	-	Basin No. 1 Backwash Valve No. 2
07	BV-07-104 Open Status	DI	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Valve No. 1
07	BV-07-104 Close Status	DI	-	-	-	-	-	OPEN	CLOSED	-	Basin No. 1 Backwash Valve No. 1
07	BV-07-105 Open Status	DI	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Solids Waste Valve No. 1
07	BV-07-105 Close Status	DI	-	-	-	-	-	OPEN	CLOSED	-	Basin No. 1 Backwash Solids Waste Valve No. 1
07	BV-07-106 Open Status	DI	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Pump No. 1 Suction Valve
07	BV-07-106 Close Status	DI	-	-	-	-	-	OPEN	CLOSED	-	Basin No. 1 Backwash Pump No. 1 Suction Valve
07	BV-07-107 Open Status	DI	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Pump No. 1 Discharge Valve
07	BV-07-107 Close Status	DI	-	-	-	-	-	OPEN	CLOSED	-	Basin No. 1 Backwash Pump No. 1 Discharge Valve
07	BV-07-109 Open Status	DI	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Pump No. 2 Suction Valve
07	BV-07-109 Close Status	DI	-	-	-	-	-	OPEN	CLOSED	-	Basin No. 1 Backwash Pump No. 2 Suction Valve
07	BV-07-110 Open Status	DI	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Pump No. 2 Discharge Valve
07	BV-07-110 Close Status	DI	-	-	-	-	-	OPEN	CLOSED	-	Basin No. 1 Backwash Pump No. 2 Discharge Valve
07	BV-07-120 Open Status	DI	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Valve No. 3
07	BV-07-120 Close Status	DI	-	-	-	-	-	OPEN	CLOSED	-	Basin No. 1 Backwash Valve No. 3
07	CP-07-101 PLC Fail (Watchdog)	DO	-	-	-	-	-	FAILURE	NORMAL	OFF	Basin No. 1 PLC Okay
07	DF-07-101 Call	DO	-	-	-	-	-	OFF	CALL	-	Basin No. 1 Call to Run
07	SPP-07-101 Call	DO	-	-	-	-	-	OFF	CALL	-	Basin No. 1 Backwash Pump No. 1 Call to Run
07	SPP-07-102 Call	DO	-	-	-	-	-	OFF	CALL	-	Basin No. 1 Backwash Pump No. 2 Call to Run
07	BV-07-101 Open/Close	DO	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Solids Waste Valve No. 2
07	BV-07-102 Open/Close	DO	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Crossover Valve
07	BV-07-103 Open/Close	DO	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Valve No. 2
07	BV-07-104 Open/Close	DO	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Valve No. 1
07	BV-07-105 Open/Close	DO	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Solids Waste Valve No. 1
07	BV-07-106 Open/Close	DO	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Pump No. 1 Suction Valve
07	BV-07-107 Open/Close	DO	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Pump No. 1 Discharge Valve
07	BV-07-109 Open/Close	DO	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Pump No. 2 Suction Valve
07	BV-07-110 Open/Close	DO	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Pump No. 2 Discharge Valve
07	BV-07-120 Open/Close	DO	-	-	-	-	-	CLOSED	OPEN	-	Basin No. 1 Backwash Valve No. 3
Tertiary Filter Basin No. 2 Control Panel (CP-07-002)											
07	AIT-07-201 Analytic Transmitter	AI					NTU	-	-		Basin No. 2 Turbidity Level
07	FIT-07-201 Flow	AI					GPM	-	-		Basin No. 2 Backwash System Flow
07	LE-07-201 Level Sensor	AI					ft.	-	-		Basin No. 2 Tank Level
07	PIT-07-201 Pressure	AI					PSIA	-	-		Basin No. 2 Backwash Pump No. 1 Suction Vaccum Pressure
07	PIT-07-202 Pressure	AI					PSIA	-	-		Basin No. 2 Backwash Pump No. 1 Discharge Vacuum Sensor
07	PIT-07-203 Pressure	AI					PSIA	-	-		Basin No. 2 Backwash Pump No. 2 Suction Vacuum Pressure
07	PIT-07-204 Pressure	AI					PSIA	-	-		Basin No. 2 Backwash Pump No. 2 Discharge Vacuum Pressure
07	PSH-07-201 High Pressure Alarm	AI					PSIA	-	-		Basin No. 2 turbidimeter Pump No. High Discharge Pressure
07	SPP-07-201 Speed Command	AO					Hz	-	-	-	Basin No. 2 Backwash/Waste Pump No. 1 Speed Command
07	SPP-07-202 Speed Command	AO					Hz	-	-	-	Basin No. 2 Backwash/Waste Pump No. 2 Speed Command
07	CP-07-201 Control Power On	DI	-	-			-	FAILURE	NORMAL	OFF	Basin No. 2 Control Power Okay
07	CP-07-201 Phase Fail	DI	-	-			-	FAILURE	NORMAL	OFF	Basin No. 2 Phase Fail Relay
07	DF-07-201 in Hand	DI	-	-			-	OFF	HAND	-	Basin No. 2 in Hand
07	DF-07-201 in Auto	DI	-	-			-	OFF	AUTO	-	Basin No. 2 in Auto
07	DF-07-201 Running	DI	-	-			-	STOPPED	RUNNING	-	Basin No. 2 Status
07	DF-07-201 Fail	DI						NORMAL	FAILURE	ON	Basin No. 2 Fault Status
07	SPP-07-201 in Hand	DI	-	-			-	OFF	HAND	-	Basin No. 2 Backwash Pump No. 1 in Hand
07	SPP-07-201 in Auto	DI	-	-			-	OFF	AUTO	-	Basin No. 2 Backwash Pump No. 1 in Auto
07	SPP-07-201 Running	DI	-	-			-	STOPPED	RUNNING	-	Basin No. 2 Backwash Pump No. 1 Status
07	SPP-07-201 Fail	DI						NORMAL	FAILURE	ON	Basin No. 2 Backwash Pump No. 1 Fault Status
07	SPP-07-202 in Hand	DI	-	-			-	OFF	HAND	-	Basin No. 2 Backwash Pump No. 2 in Hand
07	SPP-07-202 in Auto	DI	-	-			-	OFF	AUTO	-	Basin No. 2 Backwash Pump No. 2 in Auto
07	SPP-07-202 Running	DI	-	-			-	STOPPED	RUNNING	-	Basin No. 2 Backwash Pump No. 2 Status
07	SPP-07-202 Fail	DI						NORMAL	FAILURE	ON	Basin No. 2 Backwash Pump No. 2 Fault Status
07	LSH-07-201 High Level Alarm	DI	-	-			-	NORMAL	HIGH	HIGH	Basin No. 2 High Level Alarm
07	BV-07-201 Open Status	DI	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Solids Waste Valve No. 2
07	BV-07-201 Close Status	DI	-	-			-	OPEN	CLOSED	-	Basin No. 2 Backwash Solids Waste Valve No. 2
07	BV-07-202 Open Status	DI	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Crossover Valve
07	BV-07-202 Close Status	DI	-	-			-	OPEN	CLOSED	-	Basin No. 2 Backwash Crossover Valve
07	BV-07-203 Open Status	DI	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Valve No. 2
07	BV-07-203 Close Status	DI	-	-			-	OPEN	CLOSED	-	Basin No. 2 Backwash Valve No. 2
07	BV-07-204 Open Status	DI	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Valve No. 1
07	BV-07-204 Close Status	DI	-	-			-	OPEN	CLOSED	-	Basin No. 2 Backwash Valve No. 1
07	BV-07-205 Open Status	DI	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Solids Waste Valve No. 1
07	BV-07-205 Close Status	DI	-	-			-	OPEN	CLOSED	-	Basin No. 2 Backwash Solids Waste Valve No. 1
07	BV-07-206 Open Status	DI	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Pump No. 1 Suction Valve
07	BV-07-206 Close Status	DI	-	-			-	OPEN	CLOSED	-	Basin No. 2 Backwash Pump No. 1 Suction Valve
07	BV-07-207 Open Status	DI	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Pump No. 1 Discharge Valve
07	BV-07-207 Close Status	DI	-	-			-	OPEN	CLOSED	-	Basin No. 2 Backwash Pump No. 1 Discharge Valve
07	BV-07-209 Open Status	DI	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Pump No. 2 Suction Valve
07	BV-07-209 Close Status	DI	-	-			-	OPEN	CLOSED	-	Basin No. 2 Backwash Pump No. 2 Suction Valve
07	BV-07-210 Open Status	DI	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Pump No. 2 Discharge Valve
07	BV-07-210 Close Status	DI	-	-			-	OPEN	CLOSED	-	Basin No. 2 Backwash Pump No. 2 Discharge Valve
07	BV-07-220 Open Status	DI	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Valve No. 3
07	BV-07-220 Close Status	DI	-	-			-	OPEN	CLOSED	-	Basin No. 2 Backwash Valve No. 3
07	CP-07-201 PLC Fail (Watchdog)	DO	-	-			-	FAILURE	NORMAL	OFF	Basin No. 2 PLC Okay
07	DF-07-201 Call	DO	-	-			-	OFF	CALL	-	Basin No. 2 Call to Run
07	SPP-07-201 Call	DO	-	-			-	OFF	CALL	-	Basin No. 2 Backwash Pump No. 1 Call to Run

07	SPP-07-202 Call	DO	-	-			-	OFF	CALL	-	Basin No. 2 Backwash Pump No. 2 Call to Run
07	BV-07-201 Open/Close	DO	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Solids Waste Valve No. 2
07	BV-07-202 Open/Close	DO	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Crossover Valve
07	BV-07-203 Open/Close	DO	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Valve No. 2
07	BV-07-204 Open/Close	DO	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Valve No. 1
07	BV-07-205 Open/Close	DO	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Solids Waste Valve No. 1
07	BV-07-206 Open/Close	DO	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Pump No. 1 Suction Valve
07	BV-07-207 Open/Close	DO	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Pump No. 1 Discharge Valve
07	BV-07-209 Open/Close	DO	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Pump No. 2 Suction Valve
07	BV-07-210 Open/Close	DO	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Pump No. 2 Discharge Valve
07	BV-07-220 Open/Close	DO	-	-			-	CLOSED	OPEN	-	Basin No. 2 Backwash Valve No. 3

Sodium Hypochlorite Mixer Control Panel No. 1 (CP-08-101) to Central Plant PLC (CP-12-001)									
Area Code	Description	Type	Low Limit	High Limit	Engr Unit	Off State	On State	Alarm State	Comments
08	CP-08-101 Control Power Fail	DI	-	-	-	FAILURE	NORMAL	OFF	From CP-08-101 Control Power Relay
08	CP-08-101 Phase Fail	DI	-	-	-	FAILURE	NORMAL	OFF	From CP-08-101 Phase Fail Relay
08	SM-08-101 Running	DI	-	-	-	OFF	RUNNING	OFF	From CP-08-101 Motor Starter Aux
08	SM-08-101 Seal Fail	DI	-	-	-	NORMAL	FAILURE	ON	From CP-08-101 Motor Protection Relay
08	SM-08-101 Motor Overload	DI	-	-	-	NORMAL	FAILURE	ON	From CP-08-101 Motor Starter OL
08	SM-08-101 in HAND	DI	-	-	-	NORMAL	FAILURE	-	From CP-08-101 H-O-A Switch
08	SM-08-101 in AUTO	DI	-	-	-	NORMAL	FAILURE	-	From CP-08-101 H-O-A Switch
08	SM-08-102 Running	DI	-	-	-	OFF	RUNNING	OFF	From CP-08-101 Motor Starter Aux
08	SM-08-102 Seal Fail	DI	-	-	-	NORMAL	FAILURE	ON	From CP-08-101 Motor Protection Relay
08	SM-08-102 Motor Overload	DI	-	-	-	NORMAL	FAILURE	ON	From CP-08-101 Motor Starter OL
08	SM-08-102 in HAND	DI	-	-	-	OFF	HAND	-	From CP-08-101 H-O-A Switch
08	SM-08-102 in AUTO	DI	-	-	-	OFF	AUTO	-	From CP-08-101 H-O-A Switch
08	SM-08-101 Call	DO				STOPPED	CALLED	-	To CP-08-101 HOA AUTO
08	SM-08-102 Call	DO	-	-	-	STOPPED	CALLED	-	To CP-08-101 HOA AUTO
Sodium Bisulfite Mixer Control Panel No. 2 (CP-08-201) to Central Plant PLC (CP-12-001)									
Area Code	Description	Type	Low Limit	High Limit	Engr Unit	Off State	On State	Alarm State	Comments
08	CP-08-201 Control Power Fail	DI	-	-	-	FAILURE	NORMAL	OFF	From CP-08-201 Control Power Relay
08	CP-08-201 Phase Fail	DI	-	-	-	FAILURE	NORMAL	OFF	From CP-08-201 Phase Fail Relay
08	SM-08-201 Running	DI	-	-	-	OFF	RUNNING	OFF	From CP-08-201 Motor Starter Aux
08	SM-08-201 Seal Fail	DI	-	-	-	NORMAL	FAILURE	ON	From CP-08-201 Motor Protection Relay
08	SM-08-201 Motor Overload	DI	-	-	-	NORMAL	FAILURE	ON	From CP-08-201 Motor Starter OL
08	SM-08-201 in HAND	DI	-	-	-	NORMAL	FAILURE	-	From CP-08-201 H-O-A Switch
08	SM-08-201 in AUTO	DI	-	-	-	NORMAL	FAILURE	-	From CP-08-201 H-O-A Switch
08	SM-08-202 Running	DI	-	-	-	OFF	RUNNING	OFF	From CP-08-201 Motor Starter Aux
08	SM-08-202 Seal Fail	DI	-	-	-	NORMAL	FAILURE	ON	From CP-08-201 Motor Protection Relay
08	SM-08-202 Motor Overload	DI	-	-	-	NORMAL	FAILURE	ON	From CP-08-201 Motor Starter OL
08	SM-08-202 in HAND	DI	-	-	-	OFF	HAND	-	From CP-08-201 H-O-A Switch
08	SM-08-202 in AUTO	DI	-	-	-	OFF	AUTO	-	From CP-08-201 H-O-A Switch
08	SM-08-201 Call	DO				STOPPED	CALLED	-	To CP-08-201 HOA AUTO
08	SM-08-202 Call	DO	-	-	-	STOPPED	CALLED	-	To CP-08-201 HOA AUTO
Automatic Sampler									
08	Auto Sampler General Fail Alarm	DI	-	-	-	NORMAL	FAILURE	ON	From Auto Sampler

MSB-09-101 to 601 to Central Plant PLC (CP-12-001), I/O Shown on MCC/SCADA (Typ. For all 6 Blowers)											
Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
09	MSB-09-101 Running	DI	-	-	-	-	-	OFF	RUNNING	-	
09	MSB-09-101 E-Stop Engaged	DI	-	-	-	-	-	NORMAL	ESTOP	ESTOP	From E-Stop Switch
09	MSB-09-101 SSRV Fail	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From MCC
09	MSB-09-101 Surge Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-101)
09	MSB-09-101 Overload Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-101)
09	MSB-09-101 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From H-O-A Switch
09	MSB-09-101 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From H-O-A Switch
09	MSB-09-201 Running	DI	-	-	-	-	-	OFF	RUNNING	-	
09	MSB-09-201 E-Stop Engaged	DI	-	-	-	-	-	NORMAL	ESTOP	ESTOP	From E-Stop Switch
09	MSB-09-201 SSRV Fail	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From MCC
09	MSB-09-201 Surge Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-201)
09	MSB-09-201 Overload Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-201)
09	MSB-09-201 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From H-O-A Switch
09	MSB-09-201 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From H-O-A Switch
09	MSB-09-301 Running	DI	-	-	-	-	-	OFF	RUNNING	-	
09	MSB-09-301 E-Stop Engaged	DI	-	-	-	-	-	NORMAL	ESTOP	ESTOP	From E-Stop Switch
09	MSB-09-301 SSRV Fail	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From MCC
09	MSB-09-301 Surge Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-301)
09	MSB-09-301 Overload Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-301)
09	MSB-09-301 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From H-O-A Switch
09	MSB-09-301 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From H-O-A Switch
09	MSB-09-401 Running	DI	-	-	-	-	-	OFF	RUNNING	-	
09	MSB-09-401 E-Stop Engaged	DI	-	-	-	-	-	NORMAL	ESTOP	ESTOP	From E-Stop Switch
09	MSB-09-401 SSRV Fail	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From MCC
09	MSB-09-401 Surge Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-401)
09	MSB-09-401 Overload Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-401)
09	MSB-09-401 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From H-O-A Switch
09	MSB-09-401 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From H-O-A Switch
09	MSB-09-501 Running	DI	-	-	-	-	-	OFF	RUNNING	-	
09	MSB-09-501 E-Stop Engaged	DI	-	-	-	-	-	NORMAL	ESTOP	ESTOP	From E-Stop Switch
09	MSB-09-501 SSRV Fail	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From MCC
09	MSB-09-501 Surge Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-501)
09	MSB-09-501 Overload Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-501)
09	MSB-09-501 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From H-O-A Switch
09	MSB-09-501 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From H-O-A Switch
09	MSB-09-601 Running	DI	-	-	-	-	-	OFF	RUNNING	-	
09	MSB-09-601 E-Stop Engaged	DI	-	-	-	-	-	NORMAL	ESTOP	ESTOP	From E-Stop Switch
09	MSB-09-601 SSRV Fail	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From MCC
09	MSB-09-601 Surge Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-601)
09	MSB-09-601 Overload Shutdown	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From Local Blower Panel (MSB-09-601)
09	MSB-09-601 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From H-O-A Switch
09	MSB-09-601 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From H-O-A Switch
09	PSL-09-001 Blower Header Low Pressure No. 1	DI	-	-	-	-	PSIG	NORMAL	FAILURE	LOW	From Pressure Switch (PSL-09-001)
09	PSL-09-002 Blower Header Low Pressure No. 2	DI	-	-	-	-	PSIG	NORMAL	FAILURE	LOW	From Pressure Switch (PSL-09-002)
09	PSL-09-003 Blower Header Low Pressure No. 3	DI	-	-	-	-	PSIG	NORMAL	FAILURE	LOW	From Pressure Switch (PSL-09-003)

Blower Surge Panels are vendor provided. The PCSS shall coordinate with the vendor for additional I/O tags and IP addresses.

NPW Pumps Control Panel (CP-10-001) to Central Plant PLC (CP-12-001)											
Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
10	SPP-10-101 Speed Feedback	AI						-	-	-	
10	SPP-10-201 Speed Feedback	AI						-	-	-	
10	PIT-10-001 NPW System Pressure	AI	-	-			PSI	-	-	-	From Pressure Transmitter (PIT-10-001)
10	FIT-10-001 NPW System Flow	AI	-	-			GPM	-	-	-	From Flow Transmitter (FIT-10-001)
10	SPP-10-101 Speed Control Reference	AO						-	-	-	
10	SPP-10-201 Speed Control Reference	AO						-	-	-	
10	CP-10-001 Control Power Failure	DI	-	-			-	NORMAL	FAILURE		CP-10-001
10	SPP-10-101 in HAND	DI	-	-			-	OFF	HAND		From H-O-A Switch
10	SPP-10-101 in AUTO	DI	-	-			-	OFF	AUTO		From H-O-A Switch
10	SPP-10-101 Running	DI	-	-			-	OFF	RUNNING		
10	SPP-10-101 Overload Alarm	DI	-	-			-	NORMAL	FAILURE		
10	SPP-10-101 VFD Fail	DI	-	-			-	NORMAL	FAILURE		
10	SPP-10-201 in HAND	DI	-	-			-	OFF	HAND		From H-O-A Switch
10	SPP-10-201 in AUTO	DI	-	-			-	OFF	AUTO		From H-O-A Switch
10	SPP-10-201 Running	DI	-	-			-	OFF	RUNNING		
10	SPP-10-201 Overload Alarm	DI	-	-			-	NORMAL	FAILURE		
10	SPP-10-201 VFD Fail	DI	-	-			-	NORMAL	FAILURE		
10	PSL-10-001 NPW System Low Pressure Alarm	DI	-	-			-	NORMAL	LOW		From Pressure Switch (PS-10-001)
10	PSH-10-002 NPW System High Pressure Alarm	DI	-	-			-	NORMAL	HIGH		From Pressure Switch (PS-10-002)
10	LSL-08-001 Chlorine Contact Basin Low Level Lockout	DI	-	-			-	NORMAL	FAILURE		From Chlorine Contact Basin
10	LSL-08-001 Chlorine Contact Basin Low Level Lockout	DO	-	-			-	NORMAL	FAILURE		To NPW Booster Pumps
10	LSL-08-001 Chlorine Contact Basin Low Level Lockout	DO	-	-			-	NORMAL	FAILURE		To Dewatering NPW Pumps
10	SPP-10-101 Call	DO	-	-			-	-	-	-	CP-10-001
10	SPP-10-201 Call	DO	-	-			-	-	-	-	CP-10-002
10	CP-10-001 PLC Fail (Watchdog)	DO	-	-			-	-	-	-	CP-10-001

Chemical System PLC Panel (CP-11-001)

Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
11	FIT-08-001 Plant Effluent Flow	AI	-	-			GPM	-	-		From FIT-08-001
11	FIT-10-001 NPW Flow	AI	-	-			GPM	-	-		From FIT-10-001
11	PSP-11A-101 Feedback Rate	AI	-	-			GPH	-	-		From Peristaltic Pump PSP-11A-101
11	LIT-11A-101 Level	AI	-	-			Ft	-	-		
11	PSP-11A-201 Feedback Rate	AI	-	-			GPH	-	-		From Peristaltic Pump PSP-11A-201
11	LIT-11A-201 Level	AI	-	-			Ft	-	-		
11	PSP-11B-101 Feedback Rate	AI	-	-			GPH	-	-		From Peristaltic Pump PSP-11B-101
11	LIT-11B-101 Level	AI	-	-			Ft	-	-		From LIT-11B-101
11	PSP-11B-201 Feedback Rate	AI	-	-			GPH	-	-		From Peristaltic Pump PSP-11B-201
11	LIT-11B-201 Level	AI	-	-			Ft	-	-		From LIT-11B-101
11	LIT-11C-101 Level	AI	-	-			Ft	-	-		From LIT-11C-101
11	LIT-11C-201 Level	AI	-	-			Ft	-	-		From LIT-11C-201
11	LIT-11C-301 Level	AI	-	-			Ft				From LIT-11C-301
11	PSP-11C-101 Feedback Rate	AI	-	-			-	-	-		From Peristaltic Pump PSP-11C-101
11	PSP-11C-201 Feedback Rate	AI	-	-			-	-	-		From Peristaltic Pump PSP-11C-201
11	PSP-11C-301 Feedback Rate	AI	-	-			-	-	-		From Peristaltic Pump PSP-11C-301
11	PSP-11A-101 Flow Pacing Signal	AO	-	-			-	-	-		From CP-11-001, To PSP-11A-101
11	PSP-11A-201 Flow Pacing Signal	AO	-	-			-	-	-		From CP-11-001, To PSP-11A-201
11	PSP-11B-101 Flow Pacing Signal	AO	-	-			-	-	-		From CP-11-001, To PSP-11B-101
11	PSP-11B-201 Flow Pacing Signal	AO	-	-			-	-	-		From CP-11-001, To PSP-11B-201
11	PSP-11C-101 Flow Pacing Signal	AO	-	-			-	-	-		From CP-11-001, To PSP-11C-101
11	PSP-11C-201 Flow Pacing Signal	AO	-	-			-	-	-		From CP-11-001, To PSP-11C-201
11	PSP-11C-301 Flow Pacing Signal	AO	-	-			-	-	-		From CP-11-001, To PSP-11C-301
11	PSP-11A-101 Fail	DI	-	-			-	NORMAL	FAILURE		From Peristaltic Pump PSP-11A-102
11	PSP-11A-101 Low Pressure	DI	-	-			-	NORMAL	FAILURE		
11	PSP-11A-101 High Pressure	DI	-	-			-	NORMAL	FAILURE		
11	LIT-11A-101 Low Level Alarm	DI	-	-			-	NORMAL	FAILURE		
11	PSP-11A-201 Fail	DI	-	-			-	NORMAL	FAILURE		From Peristaltic Pump PSP-11A-202
11	PSP-11A-201 Low Pressure	DI	-	-			-	NORMAL	FAILURE		
11	PSP-11A-201 High Pressure	DI	-	-			-	NORMAL	FAILURE		
11	LIT-11A-201 Low Level Alarm	DI	-	-			-	NORMAL	FAILURE		
11	FS-11A-001 Emergency Eyewash Station	DI	-	-			-	NORMAL	FAILURE		From EWS-11A-001
11	LS-11A-001 Leak Detected	DI	-	-			-	NORMAL	FAILURE		From LS-11A-001
11	PSP-11B-101 Fail	DI	-	-			-	NORMAL	FAILURE		From Peristaltic Pump PSP-11B-102
11	PSP-11B-101 Low Pressure	DI	-	-			-	NORMAL	FAILURE		
11	PSP-11B-101 High Pressure	DI	-	-			-	NORMAL	FAILURE		
11	LIT-11B-101 Low Level Alarm	DI	-	-			-	NORMAL	FAILURE		From LIT-11B-101
11	PSP-11B-201 Fail	DI	-	-			-	NORMAL	FAILURE		From Peristaltic Pump PSP-11B-202
11	PSP-11B-201 Low Pressure	DI	-	-			-	NORMAL	FAILURE		
11	PSP-11B-201 High Pressure	DI	-	-			-	NORMAL	FAILURE		
11	LIT-11B-201 Low Level Alarm	DI	-	-			-	NORMAL	FAILURE		From LIT-11B-101
11	FS-11B-001 Emergency Eyewash Station	DI	-	-			-	NORMAL	FAILURE		From EWS-11B-001
11	LS-11B-001 Leak Detected	DI	-	-			-	NORMAL	FAILURE		From LS-11B-001
11	LIT-11C-101 Low Level Alarm	DI	-	-			-	NORMAL	FAILURE		From LIT-11C-101
11	LIT-11C-201 Low Level Alarm	DI	-	-			-	NORMAL	FAILURE		From LIT-11C-201
11	LIT-11C-301 Low Level Alarm	DI	-	-			-	NORMAL	FAILURE		From LIT-11C-301
11	PSP-11C-101 High Pressure	DI	-	-			-	NORMAL	FAILURE		From PSH-11C-101
11	PSP-11C-101 Fail	DI	-	-			-	NORMAL	FAILURE		From Peristaltic Pump PSP-11C-102
11	PSP-11C-201 High Pressure	DI	-	-			-	NORMAL	FAILURE		From PSH-11C-201
11	PSP-11C-201 Fail	DI	-	-			-	NORMAL	FAILURE		From Peristaltic Pump PSP-11C-202
11	PSP-11C-301 High Pressure	DI	-	-			-	NORMAL	FAILURE		From PSH-11C-301
11	PSP-11C-301 Fail	DI	-	-			-	NORMAL	FAILURE		From Peristaltic Pump PSP-11C-302
11	FS-11C-101 Emergency Eyewash Station	DI	-	-			-	NORMAL	FAILURE		From EWS-11C-101
11	LS-11C-001 Leak Detected	DI	-	-			-	NORMAL	FAILURE		From LS-11C-001
11	LS-11C-002 Leak Detected	DI	-	-			-	NORMAL	FAILURE		From LS-11C-002
11	PSP-11A-101 Start Command	DO	-	-			-	OFF	CALL		From Peristaltic Pump PSP-11A-103
11	PSP-11A-201 Start Command	DO	-	-			-	OFF	CALL		From Peristaltic Pump PSP-11A-203
11	PSP-11B-101 Start Command	DO	-	-			-	OFF	CALL		From Peristaltic Pump PSP-11B-103
11	PSP-11B-201 Start Command	DO	-	-			-	OFF	CALL		From Peristaltic Pump PSP-11B-203
11	PSP-11C-101 Start Command	DO	-	-			-	OFF	CALL		From Peristaltic Pump PSP-11C-103
11	PSP-11C-201 Start Command	DO	-	-			-	OFF	CALL		From Peristaltic Pump PSP-11C-203
11	PSP-11C-301 Start Command	DO	-	-			-	OFF	CALL		From Peristaltic Pump PSP-11C-303

Exhaust Fan Control Panel

Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
11	SFAN-11-01 Run Status	DI	-	-			-	OFF	CALL		
11	SFAN-11-02 Run Status	DI	-	-			-	OFF	CALL		
11	SFAN-11-01 Overload Fail	DI	-	-			-	OFF	OVERLOAD		
11	SFAN-11-02 Overload Fail	DI	-	-			-	OFF	OVERLOAD		

Peristaltic Pumps vendor provided. The PCSS shall coordinate with the vendor for additional I/O tags and IP addresses.

Sludge Holding Tanks to SCADA Panel IO

Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
13	Sludge Holding Tank Train No. 1 WAS Air Lift No. 1 Flow	AI	-	-			SCFM	-	-	-	
13	Sludge Holding Tank Train No. 1 WAS Air Lift No. 2 Flow	AI	-	-			SCFM	-	-		
13	Sludge Holding Tank Train No. 2 WAS Air Lift No. 1 Flow	AI	-	-			SCFM	-	-		
13	Sludge Holding Tank Train No. 2 WAS Air Lift No. 2 Flow	AI	-	-			SCFM	-	-		
13	Sludge Holding Tank Train No. 3 WAS Air Lift No. 1 Flow	AI	-	-			SCFM	-	-		
13	Sludge Holding Tank Train No. 3 WAS Air Lift No. 2 Flow	AI	-	-			SCFM	-	-		
13	SV-13-101 Air Lift Solenoid Valve No. 1 Open/Close Status	DI	-	-			-	CLOSE	OPEN		
13	SV-13-201 Air Lift Solenoid Valve No. 2 Open/Close Status	DI	-	-			-	CLOSE	OPEN		
13	SV-13-301 Air Lift Solenoid Valve No. 3 Open/Close Status	DI	-	-			-	CLOSE	OPEN		
13	LSH-13-001 Sludge Holding Tank High Level Alarm	DI	-	-			-	NORMAL	HIGH		From Level Switch (LSH-13-001)

Dewatering NPW Pumps Control Panel (CP-14B-001) to Volute Press Control Panel (CP-14D-101)

Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
14	Chlorine Contact Basin Low Level Lockout	DI	-	-			-	NORMAL	LOW	LOW	From CCB Level Switch (LSL-08-001)
14	CP-14B-001 Control Power On	DI	-	-			-	FAILURE	NORMAL	OFF	From CP-14B-001 Control Power Relay
14	CP-14B-001 Phase Fail	DI	-	-			-	FAILURE	NORMAL	OFF	From CP-14B-001 Phase Fail Relay
14	VMP-14B-101 Low Pressure	DI	-	-			-	NORMAL	LOW	LOW	From Pressure Switch (PS-14B-101)
14	VMP-14B-101 High Pressure	DI	-	-			-	NORMAL	HIGH	HIGH	From Pressure Switch (PS-14B-101)
14	VMP-14B-201 Low Pressure	DI	-	-			-	NORMAL	LOW	LOW	From Pressure Switch (PS-14B-201)
14	VMP-14B-201 High Pressure	DI	-	-			-	NORMAL	HIGH	HIGH	From Pressure Switch (PS-14B-201)
14	VMP-14B-101 in HAND	DI	-	-			-	OFF	HAND	-	From CP-14B-001 H-O-A Switch
14	VMP-14B-101 in AUTO	DI	-	-			-	OFF	AUTO	-	From CP-14B-001 H-O-A Switch
14	VMP-14B-101 Running	DI	-	-			-	OFF	RUNNING	-	From CP-14B-001 Motor Starter Aux
14	VMP-14B-101 Fail	DI	-	-			-	NORMAL	FAILURE	ON	From CP-14B-001 Fail Relay
14	VMP-14B-201 in HAND	DI	-	-			-	OFF	HAND	-	From CP-14B-001 H-O-A Switch
14	VMP-14B-201 in AUTO	DI	-	-			-	OFF	AUTO	-	From CP-14B-001 H-O-A Switch
14	VMP-14B-201 Running	DI	-	-			-	OFF	RUNNING	-	From CP-14B-001 Motor Starter Aux
14	VMP-14B-201 Fail	DI	-	-			-	NORMAL	FAILURE	ON	From CP-14B-001 Fail Relay

Polymer Blend Unit No. 1 Local Control Panel (PBU-14C-101) to Volute Press Control Panel (CP-14D-101)

Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
14	PBU-14C-101 Flow Pacing	AI	-	-			-	-	-		From CP-14D-001 to Polymer Blend Unit No. 1
14	PBU-14C-101 Call	DI	-	-			-	OFF	CALL		From CP-14D-001 to Polymer Blend Unit No. 1
14	PBU-14C-101 Low Pressure	DO	-	-			-	NORMAL	FAILURE		From CP-14D-001 to Polymer Blend Unit No. 1
14	PBU-14C-101 Low Flow	DO	-	-			-	NORMAL	FAILURE		From CP-14D-001 to Polymer Blend Unit No. 1

Polymer Blend Unit No. 2 Local Control Panel (PBU-14C-201) to Volute Press Control Panel (CP-14D-101)

Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
14	PBU-14C-201 Flow Pacing	AI	-	-			-	-	-		From CP-14D-001 to Polymer Blend Unit No. 2
14	PBU-14C-201 Call	DI	-	-			-	OFF	CALL		From CP-14D-001 to Polymer Blend Unit No. 2
14	PBU-14C-201 Low Pressure	DO	-	-			-	NORMAL	FAILURE		From CP-14D-001 to Polymer Blend Unit No. 2
14	PBU-14C-201 Low Flow	DO	-	-			-	NORMAL	FAILURE		From CP-14D-001 to Polymer Blend Unit No. 2

Volute Press Control Panel (CP-14D-101)

Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
14	LIT-14D-101 Level	AI	-	-			Ft	-	-		From Flocc Tank Level (LIT-14D-101)
14	FIT-14A-201 Sludge Flow	AI					GPM	-	-	LOW/HIGH	From FIT-14A-101 WAS Flow Meter
14	DDP-14A-101 Speed Feedback	AI	40	60	-	-	Hz	-	-		From CP-14D-001 VFD (DDP-14A-101)
14	DDP-14A-201 Speed Feedback	AI	40	60	-	-	Hz	-	-		From CP-14D-001 VFD (DDP-14A-201)
14	DDP-14A-101 Speed Command Reference	AO	40	60	-	-	Hz	-	-		To CP-14D-001 VFD (DDP-14A-101)
14	DDP-14A-201 Speed Command Reference	AO	40	60	-	-	Hz	-	-		To CP-14D-001 VFD (DDP-14A-201)
14	PBU-14C-101 Flow Pacing	AO	-	-			-	-	-		To Polymer Blend Unit No. 1 Control Panel
14	PBU-14C-201 Flow Pacing	AO	-	-			-	-	-		To Polymer Blend Unit No. 2 Control Panel
13	LSL-13-001 Sludge Holding Tank Low Level Cut-Off	DI	-	-	-	-	-	NORMAL	LOW	LOW	From Level Switch (LSL-13-001)
13	LSL-13-002 Sludge Holding Tank Low Level Cut-Off	DI	-	-	-	-	-	NORMAL	LOW	LOW	From Level Switch (LSL-13-002)
14	DDP-14A-101 Running	DI	-	-	-	-	-	OFF	RUNNING	-	From CP-14D-001 VFD (DDP-14A-101)
14	DDP-14A-101 VFD Fail	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From CP-14D-001 VFD (DDP-14A-101)
14	DDP-14A-101 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From CP-14A-001 H-O-A Switch
14	DDP-14A-101 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From CP-14A-001 H-O-A Switch
14	DDP-14A-201 Running	DI	-	-	-	-	-	OFF	RUNNING	-	From CP-14D-001 VFD (DDP-14A-201)
14	DDP-14A-201 VFD Fail	DI	-	-	-	-	-	NORMAL	FAILURE	ON	From CP-14D-001 VFD (DDP-14A-201)
14	DDP-14A-201 in HAND	DI	-	-	-	-	-	OFF	HAND	-	From CP-14A-001 H-O-A Switch
14	DDP-14A-201 in AUTO	DI	-	-	-	-	-	OFF	AUTO	-	From CP-14A-001 H-O-A Switch
14	PSL-14A-101 Press Feed Pump No. 1 Pressure Switch Low	DI	-	-	-	-	-	NORMAL	FAILURE	LOW	From Pressure Switch (PSL-14A-101)
14	PSH-14A-101 Press Feed Pump No. 1 Pressure Switch High	DI	-	-	-	-	-	NORMAL	FAILURE	HIGH	From Pressure Switch (PSH-14A-101)
14	PSL-14A-201 Press Feed Pump No. 1 Pressure Switch Low	DI	-	-	-	-	-	NORMAL	FAILURE	LOW	From Pressure Switch (PSL-14A-201)
14	PSH-14A-201 Press Feed Pump No. 1 Pressure Switch High	DI	-	-	-	-	-	NORMAL	FAILURE	HIGH	From Pressure Switch (PSH-14A-201)
14	CP-14D-001 Phase Fail	DI	-	-			-	FAILURE	NORMAL		From CP-14D-101 Phase Fail Relay
14	PBU-14C-101 Low Pressure	DI	-	-			-	NORMAL	FAILURE		To Polymer Blend Unit No. 1 Control Panel
14	PBU-14C-101 Low Flow	DI	-	-			-	NORMAL	FAILURE		To Polymer Blend Unit No. 1 Control Panel
14	PBU-14C-201 Low Pressure	DI	-	-			-	NORMAL	FAILURE		To Polymer Blend Unit No. 2 Control Panel
14	PBU-14C-201 Low Flow	DI	-	-			-	NORMAL	FAILURE		To Polymer Blend Unit No. 2 Control Panel
14	LSH-14D-101 Mixer Tank High Level	DI	-	-			-	NORMAL	FAILURE		From Flocc Tank Level Switch (LSH-14D-101)
14	SV-14D-101 Solenoid Valve No. 1 Open/Close	DI	-	-			-	CLOSE	OPEN		From Solenoid Valve No. 1 (SV-14D-101)
14	SV-14D-102 Solenoid Valve No. 2 Open/Close	DI	-	-			-	CLOSE	OPEN		From Solenoid Valve No. 2 (SV-14D-201)
14	SV-14D-103 Solenoid Valve No. 3 Open/Close	DI	-	-			-	CLOSE	OPEN		From Solenoid Valve No. 3 (SV-14D-301)
14	SV-14D-104 Solenoid Valve No. 4 Open/Close	DI	-	-			-	CLOSE	OPEN		From Solenoid Valve No. 4 (SV-14D-401)
14	SV-14D-105 Solenoid Valve No. 5 Open/Close	DI	-	-			-	CLOSE	OPEN		From Solenoid Valve No. 5 (SV-14D-501)
14	SV-14D-106 Solenoid Valve No. 6 Open/Close	DI	-	-			-	CLOSE	OPEN		From Solenoid Valve No. 6 (SV-14D-601)
14	VP-14D-101 Running	DI						OFF	RUNNING		From CP-14D-101 Volute Press VFD
14	VP-14D-101 Fail	DI						NORMAL	FAILURE		From CP-14D-101 Volute Press VFD
14	VP-14-101 Emergency Stop	DI	-	-			-	NORMAL	ESTOP	ESTOP	From CP-14D-101 E-Stop Switch
14	SCC-14D-101 Running	DI						OFF	RUNNING		From CP-14D-101 Horizontal Conveyor VFD
14	SCC-14D-101 Fail	DI						NORMAL	FAILURE		From CP-14D-101 Horizontal Conveyor VFD
14	SCC-14D-101 Emergency Stop	DI	-	-			-	NORMAL	ESTOP	ESTOP	From E-Stop Switch
14	SCC-14D-102 Running	DI						OFF	RUNNING		From CP-14D-101 Incline Conveyor VFD
14	SCC-14D-102 Fail	DI						NORMAL	FAILURE		From CP-14D-101 Incline Conveyor VFD
14	SCC-14D-102 Emergency Stop	DI	-	-			-	NORMAL	ESTOP	ESTOP	From E-Stop Switch
14	VMP-14B-101 Fail	DI	-	-			-	NORMAL	FAILURE		From CP-14B-001 Dewatering NPW Booster Fail
14	VMP-14B-201 Fail	DI	-	-			-	NORMAL	FAILURE		From CP-14B-001 Dewatering NPW Booster Fail
14	DDP-14A-101 Call	DO	-	-			-	OFF	CALL		To CP-14A-001 Dewatering Press Feed Pumps
14	DDP-14A-201 Call	DO	-	-			-	OFF	CALL		To CP-14A-001 Dewatering Press Feed Pumps
14	VMP-14B-101 Call	DO	-	-			-	OFF	CALL		To CP-14B-001 Dewatering NPW Booster Pumps
14	VMP-14B-201 Call	DO	-	-			-	OFF	CALL		To CP-14B-001 Dewatering NPW Booster Pumps
14	PBU-14C-101 Call	DO	-	-			-	OFF	CALL		To Polymer Blend Unit No. 1 Control Panel
14	PBU-14C-201 Call	DO	-	-			-	OFF	CALL		To Polymer Blend Unit No. 2 Control Panel

Exhaust Fan Control Panel to Volute Press Control Panel (CP-14D-101)

Area Code	Description	Type	Low Limit	High Limit	Low Alarm	High Alarm	Engr Unit	Off State	On State	Alarm State	Comments
14	SFAN-14-01 Run Status	DI	-	-			-	OFF	CALL		
14	SFAN-14-02 Run Status	DI	-	-			-	OFF	CALL		
14	SFAN-14-03 Run Status	DI	-	-			-	OFF	CALL		
14	SFAN-14-04 Run Status	DI	-	-			-	OFF	CALL		
14	SFAN-14-05 Run Status	DI	-	-			-	OFF	CALL		
14	SFAN-14-01 Overload	DI	-	-			-	OFF	OVERLOAD		
14	SFAN-14-02 Overload	DI	-	-			-	OFF	OVERLOAD		
14	SFAN-14-03 Overload	DI	-	-			-	OFF	OVERLOAD		
14	SFAN-14-04 Overload	DI	-	-			-	OFF	OVERLOAD		
14	SFAN-14-05 Overload	DI	-	-			-	OFF	OVERLOAD		

SECTION 13302
CONTROL SYSTEMS TESTING

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.

B. Refer to Section 13300 – Instrumentation and Controls – General Provisions for other general requirements.

1.2 RELATED WORK

A. Refer to Section 13300 – Instrumentation and Controls – General Provisions.

B. Refer to Section 01650 – Facility Start-Up.

1.3 SUBMITTALS

A. Refer to Section 13300 – Instrumentation and Controls – General Provisions.

B. Testing Submittals - Submit, in one submittal, the following testing related documents:
   1. Status sign-off 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.
         i. Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
         ii. Submit testing forms prior to start of testing.
   2. Testing Procedures:
      a. Submit detailed procedures proposed to be followed for each of the tests specified herein. The test procedures shall serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified.
      b. Documents shall be structured in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
      c. Test procedures shall indicate all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
      d. Test procedures shall be structured in a cause and effect manner where the inputs are indicated, and the outputs are recorded.
      e. Test procedures shall include the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
      f. Testing may not start 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 shall 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.

1.4 MAINTENANCE

A. Refer to Section 13300 – Instrumentation and Controls – General Provisions.

1.5 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 13300 – Instrumentation and Controls – General Provisions.

B. Results of all testing shall be tracked on a project specific status sign off form or similar document. PCSS shall be 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. Startup 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 shall coordinate all required testing with Contractor, affected Subcontractors, Engineer, and Owner.

F. No equipment shall be shipped 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. Deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to Owner.
   2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until specified requirements are met. This work shall be performed 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 should be part of any quality firm's internal QA/QC procedures.

B. Temporary network connections will be 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 shall include all control system devices shown on System Architecture drawings and provided by PCSS.

D. Tests to be performed shall include, but not be limited to, the following. Each of these tests shall be specifically addressed in Test Procedure submittal.

1. All panels and enclosures being provided shall 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 that all components have been staged for test and have been documented properly with correct model numbers, serial numbers, etc.. Following documentation of audit shall be provided at factory test and submitted 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. Panel wire pull tests shall be performed to ensure all wiring has been connected with appropriate torque to prevent wires from coming loose.
4. UPS shall be tested to verify UPS switch power correctly while keeping all UPS powered loads online. Testing of UPS to determine if they have been sized correctly to maintain specified run time shall be performed during field testing.
5. A 100 percent I/O point checkout shall be performed to verify proper operation of input/output points from panel terminations to HMI and OIT nodes. At a minimum, I/O checkout shall consist of four steps.
    a. Discrete input signals shall be jumpered at field terminal blocks in control panels to verify proper status in HMI and OIT nodes.
    b. Analog input signals shall be connected to a signal generator at field terminal blocks in control panels to verify proper status in HMI and OIT nodes and signals shall be verified at zero percent, 50 percent, and 100 percent of full scale.
    c. Discrete output signals shall be tested 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. Analog output signals shall be tested 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. All control strategies shall be verified 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, inspection shall include, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, key locks, etc.).
8. For each subpanel, inspection shall include, 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. Following systems tests shall be performed:
    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. UPS shall be removed 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 shall 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 shall 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 shall 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. System shall operate continuously throughout WFT without failure, except where initiated per established test procedures. Any unanticipated failures may, at Owner or Engineer's option, result in overall WFT being deemed unsuccessful. All deficiencies identified during these tests shall be corrected and re-tested prior to completing WFT or shipment of panels to jobsite as determined by Owner/Engineer.

D. Tests to be performed during the WFT shall include, but not to be limited to, the following:
   1. A repeat of all tests specified in the UFT.

E. Daily schedule during these tests shall 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 shall 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 will determine if equipment is ready for operation.

B. This test shall take place prior to FDT and startup. Prior to starting this test, relevant process equipment shall be installed and mechanically tested, instruments installed, control panels installed, and field wiring complete.

C. Required Documents for Test:
   1. Master copy of the PCSS developed field testing signoff 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. Any deficiencies found shall be corrected by PCSS prior to commencement of Functional Demonstration Test.

E. PCSS shall maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.

F. The following tests shall be performed 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 shall 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. This information shall be added to Instrument data sheet, shall be added to a copy of manufacturer's standard "Configuration Sheet", or a separate form shall be created.
         i. If a separate form, the form shall 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:
   i. For Discrete Devices: Actual trip points and reset points.
   ii. For Instruments: Any configuration or calibration settings entered into instrument.
   iii. For Controllers: Mode settings (PID).
   iv. 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 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 13300 – Instrumentation and Controls – 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, shall test signals under process conditions. Preferred test methods will always be to execute tests 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 simulation methods and make a note on sign-off form.
3. The following I/O tests shall be performed:
   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%, and 100% 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. Discrete output signals shall be tested 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. Analog output signals shall be tested 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. All automatic control strategies shall be verified 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 documents.

J. Repeat all systems tests specified under factory testing.

K. UPS shall be tested to verify UPS switch power correctly while keeping all UPS powered loads online. Also, test UPS sizing by switching off power to UPS and verify if they maintain specified run time.

L. For all panels with enclosures modified by this Contract, internal control panel temperature shall be tested under full running conditions to ensure proper cooling/ventilation is being provided.

M. Upon successful completion of ORT, PCSS shall 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, a Functional Demonstration Test shall be performed. 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. A witnessed FDT shall be performed on each process area. To extent possible, repeat testing performed during ORT.

D. Daily schedule specified to be followed during factory tests shall also be followed during FDT.

E. After coordinating with Operations, a "Black Start" of the plant shall be performed to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Separate tests shall be performed by recovering the plant while on generator (if a generator is specified) and while on utility power.

F. Punch list items and resolutions noted during test shall be documented on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS shall perform repairs, replacement, and/or retest within 10 days.

G. Upon successful completion of the FDT, PCSS shall submit a record copy of test results as specified in "Part 1 - General".

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, system shall undergo a test as defined in Section 01650 – Facility Start-Up.

B. While this test is proceeding, Engineer and Owner shall have full use of system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain responsibility of Owner and decision of plant operators regarding plant operations shall be final.

C. During this test, PCSS personnel shall 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 shall provide cell phone 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. Any malfunction during tests shall be analyzed and corrections made by PCSS. In event of rejection of any part or function, PCSS shall perform repairs or replacement within 5 days.

E. Throughout duration of SAT, no software or hardware modifications shall be made to system without prior approval from Owner or Engineer.

3.7 CERTIFICATE OF INSTALLATION

A. Following successful completion of SAT test, PCSS shall submit a Certification of Installation for system as required in Section 01650 – Facility Start-Up.

END OF SECTION

SECTION 13303
CONTROL SYSTEM TRAINING

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Furnish training as specified herein.

B. This Section covers the training requirements for all devices and systems furnished and installed as detailed on the Drawings.

C. Refer to Section [13300].

1.2 RELATED WORK

A. Refer to Section [13300].

1.3 SUBMITTALS

A. Refer to Section [13300] for general submittal requirements.

B. Preliminary Training Plan Submittal
   1. Prior to the preparation of the 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.

C. Final Training Plan Submittal
   1. Upon receipt of the Engineer's comments on the preliminary training plan, submit the specific proposed training plan. The training plan shall include:
      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. Training information shall be 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. The cost of the training programs shall be included in the Contract price. The training and instruction shall be directly related to the system being supplied. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.

B. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.

C. All onsite instructors must be intimately familiar with the operation and control of the Owner's facilities.

D. Provide detailed training manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project. The manuals shall be provided in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.

E. The trainer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, all training materials shall be delivered to Owner.

F. The Owner reserves the right to videotape all custom training sessions. All training tapes shall become the sole property of the Owner.

G. Cost of Travel for off-site training
1. Cost of Travel for off-site training shall be paid directly by the entity employing the staff doing the traveling.

3.2 TRAINING SUMMARY

A. The following training courses listed in the summary table shall, as a minimum, be provided:

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Manufacturer's Training				
Human Machine Interface (HMI) Basic	32	2	1	Administrator
Human Machine Interface (HMI) Advanced	32	2	1	Administrator
Historian	16	2	1	Administrator
Programmable Logic Controller (PLC) Basic	32	2	1	Maintenance, Administrator
Programmable Logic Controller (PLC) Advanced	32	2	1	Maintenance, Administrator
Onsite Training				
Control System Overview Seminar	Covered in AESS scope of work			
Operator Control System Training	Covered in AESS scope of work			
System Reports and Historian Implementation	Covered in AESS scope of work			
Installed Control System	2	2	1	Maintenance, Administrator
PLC Hardware/Software	2	2	1	Maintenance
Instrument manufacturer training - analyzers *(add a row for each specific instrument requiring manufacturer's training)*	4	2	1	Maintenance
Instruments	16	2	1	Maintenance
Instruments - Operator familiarity	2	8	1	Operations
Fiber Optics	4	2	1	Maintenance

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.

3.3 MANUFACTURER'S TRAINING

A. Human Machine Interface (HMI) Software
1. Provide manufacturer's standard training courses for Owner's personnel in the configuration, programming, and installation of the HMI software supplied. Conduct this course in separate beginner and advanced training sessions.
2. This training shall be conducted no more than two months before the Witnessed Factory Test (WFT).
3. The following training shall be provided as a minimum:
   a. Database generation.
   b. Display generation.
   c. Alarm system and configuration.
   d. Historical data system configuration.
   e. Report generation.
   f. Security system.
   g. Trending system.
   h. Remote communications.
   i. Software configuration.
   j. OLE applications.
   k. Test, adjustment, and calibration procedures.
   l. Troubleshooting and diagnosis.
4. Training shall 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.

B. Historian
1. Provide manufacturer's standard training courses for Owner's personnel in the configuration, programming, and installation of the Historian software supplied.
2. This training shall be conducted no more than one month before the Witnessed Factory Test (WFT).
3. The following training shall be provided as a minimum:
   a. Database generation and configuration.
   b. Trending system.
   c. Using data exporters
   d. Report generation.
   e. Troubleshooting and diagnosis.
   f. Managing historian Servers & data collectors
   g. Configuring clients
   h. Security
   i. Alarm and Event configuration and archiving
4. Training shall include classroom and hands-on instruction such that a student with experience in process instrumentation can configure the Historian with no guidance or with only minimal supervision when attempting complex problems.

C. Programmable Logic Controller (PLC) Hardware and Software
1. Provide manufacturer's standard training courses for the Owner's personnel in the operation, configuration, programming, installation, and maintenance of the PLC hardware and software supplied. Conduct this course in separate beginner and advanced training sessions.
2. The training shall be conducted no more than two months before the WFT.
3. The following hardware training shall be provided as a minimum:
   a. Hardware maintenance for the PLC equipment provided.
   b. Test, adjustment, and calibration procedures.
   c. Troubleshooting and diagnosis.
   d. Component removal and replacement.
   e. Periodic maintenance.
4. The following software training shall be provided as a minimum:
   a. System configuration.
   b. Application specific program development/programming.
   c. Uploading/downloading programs.
   d. Documenting program/configuration.
   e. System backups and reload procedures.
   f. TCP/IP addressing procedures.
   g. Network communications configuration.

3.4 ONSITE TRAINING

A. Training personnel shall be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel shall command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and shall be capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Installed Control System Training
1. Provide training for the Owner's personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. The training shall be held before the Functional Demonstrator Test (FDT), but not more than two months before.
2. Training and instruction shall be specific to the system that is being supplied.
3. Training shall consist of classroom instructions and hands-on instruction utilizing the Owner's system.
4. Detailed training shall be provided on the actual configuration and implementation for this Contract. Training shall cover all aspects of the system that will allow the Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. The training shall cover the following subjects, as a minimum:
   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 the Owner's personnel in the operation, maintenance, troubleshooting, etc. with the PLC hardware and software system. The training shall be held before the FDT, but not more than two months before.
2. Training and instruction shall be specific to the system that is being supplied.
3. Training shall consist of classroom instructions and hands-on instruction utilizing the Owner's system.

4. Detailed training shall be provided on the actual configuration and implementation for this Contract. Training shall cover all aspects of the PLC system that will allow the Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the PLC system. The training shall cover the following subjects, as a minimum:
   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. Manufacturer instrument training shall be provided for those instruments where specifically indicated in the Instruments section. This shall be on-site training provided by an authorized representative of the manufacturer. The manufacturer's representative shall be fully knowledgeable in the operation and maintenance of the equipment.

E. Instrument Training
1. Provide instruction on the maintenance of the field and panel instrumentation for the Owner's instrumentation technicians. This training shall be conducted before the FDT, but no more than 1 month before and at a time suitable to the Owner. This training shall take place at the Owner's facility. As a minimum the following shall be included:
   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. Test, adjustment, and calibration procedures.
   d. Troubleshooting and diagnosis.
   e. Periodic maintenance.

F. Instruments - Operator familiarity
1. Provide operator level instruction on the use of the field and panel instrumentation for the Owner's operations staff. This training shall be conducted before the 30 day site acceptance test, but no more than 1 month before and at a time suitable to the Owner. This training shall take place at the Owner's facility. Include hands on demonstration of the information each transmitter indicates and the method used to retrieve any operator information from the transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.

G. Fiber Optic Training
1. Provide instruction on the maintenance of the fiber optic system for the Owner's instrumentation technicians. This training shall be conducted before the FDT, but no more than 1 month before and at a time suitable to the Owner. This training shall take place at the Owner's facility. As a minimum the following shall be included:
   a. Fiber cable layout and basic of cable construction.
   b. Termination procedures
   c. "Jumper" installation
   d. Testing procedures.
   e. Troubleshooting and diagnosis.

END OF SECTION

SECTION 13306
APPLICATIONS ENGINEERING SERVICES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. If referred to anywhere else in the project manual, Application Engineering (AE) or Applications Engineering System Supplier (AESS) services are those services specified in this Section.

B. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system as specified herein. All equipment shall be controlled 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.
   1. Provide configuration of the PLC provided for all equipment shown on the drawings, except for controls equipment shown being provided as part of a vendor package system.
   2. Provide 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.
   3. Provide configuration of any alarm dialer(s) provided.
   4. Provide configuration of the SCADA Historian Software.
   5. Provide for and test communications and functionality 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.

C. All work shall be coordinated with plant operating personnel to minimize impacts on daily operation. Delays caused for any reason shall be noted and formally submitted to the Engineer and the Owner in the form of a letter.

1.2 RELATED WORK

A. Refer to Section 13300 “I & C - General Provisions.”

1.3 SUBMITTALS

A. Provide all required submittals in accordance with Section 01300. The submittals listed below shall be provided as a minimum;
   1. System Standards and Conventions
   2. Operator Interface
   3. Controller Program
   4. Reports
   5. Historical Data Management
   6. Software Maintenance documentation
   7. Operations and Maintenance Manuals

B. Supplement to Project Plan Submittal
   1. Supplement the "Project Plan, Deviation List, and Schedule" submittal in Section 13300 by adding the following items to the submittal requirements:
      a. List of all graphics intended to be created for this project.
      b. List of all PLC programs that will be created or modified for this project.

C. Supplement to Input/Output (I/O) List Submittal
1. Supplement the "Input/Output (I/O) List " submittal in Section 13300 by adding the following item to the submittal requirements:
a. LOGICAL POINT ADDRESS: I/O address of each point.

D. System Standards and Conventions Submittal
1. Following the standards and conventions workshop, submit the standards and conventions that will be used on this project. The submittal shall define, 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, the submitted standards and conventions shall be used as the basis for programming and configuration of the system. System programming and configuration shall not begin prior to the System Standards and Conventions Submittal.

E. 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 the 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 shall be no less than 8.5 inches by 11 inches and in full color.

F. 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 other controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Each logic segment shall be clearly presented, the function of each timer described, the purpose of each subroutine call labeled and defined, etc. Program documentation shall be sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal shall demonstrate 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. This report shall indicate total memory capacity and unused memory capacity.

c. Submit cross reference index of I/O allocation and controller memory address. Every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme shall be included.

2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit a HMI tag database showing all signals exchanged between the PLCs and HMI. Any specific communication block memory addresses shall be defined.

G. Reports

1. Following the Historical Workshop, submit all aspects of the reports generation system and shall include as a minimum the following:
   a. A complete list of all reports to be developed.
   b. A 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.

H. O&M Manuals - Software Maintenance Manuals

1. Include these manuals as part of Section 13300 "I&C General Provisions". This required information is in addition to all requirements of Section 13300.
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 in the CD 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. If available as part of the software provided, 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 CD-ROMs in original electronic format for all PLC, HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract. All changes made during or after testing, start-up, and commissioning shall be incorporated.

I. O&M Manuals - Operator Manuals

1. Provide Operator's Manuals prior to final acceptance of the system.
2. These manuals shall be separately bound and shall contain all information necessary for the operator to monitor and control the plant from the control system. The manuals shall be written in non-technical terms and shall be organized for quick access to each detailed description of the operator's procedure. Manuals shall contain, but not be limited to, 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 each piece of equipment.
   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 an individual component of the control system and also of the entire system.

e. Login / logout procedures.
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.
h. Operational description for operating HMI computer equipment and peripherals including printers, CD-ROMs, removable bulk storage devices, UPS, etc. Description shall include 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

3. Include these manuals as part of Section 13300 "I&C General Provisions". This required information is in addition to all requirements of Section 13300.

1.4 MAINTENANCE

A. Refer to Section 13300.

1.5 WARRANTY

A. Refer to Section 13300 and supplement that with the requirements below.

B. All application work shall be warranted in accordance with General Conditions of Agreement.

C. Provide telephone technical support within 4 hours of warranty claim. If failure cannot be resolved by telephone, provide onsite technical support within 24 hours of warranty claim.

1.6 COORDINATION MEETINGS AND WORKSHOPS

A. Refer to Section 13300. 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 shall be 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 a client workshop.

C. Schedule and conduct a draft graphics review meeting. The purpose of this meeting shall be 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 the factory test. Bring a working system to allow for a live demonstration of the graphics.

E. Schedule and conduct a historical data management and reports workshop. The purpose of this workshop shall be to discuss and solicit Engineer/Owner input for storage and management of historical data, format of daily, monthly and yearly reports, for the development of data entry templates, report formats and layouts, and user

interface displays for accessing and generating reports. Bring examples of all 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 the proposed tests and to provide a forum for coordinating the 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 the specifics of the proposed tests and to provide a forum for coordinating the required field-testing.

END OF SECTION

SECTION 13310
COMPUTER SYSTEM HARDWARE

PART 1 – GENERAL

A. Refer to Section 13300.

1.1 RELATED WORK

A. Section 13300 “Instrumentation and Controls - General Provisions.”

B. Section 13315 “HMI System Software.”

1.2 SUBMITTALS

A. Refer to Section 13300.

B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Spare parts list.

1.3 WARRANTY

A. Provide next day computer manufacturer on-site service for all computer system hardware devices covering parts and labor for 5 years from date of purchase. The on-site service is to be performed by an authorized representative of the manufacture of the installed equipment.

PART 2 – PRODUCTS

TECHNOLOGY OBSOLESCENCE MITIGATION

A. Refer to Section 13300.

B. Due to rapidly evolving technology of the equipment specified herein, the requirements specified are to establish a baseline for the type of equipment required. Provide the latest hardware and software of similar specification at the time of purchase equivalent in cost to that which is specified. The procedure for submitting and releasing the equipment shall be as follows:
   1. PCSS shall submit for approval the required data for the equipment as part of the Hardware submittal.
   2. Equipment shall be ordered 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. No equipment shall be ordered more than 3 months prior to when it is needed to be continuously used on the project.

2.2 Operator Tablet Interface

A. General:
1. PCSS shall supply at a minimum 4 rugged portable tablets that will provide an Ignition HMI interface of the entire plant process.
   a. This tablet shall connect to the virtual Cloud-based Ignition Server via a secure wireless internet connection.
   b. This tablet shall configured to only provide access to applications and programs required for plant operations.
2. Ruggedized table configured running Ignition, designed for harsh environments

B. Operating Temperature:
1. -20 ° F Minimum operating temperature
2. 145 ° F Maximum operating temperature

C. Certifications:
1. ANSI/ISA.12.12.01 (Class1, Division 2 Groups A, B, C, D) or equal
2. IEC 60529/IP65 (dust tight, protected against pressurized water)
3. MIL-STD-810G/H drop testing (blowing rain, blowing dust, blowing sand, vibration, functional shock, humidity, salt fog (with rubberized keyboard), altitude, explosive atmosphere, solar radiation, thermal extremes, thermal shock, freeze/thaw, tactical standby to operational)

D. Processor: Up to Intel Core Ultra Series 2 (Pro models) or 12th Gen Intel Core i3/i5/i7

E. Memory (RAM): Up to 32GB with a minimum of 16GB

F. Storage: Minimum 1 TB

G. Display: 10.1" to 12" FHD panels, high brightness (up to 1200+ nits), outdoor-readable, glove-touch capable.

H. Environmental: IP65/IP66 ratings for water/dust, MIL-STD 810H testing, drop-resistant.

I. Connectivity:
1. All network interfaces shall have the following features:
   a. Support for latest Microsoft operating system.
   b. Wi-Fi 6E/7, Bluetooth 5.2/5.4, optional 4G/5G LTE and GPS..

J. Operating System:
1. Windows 11 Professional (64-bit).

K. Other Software:
1. Microsoft Office Professional with the following programs at a minimum.
   a. Microsoft Excel.
   b. Microsoft Word.
   c. Microsoft PowerPoint.

L. Acceptable Manufacturers
1. Dell
2. Approved Equal.

2.3 SPARE PARTS

A. General requirements for spare parts are specified in Section 13300.

PART 3 – EXECUTION

3.1 GENERAL

A. Refer to Section 13300.

END OF SECTION

SECTION 13311
PLC HARDWARE AND SOFTWARE

PART 1 - GENERAL

1.1 SUMMARY

This section specifies the design, construction, and installation of a programmable logic controller (PLC) and accessories to be installed at each site. Installation of the PLC and accessories shall be completed by the accepted Control Panel Manufacturers.

1.2 RELATED WORK

A. Division 13 – Special Construction

B. Division 16 - Electrical

1.3 SUBMITTALS

A. Provide shop drawings and product data, including schematic piping and detailed installation instructions and drawings. Submit as specified in Division 1, General Requirements.

B. Provide I/O point list and wire tag list.

C. Furnish four (4) sets of operation and maintenance manuals containing all necessary drawings, instructions, and parts lists. These will be included in the project operation and maintenance manuals as described in Section 01300 – Submittals.

1.4 GUARANTEE

For a period of 12 months after final acceptance, the manufacturer shall warrant that the equipment shall be free of defects in material and workmanship under normal use and service when properly installed. The manufacturer shall repair or replace, F.O.B. point of shipment, such equipment or any part thereof furnished by the manufacturer which is found to be defective after inspection by the manufacturer.

1.5 QUALITY ASSURANCE

A. Provide all specified equipment of the latest and most modern design guaranteed by the manufacturer to meet the performance requirements as specified herein.

B. In case of specified equipment being discontinued within eighteen (18) months of submittal, notify and submit manufacturer suggested equivalent replacement.

C. Provide a qualified technical representative of the manufacturer to inspect the completed equipment installation, make all the adjustments necessary to place the equipment in trouble-free operation, and to instruct operating personnel in the proper care and operation of the equipment furnished.

1.6 ACCEPTABLE MANUFACTURERS

All specified equipment must be furnished by a single manufacturer or its agent. The purpose is to maintain unified responsibility of system components.

A. Provide PLC equipment as manufactured from the following acceptable manufacturers:
   1. Schneider Electric Modicon

1.7 ACCEPTABLE INTEGRATORS

A. The following is a list of acceptable Control Panel Manufacturers:
   1. Texas Industrial Control Manufacturing
   2. Prime Controls
   3. Weimar Manufacturing
   4. Ace Controls
   5. Macauley Controls
   6. Mercer Controls
   7. Waymire Systems Inc.
   8. Pre-approved Equal

1.8 PERFORMANCE AND DESIGN REQUIREMENTS

The PLC system shall accomplish the control requirements of the process control narratives, Drawings and Specification sections. PLC programming shall be documented and factory tested by the Contractor/Integrator.

PART 2 – PRODUCTS

2.1 COMPONENTS

PLC units shall be a complete and operating system including, but not limited to, the following components: PLC Central Processing Unit (CPU), PLC modules, chassis, power supply, connection bases, and connection cables.

A. Provide a PLC as listed in Specification 13330A with the following PLC components:
   1. PLC Central Processing Unit (CPU) with a minimum of one (1) Ethernet port.
      a. Modicon M340
   2. I/O Modules
      a. 24VDC I/O power supply module: Modicon M340 BMX CPS 2010
      b. Compact 8 channel analog input modules: Modicon M340 BMX AMI 0810
      c. Compact 16 channel digital DC input modules: Modicon M340 BMX DDI 1602
      d. Compact 8 channel analog output module: Modicon M340 BMX AMO 0800
      e. Compact 16 channel digital DC output module: Modicon M340 BMX DDO 1602
      f. Additonal as required to satisfy project IO requirements
      g. IO shall be supplied to provide 20% spare IO capacity for each type.
   3. Terminal Blocks: BMX FTB 2000; BMX FTB 2800
   4. Back Panel: BMX XBP 1200
   5. Empty Slot Covers: BMX XEM 010
   6. If required: Rack Expansion Kit BMXXBE2005: 2 BMXXBE1000 rack expansion modules, 1 BMXXBC008K extension cordset, and 1 TSXTLYEX line terminator (Set of 2)

7. Ethernet TCP/IP switch
   a. Schneider Electric Modicon Standard Unmanaged Switch MCSESU053F1CU0
   b. Or BMX NOC 0401
   c. Schneider Electric Modicon Managed Switch MCSESM053F1CS0 *(4 copper + 1 SM Fiber managed for remote access)*
8. Power Surge Protection on every component
   a. Combination lighting arrestor and transient voltage surge suppressor din rail mounted, Phoenix Contact Combotrab 2856702.
9. Real time clock (AM/PM)
10. Updateable EPROM
11. 64-bit processor
12. Contractor to provide required number of I/O plus 25% Spare I/O of each type; at minimum, 4 spare points of each type.
13. If the number of required I/O modules exceed single rack capacity, additional rack, power supply, rack extender modules, communication cables, and other necessary items shall be provided to have a complete and working system.
14. The PLC shall have a surge protection device installed prior to the UPS and located inside the Autosensory Panel. Surge protection device shall be Phoenix Contact SPF 1-14/120AC or pre-approved equal.
15. The PLC shall utilize a UPS with battery backup system. The UPS shall be designed for 150% of the required load and the battery shall be designed to back up the PLC for a minimum of 30 minutes.
16. Provide a "PLC Failure" alarm to be transmitted to the Cellular Autodialer.
17. PLC power supply shall not be used to power field devices. A separate power supply must be used for field devices.

B. Provide an HMI Panel as listed in Specification 13330A:
   1. HMI Panel
      a. HMI DT551 *(10")*, HMI DT651 *(12")*, HMI DT752 *(15.6")*
      b. HMI G3U *(outdoor);* HMI G5U2 *(more powerful)*
      c. Panel Mounted Industrial PC – Refer to Specification 13310

C. Provide the following spare parts:
   1. Spare Parts
      a. One (1) spare CPU
      b. One (1) spare I/O card of each type
      c. One (1) spare power supply

D. Provide PLCs and its associated hardware as required from the Drawings.
   1. PCSS shall supply all non-vendor PLCs as shown on the Drawings.

2.2 INPUT/OUTPUT

The PLC shall have the digital and analog I/O as shown on the contract drawings.

PART 3 – EXECUTION

3.1 PROGRAMMING

A. Contractor shall provide the following with the PLC submittal:
   1. PLC including display, I/O expansion cards, and power supply.
   2. Device Layout

3. Terminal Block I/O list.
4. AESS shall provide all software programming services.

3.2 INSTALLATION

A. Install the PLC as shown on the plans. Use stainless steel hardware and anchor bolts.

B. Connect the PLC to the appropriate input and output devices with appropriate wiring and conduits.

3.3 MANUFACTURER'S REPRESENTATIVE

A. Provide the services of a factory-trained representative of the manufacturer for installation and correction of any defects or malfunctions.

PART 4 – RECORD DOCUMENTS

4.1 PLC DOCUMENTATION

A. Provide the complete PLC program in digital format and all files required for programming the PLC.

B. Provide a bill of materials.

C. Provide a PDF file of all ladder logic.

END OF SECTION

SECTION 13315
HMI SYSTEM SOFTWARE

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Refer to Section [13300].

B. Furnish and install a Human Machine Interface (HMI) system as shown on the Drawings and as specified herein.

1.2 RELATED WORK.

A. Section [13300] “Instrumentation and Controls - General Provisions.”

B. Section [13310] “Computer System Hardware.”

1.3 SUBMITTALS

A. Refer to Section [13300].

B. Descriptive literature, bulletins, catalog cuts and drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Any deviation of the hardware or software systems from the preliminary submittal included in the Project Plan shall be described in detail.

E. Spare parts list.

1.4 WARRANTY

A. Refer to Section [13300].

1.5 MANUFACTURER SUPPORT

A. Provide a written proposal for a manufacturer support agreement for all products specified herein for a minimum of 12 months starting at final completion of the project. The cost of this manufacturer support agreement shall not be included in the Contract Price. The support agreement shall be executed in the name of, and for the benefit of, the Owner. At a minimum, this agreement shall provide the Owner with:
   1. 8 AM to 5 PM, 5 day per week manufacturer telephone support.
   2. Access to the manufacturer's technical support website.
   3. Software updates.

PART 2 – PRODUCTS

2.1 HUMAN MACHINE INTERFACE (HMI) SOFTWARE REQUIREMENTS

A. General Requirements:

1. HMI software shall be the latest version at time of project plan submittal of one of the following packages and shall be compatible with the operating system supplied with the computers:
    a. Ignition by Inductive Automation – Ultimate Package.
    b. No acceptable Alternative.
2. SCADA software shall be commercially available off-the shelf and shall be non-proprietary, such that independent systems integrators are able to provide configuration and maintenance services as required.
3. Software shall be a Client/Server architecture. No Microsoft Client Access Licenses (CAL) or Terminal Services shall be required for full installation (thick) or browser-based (thin) clients.
4. Software shall be developed in an environment certified to be in compliance with IEC 62443 Security for Industrial Automation and Control Systems, Part 4-1.
5. Software shall offer options for unlimited, concurrent Thin Client connections for connectivity of common mobile device operating systems.
6. Software shall support running in a virtualized server environment.
7. Software shall support installation on a Storage Area Network (SAN) or Network-Attached Storage (NAS).
8. Software shall provide native support for multi-monitor applications.
9. Software shall support IPv6 addressing and be able to run on networks that support IPv4, IPv6 or both.
10. Software licenses shall be upgradable for an annual fee such that the client is able to download and install the current version of the product.
11. Software shall be tag-based and have an integrated development environment for creation of all aspects of the application.
12. Software shall be compatible with commercially available, off-the shelf PC hardware running Microsoft Windows client and server operating systems currently available at the time of installation.
13. Software shall not require dedicated server-level PC hardware for any individual system components.
14. Software shall support any computer running a thick copy of the software performing as both an application server and a user interface. Software shall support automatic server failover to an unlimited number of servers.
15. Software shall support running as a Microsoft Windows® service.
16. Software shall support development from a thin client.
17. Software shall include the following integrated components available as standard components or for an optional add-on price. These components shall not require 3rd party software. However, the system shall allow 3rd party components to be used if required.
    a. Online application development environment with version control.
    b. I/O drivers for a wide selection of communication protocols.
    c. Alarms management and alarms/events history.
    d. Fully integrated historian.
    e. Real-time and historical data trending and tabular views.

f. Report generation.
g. Security management.
h. Unlimited operator logbooks.
i. Support for networked applications.
j. Support for server redundancy.
k. Native High Performance / HMI widgets.
l. Support for master applications, which can monitor multiple independent subordinate applications.
m. An object-oriented scripting language with a function selection dialog for expression development and debugging tools.
n. Browser-based thin clients for PCs and Mobile devices.
o. Alarm notification to off-site operators (email, text message, and voice.)
p. Interfaces for 3rd party software programs to access data and alarms from the SCADA software via ODBC/SQL, ODBC using a REST interface, OPC, SNMP.
q. Drivers to read OPC-UA, MQTT, JSON, SQL, and XML data sources.
r. MQTT driver to support the Sparkplug B protocol.
s. Support for translating the user interface into any language.
t. Support for an integrated web browser window, configurable within any user interface screen.
u. Support for monitoring the video feed from network-connected video cameras where the feed is provided as a motion JPEG.

18. Software shall automatically compensate for deploying the same application simultaneously on a variety of monitor resolutions, while maintaining the aspect ratios of all displays.
19. Software shall protect against file corruption in the event of an unexpected loss of power or hardware failure. Software shall support an automatic, orderly shutdown when power levels drop to a user defined setpoint.
20. Software shall support automatic startup upon computer restart, to full operation without user intervention.
21. Software shall provide a mechanism to backup and restore the entire application configuration.
22. Software shall include an integrated security system supporting an unlimited number of user accounts, roles, and privileges. System users with appropriate account privileges shall be capable of changing the application configuration without requiring the software supplier's assistance. No lockout mechanisms or passwords shall be withheld from the final customer.
23. Software shall support recipe and batch processing.
24. Integrated software help manuals shall be provided to assist operators and maintenance personnel with operational and configuration tasks.
25. HMI software shall support alarm synchronization between all server and client nodes. All HMI Client nodes shall display and update the master database held on the SCADA servers and shall display the same alarm information at the same time. It shall not be necessary to acknowledge any alarm at more than one HMI workstation. The system shall have the ability such that acknowledging an alarm at any workstation shall acknowledge that alarm at all workstations.
26. No HMI client shall communicate directly with the field devices. Data for client display nodes shall be collected from the currently online SCADA server. The runtime client nodes shall include full read/write and

supervisory control capabilities. The number of client licenses (both thick and thin) shall be as shown on System Architecture Drawing.

27. Primary and backup I/O Servers shall be supplied with full development software installed whereas the clients shall be supplied with run-time or view packages. It shall be possible for personnel with adequate security clearance to perform all configuration tasks from the servers.
28. Software package shall include an I/O driver capable of performing all scanning of PLC data tables for transferring analog and discrete data to and from the PLC. Scan periods shall be adjustable to ensure that the PC/PLC communications is scanning at the fastest possible time increment, without data degradation. All communications between the PLCs and the operator interface software shall use the Local Area Network (LAN) directly.
29. HMI software shall permit manual data entry through any of the terminals. This data shall consist of laboratory inputs and entering or changing such things as alarm limits, setpoints, or constants. Confirmation shall be required via the respective display prior to actual entry into the process memory. Data entry and confirmation shall be available without using a keyboard.
30. HMI software shall provide an open architecture that allows interaction with other programs. It shall provide a mechanism for other programs to access individual data elements and fields within the database in real time. File transfer mechanisms are not acceptable; the access shall be direct to the memory-resident databases held on the SCADA Servers.

B. Virtual Servers

1. Ignition will run on any hypervisor that properly emulates hardware and an Operating System. When Ignition is running on a local VM, contractor shall utilize VMWare.
   a. AWS or MS Azure shall be used for all cloud based services..
2. CPU and memory allocation for small to medium systems shall be at minimum 4 vCPUs with 8GB of RAM. Very large systems shall be at minimum 32 vCPUs with 64+GB of RAM. All VMs shall have dedicated vCPUs and memory.
3. It is best practice to maximize Ignition's performance by configuring the Ignition service to have its max heap set to 66% of the max memory on a Windows system.

C. Licensing Requirements:

1. Provide a HMI server license for each SCADA server as shown on the Drawings and as specified herein. The license shall allow collection of unlimited I/O points and have no licensing restrictions on the number of connected HMI clients. The license shall allow an unlimited number of graphic displays and allow an unlimited number of operator logins available.
2. Provide a HMI development license for each connected engineering workstation as shown on Drawings and specified herein. The license shall allow viewing and configuration of unlimited I/O points. The license shall allow an unlimited number of graphic displays.
3. Provide a HMI client license for each connected operator workstation as shown on Drawings and specified herein. The license shall allow viewing of unlimited I/O points. The license shall allow an unlimited number of graphic displays.

4. Provide a HMI thin client license for each connected thin operator workstation as shown on Drawings and specified herein. The license shall allow viewing of unlimited I/O points. The license shall allow an unlimited number of graphic displays.
5. SCADA Software License Requirements
    a. Provide at minimum the following licenses:
6. License Type
    a. Ignition Platform
        1) Tag Limit: Unlimited
        2) Designer Clients: Unlimited
    b. Perspective or Vision Visualization (Client Preference)
    c. Additional Components
        1) Industrial Historian Solution Suite
        2) Reporting Module
        3) Alarm Notification Module
            a) Voice Notification Module
            b) SMS Notification Module
    d. OPC Comm Module (If required to talk to existing devices)

D. Gateway Architecture
1. A dedicated Ignition Gateway shall be provided for each environment (Production, Test, Development).

2. Gateway redundancy shall be implemented where system availability is critical.

3. The Gateway shall host:
    a. Tag Providers
    b. Alarm Pipelines
    c. Scripting resources
    d. Database connections

E. Database Connectivity
1. All database connections shall be configured at the Gateway level.

2. Named Queries shall be used for all database access.

3. Inline SQL in components or scripts shall not be permitted.

4. Database credentials shall not be hard-coded.

F. Historian
1. Historian shall support logging of all the SCADA system data, including real-time, historical, transactions, alarms, and events, regardless of the number of tags in the system. For example, a 25,000 tag system shall support historical data storage for 25,000 tags, plus alarms and events.
2. Software shall include an integrated Historian and historical data storage at no additional cost, but may optionally use [Oracle,] [MySQL,] [Microsoft SQL Server,] [SQLLite,] [PostgreSQL] as the database.
3. The Historian and its historical data storage shall not require dedicated server computers; however, dedicated servers may be used if preferred by the customer.

4. Historian shall be capable of logging up to 4,000 values per second.
5. A synchronization scheme shall be included such that a copy of all historical data storage resides on all designated computers. Data shall be synchronized in real-time.
6. Any historical database that has been offline must be automatically resynchronized with the historian holding the most recent data. Software shall be capable of synchronizing 100,000+ values per second between databases. This process shall occur in parallel with runtime SCADA processes and shall be designed to minimize interference.
7. Distributed Historian architecture shall be supported. For example, two plants (A and B) may be responsible for historical storage for locally collected data, while a central facility (C) may be responsible for redundant historical storage for both A's and B's data. This architecture shall be scalable to support the addition of future plants.
8. Historian shall support SQL queries of logged historical data. Queries of historical data may be for raw data or summary (value at beginning, average, max, min, delta) over a period.
9. Historian shall support named SQL views of pre-selected tags and data attributes.
10. Historian shall support SQL queries through a REST interface, using either GET or POST requests.
11. Historian shall be able to import collected data that was not available to be logged in real-time.
12. System shall provide for archival of all historical data. Data shall be archived for long-term storage and retrieval. The long-term historical data to be archived shall be stored in an OBDC compliant file format to facilitate access to operator activity, system events, alarm messages, and point values using relational-database compatible software for data analysis, reporting and archiving. Short- term historical data (less than 90 days) may be stored in a format readily accessible to the HMI software.
13. System shall be capable of logging all system activity such as command and macro usage, operator comments, system errors, system messages, and communication network errors, if selected by the operator/system administrator.
14. System shall provide for automatic purging of short-term historical data files.
15. Data Quality: Data Quality flags shall be provided to indicate the quality of all data points stored in any data archive.
16. Manual Input Data Handling: This data shall consist of additional values not obtainable by the SCADA system such as laboratory analysis for use in reports. All manually entered data shall be entered and stored in the appropriate engineering units.

G. Transaction Data
1. System shall provide a means to reliably collect and log (to historical data storage) transaction data from a field device. Transaction data is defined as a data set of related values stored with the same timestamp.
2. The transaction data capture process must include error checking.

H. Historical Data Display (trend plots and tabular)
1. Software shall display historical and real-time data in both plot and tabular format.
2. Software shall allow users to generate ad-hoc plots of historical data by clicking on each of the values to be trended. Selected groups shall be recordable for future recall.

3. Software shall support ad-hoc and preconfigured trend plots of real-time and historical data as integrated elements of graphical process displays. Historical and real-time plotted values shall be shown in a continuous, uninterrupted, scrolling fashion. The display shall support:
   a. An unlimited number of pens (i.e., tag values), including both analog and digital values. Name and description of each tag shall be provided.
   b. Analog pens can be viewed as either layered or as stacked individual plots.
   c. Time frame selectable from one second to five years.
   d. Scaling for each pen as high/low values or graduated divisions.
   e. Value of each tag at the date/time of the mouse location.
   f. Statistical data, including average, minimum and maximum values, for each plot.
   g. Annotating trends
   h. Stop/pause scrolling.
   i. Zoom in/out on the time (x) and value (y) axis'.
   j. Pan/Scroll along the time axis or select a date to display.
   k. Move analog tag plots vertically (in the value (y) axis), either individually or as a group.
   l. Print displayed plot data.
   m. Annotate a moment in time on the plot.
   n. Display alarm setpoints that are associated with the tag(s) as continuous marker lines across the plot.
   o. Export plotted data to comma separated value (.csv) file or directly to a database, for use by 3rd party data analysis software.
   p. Display plot data on a dedicated page, or as a component of a process display page.
   q. Allow configuration of the plot display characteristics.
   4. For tabular data, means shall be provided for the following.
   a. An unlimited number of pens (i.e. tag values), including both analog and digital values. Name and description of each tag shall be provided.
   b. Time frame selectable from one second to five years.
   c. Stop/pause scrolling.
   d. Show raw data.
   e. Show summary data for a duration sampled at consistent periods (e.g. average, minimum, or maximum value every 15 min for past 8 hours).
   f. Export plotted data to comma separated value (.csv) file or directly to a database, for use by 3rd party data analysis software.

I. Protocols and Scripting
   1. HMI software shall support Open Database Connectivity (ODBC) for sharing data from its database to any other ODBC compliant database through SQL queries, via an ODBC dynamic-link library (DLL) driver for real-time data and alarm information. At a minimum the database shall support communication with Microsoft Access, SQL Server, and Oracle.
   2. OLE for Process Control (OPC). The HMI software shall be support OPC clients for communicating to any OPC complaint server as well as an OPC server to serve data to any OPC complaint client.

3. Visual Basic for Applications (VBA). The HMI software shall have VBA embedded as part of the development environment. VBA support shall be used for pre-built scripts & custom scripts. It shall also support search and replace and the ability to copy all forms modules and scripts from one object to the next.
4. OCX or ActiveX. The HMI software shall support the ability to have any third-party OCX (ActiveX control) placed into its container. All third-party controls shall have the right to behave like any object created by the HMI software. The HMI software shall contain any bad or misbehaving OCX or ActiveX control and be able to shut down the control without shutting down the graphic picture, system, or Node.
5. HMI software shall support real-time SQL database connectivity.

J. I/O Drivers (Field Device Communications)

1. A software driver shall be supplied to communicate with every type of device shown on the systems architecture drawings. The communications driver shall be configurable on-line.
2. Use of Microsoft OPC 2.0 or later shall be supported. The OPC Server shall have the capability to be used for PLC communication.
3. Device communications program shall perform error checking on messages such as lost response (time-out) and data error (checksum, LRC, CRC, etc.). If communications errors are detected, the software shall automatically indicate that the data (on graphic displays, in historical files, etc.) is no longer valid. The invalid data shall be replaced with user-defined characters or pre-defined text. The HMI software shall automatically attempt to re-establish communications, and, if successful, shall then replace the characters with valid data. These capabilities shall be built-in to the software and shall not require any user programming or other actions to implement. Failover to a user-configurable back-up port shall be provided as a function of the driver.
4. Software driver shall include a diagnostic program capable of running on-line or off-line that can monitor message rates from the communication program. The diagnostic program shall display the number of new messages, retries, time-outs, any occurrences of error, and the specific error code. Software shall support an unlimited number of field devices and different I/O drivers in the same application.
5. Software shall include support for communications over TCP/IP including but not limited to OPC UA, MODBUS TCP, EtherNet/IP, and DNP3.
6. Software shall be capable of importing tags from Rockwell Ethernet I/P (CIP) devices.
7. Software shall support the development of additional I/O drivers where necessary.
8. Software shall support multiple communications protocols over a single communications port.
9. I/O drivers shall support redundant failover to one of more server computers. Software shall support redundant physical links to any field device, such as primary connectivity via Ethernet and redundant connectivity via serial port. Redundant links shall support similar or different protocols.
10. Software shall provide tools for polling telemetry devices (e.g. RTUs) directly. Software shall allow real-time tuning of each device's polling frequency without interrupting the polling cycle or restarting the application. To optimize I/O communications for telemetry applications, the polling order shall be configurable, and polling shall be asynchronous (if permitted by the remote telemetry unit.)
11. Software shall be capable of pooling modems connected to one or more servers, for use in I/O communications.

12. Tools shall include methods for monitoring communication statistics and reporting errors for each I/O driver. Software shall support radio diagnostics monitoring for radio modems (e.g. Dataradio/Calamp, MDS.)
13. Software shall support writing to multiple output tags via a single write request. This shall allow writing a set of default values to a set group of field device registers.
14. Software shall support rewriting the last written value to an output.

K. Tag Database

1. A browser shall be provided for tag creation, modification and deletion. The tag browser shall include a summary of all tags' current addresses and values.
2. A tag export/import utility shall be provided to allow bulk tag changes using Microsoft Office tools.
3. Software shall support the creation of template tag structures to represent a typical piece of equipment (e.g. a pump, an engine.)
4. Tag configuration shall support the use of expressions that can set configuration parameters based on developer-defined rules.
5. Template tag structures shall be copied and pasted to create any number of equipment instances having similar structures but differing configuration.
6. The contractor shall use fully-qualified tag paths in the project, especially with visualization templates and screens. A fully-qualified path allows Ignition to know exactly where the tag is, including the tag provider name. For example, a non-fully-qualified tag path looks like the following: Path/to/my/tag
7. With that path, the tag provider is unknown. An Ignition project will use the project’s default tag provider, which is only one provider.
8. A fully-qualified tag path looks like the following: [TagProviderName]Path/to/my/tag

L. Configuration Management

1. Software shall be capable of on-line configuration. That is, changes to most aspects of the application (e.g. tags, displays, calculations, reports, trends, server lists) can be deployed in real-time without recompiling or restarting the application or restarting computers.
2. Software shall be capable of offline configuration, such that changes to most aspects of the application can be imported and deployed without recompiling or restarting the application or restarting computers.
3. Software shall be capable of testing configuration changes to tags and displays in the runtime environment before changes are deployed.
4. Users shall be able to deploy a set of changes either automatically or manually, with the option to select and deploy specific changes.
5. Software shall allow multiple users to configure an application simultaneously.
6. Any shut down client shall automatically download newly deployed changes from the server when the client is restarted.
7. All application servers and clients shall automatically synchronize with the primary application server. No manual file duplication shall be required

M. Application Version Control

1. The software shall have an integrated version control system that automatically logs application configuration changes to an encrypted repository. Versions shall be auto-numbered. No manual changes to the repository shall be permitted.
2. A chronologically ordered summary of versions shall display the time and date when the version was created, the user who created the version and any comments entered by the user when deploying the version.
3. It shall be possible to determine which version is currently deployed on each client and server station.
4. The version history shall allow review of all changes applied within each version.
5. The version control system shall allow the following version management methods.
6. Switch (aka rollback) to a previous version of the application.
7. Reverse changes applied during a specific version.
8. Merge changes made local to a specific workstation.
9. Option to include or exclude security changes made between the current revision and the target revision when switching.

N. Multi-Plant Application Support
1. Software shall allow centralized configuration, security management and monitoring of multiple sub-applications by one master application. The sub-applications may be connected via either LAN or WAN.
2. Tags viewed in both the sub-application and the master application shall not be counted twice.
3. The master application shall be capable of monitoring all tags, pages, alarms, etc. in all sub-applications.
4. Data logging shall be managed by each sub-application, but the master application shall be able to generate reports using any sub-application’s data.
5. Each of the sub-applications must be capable of running autonomously in the event of network unavailability.
6. Software shall allow users to be authorized for access to information from one or more sub-applications, or all sub-applications, of the large application.
7. Software shall support limiting the sub-applications that can be accessed from a specific SCADA node.

O. Site Lists and Mapping
1. Software shall allow for the creation of "sites" which are collections of I/O tags, with an optional location that can be represented using Latitude and Longitude coordinates.
2. Sites shall be user-definable to store and provide a configuration interface for any user-specified data.
3. Sites shall be user-configurable to control whether and how they are to be displayed in Site Lists.
4. Sites shall be user-configurable to control whether they will open a pre-defined screen showing the associated collection of I/O tag data or open a user-selected display screen.
5. Software shall include an integrated map display with zoom and pan features such that remote assets can be automatically mapped based on latitude and longitude coordinates.
6. Software shall be compatible with map providers using either .PNG or .JPG format tiles.
7. Software shall support user-selection of the map style to use, including night-time and day-time modes.
8. Software shall allow for user creation and selection of the icons used to represent sites on the map.
9. Software shall allow users to navigate the map including zoom and pan features.

10. Icons used to represent sites on the map shall be capable of displaying information about the site including current connection status and presence or absence of active alarms within the site.
11. Icons used to represent sites on the map shall include a built-in navigational link to either an automatically generated page displaying all I/O tags within the site, or to a user-selected page.
12. Software shall provide a means to define and display pipes or other connections between sites.
13. Pipes or other connections between sites shall be user-configurable to include any relevant information about the connection

P. Integrated Development Environment and Graphic Displays:
1. An intuitive graphical development environment with drag and drop tools shall be used for configuration of application displays. A ribbon bar along the top of the display, as common to Microsoft office tools, is preferred.
2. The Specification for HMI/SCADA graphics is detailed in section [ ].
3. Displays shall support zoom and pan actions.
4. A large library of static and animated graphics including High Performance / HMI tools shall be provided with the software. Software shall support dragging and dropping additional graphics into the library.
5. Standard features shall be included for the following;
    a. Analog and digital inputs and outputs.
    b. Retentive counters. Values will persist if power is lost and subsequently restored or if failing over to a backup server.
    c. Retentive totalizers. Values will persist if power is lost and subsequently restored or if failing over to a backup server.
    d. Historical calculations (e.g. average flow over last hour.)
6. Software shall include pre-built displays for standard user interfaces. The following pre-built displays shall be provided as a minimum;
7. Alarm display that can be filtered by name and includes current, unacknowledged, disabled, shelved and history.
8. Trending and tabular viewing of historical data.
9. Report creator.
10. Operator notebook.
11. Site map.
12. Site list.
13. Software shall allow calculations to be associated with each graphic object to facilitate movement, visibility, sizing and rotation.
14. Software shall allow multiple objects to be saved as a template graphic. The following template capabilities shall be supported:
    a. A template may be associated with a tag structure.
    b. Each new instance of the template will inherit the properties of the template, such that changes to the template will automatically update all instances created from it.
    c. The template may have any number of parameters, including tags and text values, which can be used to animate objects within the template. Each new object created from the template may include different parameters.

d. Templates may be imported from other projects.
e. Copy/paste/rename/delete for any template.
f. Ungrouping of any instance of the template.

15. Software shall support the creation of template displays. The following capabilities shall be supported:
    a. A template display may be associated with a tag structure.
    b. Each new instance of the template will inherit the properties of the template, such that changes to the template will automatically update all instances created from it.
    c. The template may have any number of parameters, including tags and text values, which can be used to animate objects within the template. Each new object created from the template may include different parameters.
    d. Templates may be imported from other projects.
    e. Copy/paste/rename/delete for any template.
16. There shall be no limit to the number of animated graphics that can be used to represent the same tag value.
17. Software shall support background bitmaps on graphical pages.
18. Users shall be able to select all or a subset of the graphics on any display and see a list of the associated tags. The list of tags shall be modifiable individually or using search and replace tools.
19. Graphic display package shall provide a means of creating and displaying color object-oriented graphic displays that will be used by the operator to monitor and control the process. Real-time values being read from the field devices shall be capable of being displayed in a variety of user-configurable formats.
20. Graphic displays shall be standard Microsoft Windows files and shall be able to be stored on the system disk, removable media, or file server, based on user-entered selections. There shall be no limit (other than physical disk size) to the number of displays that can be developed and accessed on-line.
21. Support for displays larger than the size of the monitor shall be provided. If used, graphics should be dynamically re-sized or scroll bars shall be provided to allow the user to move to other areas of the display. Also, support for using Multi Display Screens for viewing graphics shall also be available without any complex configurations or with minimal programming.
22. If the HMI manufacturer offers a specialized water/wastewater package that includes unique symbols and functions to improve graphics development, the package shall be provided.
23. Graphic display package shall be capable of importing graphics from other drawing packages such as CorelDRAW and AutoCAD.
24. Graphic display package shall be capable of importing graphics from Microsoft Windows clipboard.
25. Graphic editor shall be menu driven, and contain standard geometric symbols such as lines, circles, rectangles, etc., making creation, modification and copying of graphics a simple task. The graphic editor shall be provided with "wizards" and other scripting functions to reduce screen development time.
26. Animation connections shall be constructed using an intuitive Point and Click interface for point configuration without additional user configuration.
27. Graphic editor shall have capability of multiple dynamics of differing type to be applied to the same object (e.g., a size dynamic, and a color dynamic both added to a rectangle).
28. A method shall be provided for allowing graphics objects or groups of objects to be re-used easily. It shall allow the developer to insert native language prompts that request appropriate tag or other animation information whenever the object or grouped object is reused in another graphic display. These objects,

either single or grouped, shall be intelligent, Windows wizard-like objects, so that it is possible to have a single prompt request and substitution. A method shall be provided to update all these wizards used in the application if the Master object from the library is updated.

Q. Alarm and Event System:

1. Software package shall perform alarm monitoring of discrete and analog inputs/outputs. Alarms shall be capable of being assigned to one of three severity categories with each category producing a distinct sound via the System speaker.
2. In order to logically divide a process into smaller units, the system shall allow for named individual alarm areas to be defined. These alarm areas shall be definable on an individual tag level. All alarm areas shall be accessible by each tag.
3. Alarm condition shall be specified as a discrete input or output change of state, analog values above and below limits, high or low analog rate-of-changes as defined in the database, or failed communication link.
4. System shall print a descriptive message with a time stamp and user ID on the alarm printer or to an alarm file whenever any of the following events occur:
    a. Alarm.
    b. Alarm acknowledgment.
    c. Data entry into a tag.
    d. Restarting the HMI software.
5. Software shall include alarms and events management tools consist with implementation of the ANSI/ISA 18.2-2009 Management of Alarm Systems for the Process Industries standard.
6. Software shall include a predefined alarms and events management interface. The interface shall provide the following operational tools.
    a. Lists of Current, Unacknowledged, Disabled, Active, Configured Historical and Shelved alarms and events.
    b. Tools for searching and filtering lists.
    c. Add a blog-style note to any alarm.
    d. Notes may not be edited after saving, but comments may be added.
    e. Day and night view toggle.
    f. Acknowledgement of individual alarms or all visible alarms.
    g. Option to require confirmation before acknowledging all alarms in the list.
    h. Option to require that a note be created when alarms are acknowledged.
    i. Font size adjustment for visually impaired users.
    j. Representation of alarm priorities using shape, color and numeric priority level for enhanced operational awareness.
    k. Option to plot data associated with an alarm.
    l. Option to open a process display where the alarm is currently shown.
    m. Option to have a relevant process display open automatically if there is no operator action for a defined period following the triggering of that alarm.
    n. Alarm mute and silence.
    o. Alarm shelving options for a defined period or indefinitely. Shelved alarms shall still be recorded to the alarms history but shall not announce or require acknowledgement.

p. Option to include or exclude shelved alarms in the list of Current, Unacknowledged, and Active alarms. Shelved alarms to be visible at all times in lists of Historical alarms and events, Configured alarms and Shelved alarms.

7. Alarm acknowledgement shall immediately be propagated to all networked stations.
8. A full redundant copy of alarm and event history shall be stored on every workstation, allowing that workstation to continue to process local alarms if it becomes isolated from the network. History to be automatically synchronized when the workstation is reconnected to other servers.
9. Software shall allow the creation of multiple alarm databases for load distribution in large or distributed applications.
10. Software shall allow direct assignment of alarms to alarm databases.
11. Software shall allow alarms to be associated with functional areas, such that a user need only deal with alarms in his/her functional area(s).
12. Alarm occurrence, acknowledgement, clear, disable and shelve actions shall be recorded.
13. Alarm disabling to be provided only as a configuration option, not as an operational action.
14. Software shall provide user-configurable settings for deadband on analog alarms and delay on analog and digital alarms.
15. Alarms and events records shall include:
    a. Time/Date stamp.
    b. The name and description of the alarm tag.
    c. Priority.
    d. Status of Alarm (i.e. Active, Acknowledged, Cleared). Alarm Acknowledgement records shall include the name of the user who acknowledged the alarm.
    e. The value of the associated tag at the time of alarm occurrence.
    f. The value of the alarm setpoint at the time of alarm occurrence.
16. Software shall support an unlimited number of alarm priorities and shall allow unique annunciation sounds, shapes, and colors for each.
17. Alarm annunciation shall be configurable to use alarm tones, text to speech descriptions, sound files or popup displays.
18. Users must be notified, both visibly and audibly, of the occurrence of an alarm, regardless which display is presently being viewed.

R. Alarm System Auditing and Reporting

1. Software shall support printing of alarms/events created over a range of dates/times.
2. Software shall provide a means to identify frequently occurring alarms (e.g. nuisance alarms.
3. Software shall provide a means to identify and analyze alarm flood conditions.
4. Software shall provide a summary of alarm percentages by priority, for comparison with generally accepted percentages as defined in the ANSI/ISA 18.2-2009 Management of Alarm Systems for the Process Industries standard.

S. Alarm Notification System (for remote users)

1. The Alarm Notification System shall support alarm notification via dial-out over voice modem (using text-to-speech), VOIP (voice over Internet protocol), an Internet service such as Twilio®, SMS text message,

email and alphanumeric pager. Alarm acknowledgement shall be supported during voice calls and via email and text message.

2. The Alarm Notification System shall allow status retrieval and alarm acknowledgement via dial-in over voice modem (using text-to-speech.)
3. The Alarm Notification System shall be an integrated feature of the SCADA systems and shall not require a separate tag database and security system.
4. Email messages shall support outgoing mail with transport layer security (e.g. Gmail, Yahoo Mail, or corporate email server.)
5. The Alarm Notification System shall be capable of annunciating alarms to rosters of users with up to 39 contacts per roster. An unlimited number of rosters shall be supported. The system shall support associating rosters with functional areas, such that alarms in these functional areas will activate notification to the appropriate contacts.
6. The Alarm Notification System shall allow the configuration of delays between, and repeats of, any individual contact or group of contacts in a contact list.
7. Security rights to edit a roster shall be controlled by a dedicated privilege, not dependent on any other tag-modification privileges.
8. System shall support an API allowing user-defined views of roster contact lists.
9. System shall support a means of disabling or enabling a contact in a roster without needing to open or edit the contact list.

T. Error Detection, Recovery, and Diagnostics:

1. Software driver shall provide on-line diagnostics that display the current status and operation of the local area network and its nodes. The diagnostic display shall include the LAN adapter status for the machine showing the display, as well as the current number of messages, errors and retries.
2. HMI software shall automatically detect and recover from any network condition or software problem that results in a failure of communications between the HMI client and the SCADA server(s) or between the SCADA server and I/O devices. It shall be possible to log all connection/disconnection events of sessions between the SCADA server and clients.
3. If network communications errors are detected, the software shall automatically indicate that the data (on graphic displays, in historical files, etc.) is no longer valid and shall replace the invalid data with user defined characters or pre-defined status text. The HMI software shall automatically attempt to re-establish communications, and, if successful, shall then replace the characters with valid data. This capability shall be built-in to the software and shall not require any user programming or other user-dependent actions to implement.

U. Report Generation and Printing:

1. Operator interface software shall support at least one alarm/event printer and one report printer. Printers shall support both USB and/or parallel ports for printing.
2. Authenticated operators shall, in the runtime environment, be able to produce reports including any analog, digital or calculated tag data from the historical database.
3. Data format options shall be as follows:
    a. To screen.

b. To a comma separated value (.csv) file.
c. To a text file.
d. To an ODBC-compliant database.
e. To any direct-connected or networked printer.
f. To a 3rd party software (e.g. Microsoft Excel) template for advanced data analysis and formatting.
g. To e-mail if an external email server is provided.

4. Reports may be created for one-time use or saved for reuse.
5. Report generation shall be invoked either on demand, by a monitored event, or on a scheduled basis.
6. For reports that are created on a scheduled basis, a mechanism shall be provided to allow operators to re-create the last scheduled report.
7. Software shall support ODBC and OPC connections for use by third-party report generation programs such as XLReporter and DreamReports.
8. Software shall supply a data-query add-in tool for Microsoft Excel®, thereby allowing reports to be generated in that program.
9. Software shall support a REST interface for development of web-based query tools.

V. Electronic Operator Notebooks

1. System shall support operator logbooks for recording ad-hoc notes or predefined notes as threads, in that notes can have associated comments.
2. Notebooks shall be searchable by keyword, user account and time/date.
3. Notebooks shall be color-coded for easy identification.
4. System shall support creation of an unlimited number of notebooks for association with system elements, such as equipment and trended pen groups.
5. All notes shall be encrypted and include the name of the user's account and the time/date of creation. All notes entered into the notebook shall be immediately viewable from all clients and servers.
6. System shall not allow editing or deleting notes once created, to prevent tampering.
7. System shall support the addition of comments to existing notes.
8. System shall support the option of requiring operator authentication as part of the note creation process.
9. System shall support printing of notes by range of dates/times.
10. System shall support the export of notes for a selected range of dates, to a format that can be easily viewed / printed from any workstation without the need for a (HTML)

W. Security:

1. Software shall include a security system with privilege and role-based user accounts. Level-based access shall not be acceptable.
2. All output controls shall be locked automatically when no user is signed in. After a predetermined time of no operator activity, which is adjustable by the system administrator, the operator workstation shall default to the lowest system security.
3. Security system shall support an unlimited number of user accounts and roles. System shall allow creation of an unlimited number of additional security privileges where necessary.

4. User passwords must be configurable to require a minimum length, contain a combination of letters, numbers, and special characters, and expire after a pre-set period. User passwords shall be stored in an encrypted format.
5. System shall allow changes to user accounts, roles, and privileges while the application is running. Changes shall become effective immediately.
6. System shall provide a mechanism to suspend a user account. Suspending an account shall cause a user to be signed out immediately.
7. Operator interface functions such as commands, macros, graphic displays, OLE objects, and point IDs shall be capable of each being assigned a separate security level.
8. Software package shall provide the ability to "lock" a user into the runtime graphics environment. Specifically, disabling any combination of the following shall be supported:
    a. Starting other applications.
    b. Switching to other applications that may be running.
    c. Exiting from the software package.
    d. Keystrokes (i.e., <Ctrl><Alt><Delete>, <Alt><Tab>).
    e. Switching to graphics configuration mode.
9. User sign-in and sign-out activity shall be recorded in the application event log. Disabling accounts after X failed attempts within Y seconds shall be supported where X and Y are configurable options.
10. System shall provide a mechanism to limit client access to specific IP addresses.
11. System shall support authentication of user accounts via a Windows domain and authorizing SCADA user roles from domain security groups.
12. System shall provide an Active Directory Query utility to assist security managers by confirming group names assigned to user accounts.
13. When running as a Windows service, system shall support the use of Smart Cards as a form of two-factor authentication.
14. System shall support the use of proximity cards/readers.
15. System shall support the use of OAuth 2.0 authorization for integration with Google™ or Microsoft 365™ email systems.
16. The integrated version control system shall allow the option of including or excluding security-related changes if returning the application to an earlier configuration state.
17. System shall support the use of Open-ID Connect for authentication of users connecting via thin clients.
18. System shall support the creation of read-only workstations that provide operators with view-only access.
19. System shall support privilege masking on read-only workstations that will override any connected user's assigned privileges.

X. Product Upgrades, Support and Training

1. Software must have a history of allowing applications that have been deployed on current technology (operating systems and PC hardware) to be upgradable to new technology with minimal change to the application.
2. Software must have a history of allowing applications that have been deployed on one version of the product to be upgradable to a new version with minimal change to the application.

3. Software manufacturers shall offer product support via phone, email, user forum and remote access methods (e.g. Remote Desktop.)
4. Software training shall be available from the manufacturer via classroom courses and self-directed study (e.g. workbooks and tutorials online.)

2.2 THIRD PARTY REPORTING SOFTWARE

A. General:
1. Reporting software shall be a separate software package from the HMI. It shall run on a server as shown on the Drawings.
2. Reporting software shall be licensed to allow at least two concurrent users and development for at least ten report templates.
3. Additional licenses, if required for the reporting package, shall be provided to include support for the selected HMI software.
4. Reporting software shall be provided with a minimum of 1 year of support from the manufacturer.

B. Reports:
1. Process report generation software shall provide the means to process and store data for historical records. Software shall be flexible so that contents of the reports can be easily modified. The software shall provide for collecting, processing and storing values.
2. Reporting software shall be the latest version of the following:
   a. Hach WIMS by Hach.
   b. ReportWorX by ICONICS.
   c. XLReporter by SyTech.
   d. Operator10 by AllMax.
   e. Or equal.
3. An interface shall be provided to the HMI software/Historian for automatic collection of daily/hourly/15 minute/one minute summarized data from historical file. Interfaces shall run with no user intervention and shall be able to be run as a Windows Service.
4. Following data collection functions shall be provided:
   a. Instantaneous values may be collected based on the change value of the data point.
   b. Instantaneous values shall be averaged every 15 minutes. For some state reports, this 15-minute data will be retained.
   c. 15 minute averages shall be maintained for 72 hours.
   d. 15 minute averages shall be reduced to hourly averages and maintained for 60 days.
   e. Hourly averages shall be reduced to daily averages and maintained for 18 months.
5. For each 24-hour period, the maximum and minimum values and totalized value for flow signals shall be maintained for 18 months.
6. All averages shall have the capability of being archived to removable media.
7. Capability shall be provided to obtain log information on demand for screen display and archival to removable media.

8. Reporting software shall be able to interface with the HMI Software and Historian Software and shall be compatible with the operating system supplied with the computers.
9. A calculation extension capability shall be provided to perform calculations on data that have been accumulated for report generation. Calculations shall include:
    a. Standard operators (+, -, *, and /).
    b. Functions (abs, retrieve forward or backward any day, exponential and logs, reciprocal, round, if-then-else, averages, and summations for daily, moving, weekly, monthly, and fiscal periods).
    c. Difference (with specified rollover or without).
10. Calculations shall provide the capability to calculate loadings, percent removals, MCRT, and CT at a minimum. Results can be calculated daily, hourly, or minutely. These calculated data values shall be stored in the database, thus ensuring the consistency of the data and allowing the same data to be readily available for analysis. Historical equations shall allow definitions of the calculation by date.
11. Reporting system shall generate reports from process and operation data stored in historical files or a database. The reporting software shall retrieve these data upon specifying a time period.
12. Date and time configuration shall be developed to meet the facility requirements. For example, a "day range" may start at 7:00:00 AM and end at 6:59:59 AM instead of midnight.
13. Reports shall be capable of being initiated automatically based upon time of day, month and year, or by event trigger. Reports shall also be capable of being generated manually upon operator'(s) request.
14. When the reports are generated manually, the reporting system shall be able to interface with the operator(s) through the HMI software to generate the needed reports. The operator interface should prompt the user to enter a day, a month and a year to retrieve the data.
15. User interface displays shall allow the operator to define the desti-nation of the report (e.g., display, printer, computer file, email, etc.) and when it is to be printed (e.g., immedi-ately, on demand, or automatically at a specified time).
16. Reporting system shall start automatically when re-starting the workstation to ensure data is not lost during power fail or system fail.
17. Reporting system shall include several security settings that will give permissions to develop and modify data while limiting unauthorized access to data monitoring and/or data entry.
18. It shall be possible to print data quality tags alongside the value.

2.3 SCADA THIN CLIENT MANAGEMENT SOFTWARE

A. General
1. Thin client hardware is specified in Section [13310]. The software shall be compatible with the thin client hardware.
2. Software is not a substitution for any required HMI thin client licenses or Microsoft Remote Desktop Services Client Access Licenses required for fully operation SCADA system.

B. Thick (full-installation) Client User Interface
1. Software licensing shall not limit the number of application display pages allowed.
2. Software shall support the following navigation methods:

3. A menu for navigating from one display to another. Menu shall be configurable to allow logical grouping of displays.
4. Tiled view of any number of displays concurrently, all tiles showing real-time data or pictures of displays (user-selectable). Selecting one of the tiles will switch to the full-screen view of that display.
5. Mouse-over selectable hot box for navigating to a specific display.
6. Button for navigating to a specific display.
7. Browser-like forward and reverse buttons to scroll through previously viewed displays.
8. A list of previously viewed displays with the option to navigate to a selection from the list.
9. A mapped view of assets with the option to navigate to an application display by selecting any asset from the map.
10. Application displays shall be event-driven, in that data will be delivered to client computers by the server immediately upon receipt. Client computers will not poll the server for new data.
11. Means shall be provided to allow the operator to print graphical displays.
12. Software shall support flagging tags as 'questionable data' (i.e., not commissioned or value is in question.) These values will continue to display the incoming values. These flags shall be removable by users with sufficient privileges.

C. Thin (browser-based) Clients

1. Software shall offer an optional zero-footprint thin client for use with HTML5-compatible browsers running on operating system variants, including
   a. Windows
   b. Linux
   c. Apple
   d. Android
2. Server for thin clients shall be an integral feature of the SCADA software. Use of the thin client shall not require a 3rd party Internet server software (e.g., Microsoft IIS, Apache).
3. Thin client shall not rely on an RDP (remote desktop protocol) connection. Network traffic required by the thin client shall not exceed 1/8th of the bandwidth of similar systems that do use RDP connections.
4. System shall support [two] [three][four][other] levels of server redundancy for thin client connectivity, with automatic failover and client load sharing.
5. System shall support cyber security measures including Firewalls, Virtual Private Networks (VPN) and Secure Socket Layer (SSL.)
6. OpenID Connect shall be supported for secure thin client logons.
7. Thin client connections shall be concurrent. Tools shall be provided to monitor client connectivity and to disconnect users or switch them to alternate servers on demand.
8. The thin client shall share the same security accounts as the rest of the SCADA Software. A separate privilege shall be required for browser client access. Revocation of this privilege will immediately terminate the user's client connection.
9. Thin Client displays shall be generated automatically, requiring no additional configuration.
10. Online configuration changes shall be deployed immediately to all thin client interfaces without requiring the client interface to be restarted or refreshed.
11. An authorized user on a thin client connection shall be able to perform configuration changes.

12. Thin clients shall provide support for multiple-monitor configurations.
13. The Thin Client user interface shall be offered in two variants, the choice of which to use being user-selectable.
    a. Graphical (preferred for large user interfaces) – A user experience mirroring (graphically and operationally) that of the Thick Client.
    b. Text-based (preferred for mobile phone interfaces) – Simplified lists of monitored values, with support for control actions, alarms management, trending and mapped asset view.
14. Licenses shall be provided from the HMI Manufacturer to allow the required number of thin clients to operate concurrently in addition to two additional licenses to be used for access from outside the plant network.

D. Window Layout and Navigation
1. 1.1 Title Bar
    a. The system shall implement a persistent title bar using a Perspective fixed view or Vision docked template.
    b. The title bar shall display:
        1) Project name and facility name
        2) Environment indicator (PRODUCTION / TEST / DEVELOPMENT)
        3) Gateway-synchronized system date and time
        4) Logged-in username and assigned security roles
        5) The title bar shall include visual indication of system health, including:
            a) Gateway connectivity
            b) PLC or Tag Provider heartbeat
2. 1.2 Navigation Strategy
    a. The system shall use a hierarchical navigation structure.
    b. Navigation shall be implemented using reusable components (Perspective embedded views or Vision templates).
    c. The navigation hierarchy shall follow these levels:
        1) Level 1: Plant Overview
        2) Level 2: Area Overview
        3) Level 3: Unit Process
        4) Level 4: Equipment Detail / Faceplate
    d. No operator function shall require more than three navigation actions.
3. 1.3 At-a-Glance Alarm Display
    a. A persistent alarm banner shall be visible on all primary screens.
    b. The banner shall display:
        1) Highest active alarm priority
        2) Number of active alarms
        3) Number of unacknowledged alarms
    c. Alarm animation and color shall comply with the project alarm philosophy.
    d. Decorative or non-alarm flashing shall not be used.
4. 1.4 Project Branding
    a. Project branding shall be implemented using shared style classes or templates.
    b. Branding elements shall not obscure alarms, process values, or controls.

E. Visual Design (High Performance HMI)
1. 2.1 Color Usage
    a. Normal operating conditions shall be displayed using neutral grayscale colors.
    b. Color shall be reserved exclusively for abnormal, alarm, warning, or manual states.
    c. Gradients, textures, and 3D effects shall not be used.
2. 2.2 Text and Fonts
    a. A single sans-serif font family shall be used project-wide.
    b. Minimum font sizes shall be:

1) Titles: 16–20 px
2) Labels: 12–14 px
3) Values: 14–16 px

c. Terminology and capitalization shall be consistent across all screens.

F. Ignition Architecture Requirements

1. 3.1 Gateway Architecture
   a. A dedicated Ignition Gateway shall be provided for each environment (Production, Test, Development).
   b. Gateway redundancy shall be implemented where system availability is critical.
   c. The Gateway shall host:
      1) Tag Providers
      2) Alarm Pipelines
      3) Scripting resources
      4) Database connections
2. 3.2 Security
   a. Role-Based Access Control (RBAC) shall be enforced for all operator and administrative actions.
   b. Integration with Active Directory or identity providers shall be implemented where available.
   c. The principle of least privilege shall be applied.
   d. Security auditing shall be enabled for:
      1) Logins and logouts
      2) Alarm acknowledgments
      3) Tag writes and control actions
3. 3.3 Database Connectivity
   a. All database connections shall be configured at the Gateway level.
   b. Named Queries shall be used for all database access.
   c. Inline SQL in components or scripts shall not be permitted.
   d. Database credentials shall not be hard-coded.
   e. All device connections shall be documented with addressing, scan rates, and timeout behavior.

G. Operator Interface Requirements

1. 4.1 Color and State Indication
   a. Equipment states shall be visually distinguishable.
   b. The following color meanings shall be enforced:
      1) Normal: grayscale
      2) Warning: amber/yellow
      3) Alarm/Fault: red
      4) Manual or Maintenance: blue or gray-blue
2. 4.2 Interlocks and Permissives
   a. All interlocks and permissives shall be implemented in PLC logic.
   b. The HMI shall provide visibility of active interlocks and failed permissives.
   c. Operator-friendly descriptions shall be provided.

3. 4.3 Alarms
    a. All alarms shall be implemented using Ignition tag-based alarming.
    b. Alarm priorities shall be defined as:
        1) High (Priority 3–4)
        2) Medium (Priority 2)
        3) Low (Priority 0–1)
        4) Each alarm shall include clear text, setpoint or condition, and operator guidance.
4. 4.4 Graphics and Faceplates
    a. Process graphics shall be 2D and schematic in nature.
    b. Reusable equipment faceplates shall be implemented using embedded views or templates.

H. Alarm Philosophy (Project-Wide)
1. A single alarm philosophy document shall govern the project.
2. Alarm performance targets shall be:
    a. Average alarm rate: less than 1 alarm per 10 minutes
    b. Peak upset rate: less than 10 alarms in 10 minutes
    c. Alarm shelving, suppression, and state-based alarming shall be implemented.
    d. Alarm rationalization shall be completed prior to commissioning.

I. Tag Management
1. 6.1 Tag Naming
    a. Tags shall use structured paths including area, unit, equipment, and signal.
    b. Spaces and special characters shall not be used.
2. 6.2 User Defined Types (UDTs)
    a. UDTs shall be used for all repeatable equipment.
    b. UDTs shall include status, commands, alarms, and runtime data.
3. 6.3 Folder Structure
    a. Tag folders shall mirror process areas, navigation structure, and historian organization.

J. Historian Requirements
1. Ignition Tag Historian shall be used for all historical data.
2. Sample rates and deadbands shall be configured based on process requirements.
3. Non-critical or static tags shall not be historized.

K. Analytics and Trending
1. Predefined trends shall be provided for key process and equipment metrics.
2. Trend views shall use standardized time ranges and scaling.

L. Reporting
1. The Ignition Reporting Module shall be used for operational and compliance reports.
2. Reports shall support scheduled and on-demand execution.
3. Reports shall export to PDF and CSV formats.

M. Ignition Module Requirements
1. The following Ignition modules shall be provided unless otherwise approved:
2. Vision Module (if desktop clients are required)
3. Perspective Module (for web and mobile clients)
4. Tag Historian Module
5. Alarm Notification Module
6. Reporting Module
7. The following optional modules shall be implemented when applicable:
    a. Gateway Redundancy Module – for high-availability systems
    b. Enterprise Administration Module (EAM) – for multi-site management
    c. MQTT Transmission / Engine Modules – for IIoT architectures
    d. Sepasoft MES Modules – when production tracking or OEE is required

N. Governance, Submittals, and Change Management
1. 11.1 Bid Compliance
    a. Bidders shall acknowledge this specification in their proposal.
    b. Any deviation from this specification shall be clearly identified in a written exception list.
    c. Failure to disclose deviations shall be grounds for rejection or corrective action at no additional cost to the Owner.
2. 11.2 Required Submittals
    a. The successful bidder shall provide the following deliverables:
        1) Ignition system architecture diagram
        2) Module list with license counts
        3) Alarm philosophy acknowledgment and alarm priority mapping
        4) Tag naming and UDT structure documentation
        5) Sample screen hierarchy and navigation map
        6) Example equipment faceplate (pump or valve)
        7) Security role matrix
        8) Database schema or reporting data flow diagram
3. 11.3 Factory Acceptance Testing (FAT)
    a. A formal FAT shall be conducted prior to site deployment.
    b. FAT shall verify:
        1) Navigation structure compliance
        2) Alarm functionality and priorities
        3) Interlock visibility
        4) Historian logging
        5) Reporting execution
    c. FAT results shall be documented and approved by the Owner.
4. 11.4 Site Acceptance Testing (SAT)
    a. A SAT shall be conducted after installation and commissioning.
    b. SAT shall confirm full compliance with this specification.

c. Any deficiencies shall be corrected prior to final acceptance.

5. 11.5 Training and Documentation
   a. The Contractor shall provide operator training and administrator training.
   b. Training materials shall be submitted in electronic format.
   c. Final documentation shall include:
      1) Gateway backup
      2) Final project files
      3) As-built screen captures
      4) Final alarm database export

6. Change Management
   a. All changes after award shall follow a formal change management process.
   b. Scope changes shall not be implemented without written Owner approval.
   c. Unauthorized deviations shall be corrected at the Contractor's expense.

O. Acceptance and Warranty
1. Final system acceptance shall occur only after successful SAT completion.
2. The Contractor shall warrant the Ignition system for a minimum of one (1) year after acceptance.
3. Warranty shall include defect correction and configuration support related to this specification.

2.4 VIRTUALIZATION SOFTWARE

A. The architecture is assumed to be used on a 64-bit operating system windows operating system such as Microsoft Server 2022 or Microsoft Server 2025.

B. Software will run on 'X' number of physical machines, each with a minimum of four processors. Each virtual machine will access all available processors for load balancing. All virtual machines shall be dedicated entirely to the SCADA components that they are running.

C. Software shall have a centralized performance dashboard with views into virtual machine/network health, workload conditions and resource usage and management.

D. By default, the software shall implement a fair share resource split for network, disk and processor resources.

E. Software can support up to 4 virtual machines on one physical machine.

F. Software can support a minimum of four processors and 128GB of vRAM per host.

G. Software shall support at least 5 virtual NICs per VM.

H. Software shall provide an agentless backup/restore and roll-back/recovery solution of virtual machines.

I. Software shall have an agentless antivirus and antimalware protection for virtual machines.

J. Software shall come with a three-year manufacturer support contract and a one-year limited warranty.

K. Manufacturers:
   1. VMWARE – vSphere.
   2. Microsoft – Hyper V.
   3. Or Equal.

PART 3 – EXECUTION

3.1 GENERAL

A. Refer to Section [13300].

END OF SECTION

SECTION 13320
CONTROL AND DATA NETWORK EQUIPMENT

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Furnish the labor and materials required to install and bring into operation the control and data network as shown on the Drawings and specified herein.

B. The network shall be capable of supporting communications between all servers, operator workstations, PLCs, RTUs, and other communication devices as shown on the system architecture block diagram(s). Furnish all necessary cables, face plates, connectors, modems, transceivers, repeaters, modules; splice kits, etc. required for a complete and operational network. The system architecture diagram(s) are for network understanding only. Some communication devices maybe required for network operation, which may not be explicitly shown on the Drawings. The system shall be designed to accommodate an increase of 100 percent of network nodes.

C. Furnish and install a complete Remote Input/Output (RIO) data highway capable of supporting communications between all PLCs as shown on the system architecture block diagram. Furnish all necessary cables, face plates, connectors, modems, transceivers, repeaters, modules; splice kits, etc. required for a complete and operational RIO data highway.

D. The control and data network shall include all nodes on the network. Communication between nodes may be via Ethernet, serial, fieldbus, or other method as shown on the drawings.

1.2 RELATED WORK

A. Refer to Division 16 Sections.

B. Refer to the E-sheets in the Drawing package.

C. Refer to Section 13300 “I&C - General Provisions.”

D. Refer to Section 13321 “Fiber Optic Cabling and Equipment.”

E. Refer to System Architecture drawing.

1.3 SUBMITTALS

A. Refer to Section 13300.

B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Spare parts list.

E. Complete system architecture diagram showing in schematic form, the interconnections between major hardware components including control centers, panels, power supplies, consoles, computer and peripheral devices, networking equipment, processors, I/O modules, local operator interfaces, process equipment vendor controllers, and like equipment. The system architecture shall be complete and shall depict all required cables, media type between components, network protocol used at each network level, details on connection requirements such as cable pin-outs, port numbers, and rack slot numbers. The intent of this specification requirement is to develop a diagram that is complete in every aspect to allow purchase of all required equipment by part number, and to allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature. Sheet size shall be 11"x17" and using more than one sheet is acceptable.

F. Submit details of I/O level networks, including field instrument, valve, power monitoring, and field device digital networks. Submittal shall include details of the field device digital networks technology including type, wiring requirements, configuration details, device addressing, and interface to the process control system. Include details of the field device digital network configuration for each field level digital network and subnetwork.

1.4 REFERENCE STANDARDS

A. Refer to Section 13300.

1.5 QUALITY ASSURANCE

A. Refer to Section 13300.

1.6 SYSTEM DESCRIPTION

A. System Responsibility:
1. The Drawings and specifications depict a control and data network, which shall function as one unit. This network may be comprised of multiple communication protocols over various media

1.7 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300.

1.8 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300.

1.9 MAINTENANCE

A. Refer to Section 13300.

1.10 WARRANTY

A. Refer to Section 13300.

1.11 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300.

PART 2 – PRODUCTS

2.1 INDUSTRIAL MANAGED ETHERNET SWITCH

A. General
1. Provide an industrial managed Ethernet switch for connection to the control network backbone as shown in the Drawings and specified herein.

B. Physical Features
1. Minimum fiber uplinks: 2 x 100/1000 SFP ports
2. Minimum fiber Ports: Two (2) Gigabit Ethernet ports shall be hot pluggable into the SFP uplink. Ports shall be duplex LCE and operate at a wavelength of 850 nm over multimode cable.
3. Minimum copper ports: 16 x 10/100 TX RJ45 ports
4. Operating temperature: 0 to 130 °F
5. Power: 24 VDC redundant power supply inputs
6. Enclosure: Metal case, DIN-rail mountable
7. Rating: UL Class 1, Division 2 Groups A, B, C, and D

C. Network Features
1. Fault tolerant for use in a ring topology if shown on drawings. The switch shall be able to detect a blocked port and redirect data flow in the opposite direction within 30ms.
2. Layer 2 switching
3. Full duplex on all port
4. Auto negotiation and manual configurable speed and duplex
5. Wire speed switching fabric
6. IEEE 802.1w Rapid Spanning Tree Protocol
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.

D. Additional Features
1. The switch shall come equipped with a dry contact rated for 120 VAC 5A that shall be used for common trouble alarm. The alarm shall be programmable. 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.

E. Manufacturers
1. Stratix
2. Moxa
3. Hirschmann
4. N-Tron
5. Or equal

2.2 INDUSTRIAL UNMANAGED ETHERNET SWITCH

A. General
1. Provide an unmanaged Ethernet switch for connection to the control network backbone as shown in the Drawings and specified herein.

Physical Features

2. Minimum copper ports: 4 – 10/100 TX RJ45 ports
3. Operating temperature: 0 to 130 °F
4. Power: 24 VDC
5. Enclosure: Metal case, DIN-rail mountable
6. Rating: UL Class 1, Division 2 Groups A, B, C, and D

B. Network Features

1. Auto sensing duplex and speed
2. LED link/activity status indication

C. Additional Features

1. The switch shall come equipped with a dry contact rated for 120 VAC 5A that shall be used for common trouble alarm. The alarm shall be programmable. 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.

D. Acceptable Manufacturers

1. Phoenix contact
2. N-Tron
3. Moxa
4. Or equal

2.4 ETHERNET MEDIA CONVERTER

A. General

1. Provide an Ethernet media converter as shown in the Drawings and specified herein.

B. Physical Features

1. RJ45 port: 10/100/1000BaseTX to 1000BaseTX
2. Fiber uplink: 100BaseTX to 100BaseFX (ST/SC connectors)
3. Fiber optics: Multi- or single-mode capability as shown in the Drawings
4. Operating temperature: 0 to 130 °F
5. Power: 24 VDC
6. Enclosure: DIN-rail mountable

C. Additional Features

1. The converter shall come equipped with a dry contact rated for 120 VAC 5A that shall be used for common trouble alarm. The alarm shall be programmable. 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.

D. Acceptable Manufacturers

1. Phoenix Contact
2. N-Tron
3. Moxa
4. Or Equal

2.5 WIRES AND CONNECTORS

A. Ethernet 10/100/1000 BASE-T/TX Cable.

1. The unshielded twisted pair cable shall be designed for use with a high speed (10/100/1000 Mbps) Ethernet 10/100/1000 BASE-T/TX communications network. The twisted pair cable shall have a nominal impedance 100 ohms at one MHz, a maximum attenuation of 8 dB per 1000 feet at one MHz. The twisted pair cable must have frequency tested up to 250 MHz or more. The twisted pair cable shall be plenum rated and shall have a minimum of four 23 AWG solid copper conductor pairs. All 10/100/1000 BASE-T/TX (RJ-45) terminations on the twisted pair cable shall be done in a professional and workman like manner. Terminations shall provide for proper strain relief on the cable jacket. Strain relief on the wire and/or wire insulation shall not be acceptable.

B. RIO Data Highway Cable

1. The RIO data highway cable shall be plenum rated cable of the type as recommended by the PLC manufacturer. All terminations shall be done in a professional and workman like manner. Terminations shall provide for proper strain relief on the cable jacket. Strain relief on the wire and/or wire insulation shall not be acceptable.

2.6 NETWORK FIREWALL

A. General

1. Provide a firewall for connection to the control network backbone as shown in the Drawings and specified herein.

2. This specification defines the minimum functional, performance, security, management, environmental, and testing requirements for a hardware firewall appliance used to enforce segmentation, access control, and secure remote connectivity for the wastewater plant SCADA/OT network. Device will be deployed at zone boundaries (OT↔IT, OT DMZs, and remote access gateways).

3. The PCSS shall setup and configure the network firewall to establish a secure connection between the Ignition Panel PC and the Cloud-Based Virtual Ignition SCADA server.
   a. The Virtual Ignition SCADA server shall be accessible via a VPN connection on Owner devices such as the proposed rugged tablets.
   b. The network firewall shall connect to the Owner's existing internet connection located in the Electrical Building's Control Room.

B. Physical Requirements

1. Panel Din Rail Mountable
2. Dual redundant, hot-swappable PSUs.
3. Operating temp: 0–50°C; humidity ≤95% non-condensing.
4. MTBF data provided; lifecycle ≥5 years.
5. ISA/IEC 62443 certified components.
6. Integration with SIEM/OT monitoring platforms.

C. Functional Requirements

1. Stateful packet inspection for IPv4/IPv6, application-aware filtering.
2. Industrial protocol awareness (Modbus, DNP3, IEC 60870-5-104, OPC/UA).
3. Deny-by-default zone policies and VLAN-aware routing.
4. VPN: IPsec/IKEv2 and TLS, AES-256 encryption, certificate-based authentication.
5. Integrated IDS/IPS with signature and anomaly detection.

6. High Availability (HA): Active/Passive or Active/Active with <5s failover.
7. Syslog over TLS, SIEM integration, SNMP v3 monitoring, audit logs.
8. RBAC for administrators, MFA support, RADIUS/TACACS+ integration.
9. Traffic shaping and QoS for SCADA-critical flows.
10. Fail-safe behavior configurable (fail-open vs fail-closed).

D. Minimum Performance & Capacity Requirements
1. Baseline: ≥1 Gbps IMIX, ≥500,000 concurrent sessions, ≥200 VPN tunnels, ≥300 Mbps IPS.
2. Medium: ≥5–10 Gbps, ≥2,000,000 sessions, ≥1000 VPN tunnels, ≥2 Gbps IPS.
3. High: ≥10–40 Gbps, ≥10,000,000 sessions, ≥5 Gbps IPS.

E. Cryptography and Key Management
1. FIPS 140-2/3 validated modules preferred.
2. TLS 1.2 minimum, TLS 1.3 preferred. Disable legacy ciphers.
3. Support for certificate revocation (CRL/OCSP).
4. Secure key storage (TPM or equivalent).

F. Integration & Compatibility
1. Forward logs to SIEM (syslog TLS, CEF, LEEF).
2. REST API for configuration/monitoring.
3. Support configuration templates for automation.

G. Supply Chain & Firmware Management
1. Signed firmware images with secure update process.
2. Vendor provides SBOM on request.
3. Patch support lifecycle ≥5 years.

H. Support, Maintenance, & Licensing
1. 24x7 technical support with defined SLA (≤4h for critical).
2. Transparent licensing model.
3. Annual cost estimates for threat feeds and subscriptions.

I. Management & Administrative Controls
1. RBAC, unique accounts, no shared admin accounts.
2. Session timeout defaults (≤15 min idle).
3. MFA required for admin access.
4. Configuration backup/restore with integrity validation.

J. Privacy & Logging Retention
1. Local logs retained ≥90 days.
2. Forward logs to SIEM for ≥1 year online retention, ≥7 years archive (if required).

K. Safety & Operational Retention
1. Support detection-only IDS/IPS mode for testing.
2. Documented rollback procedures for changes.
3. Runbooks for common operations provided.

L. Procurement / Specification Summary Table
1. Firewall throughput baseline ≥1 Gbps IMIX.
2. Concurrent sessions ≥500,000 (baseline).

3. VPN tunnels ≥200 (baseline).
4. Industrial protocol awareness required.
5. HA clustering with stateful sync required.
6. Syslog TLS and SIEM integration required.
7. Dual PSUs mandatory.
8. Support lifecycle ≥5 years.

M. Manufacturers
1. Cisco (Firepower Next-Gen Firewalls)
2. Fortinet (Fortigate Rugged Series)
3. Palo Alto (PA-series Firewalls)
4. Check Point (Quantum Security Gateways)
5. Approved Equal

2.7 VIRTUAL PRIVATE NETWORK (VPN) FOR SCADA/OT ACCESS

A. General
1. This specification defines the minimum security, performance, management, and operational requirements for a Virtual Private Network (VPN) solution providing secure remote access into the wastewater plant's SCADA/OT network.
2. The VPN will be used by authorized plant operators, engineers, and vendors requiring access to SCADA, PLCs, and engineering workstations while ensuring segmentation, monitoring, and compliance with cybersecurity best practices.

B. Physical Requirements
1. Hardware or virtual VPN appliance (enterprise-grade, FIPS validated)
2. Baseline capacity: ≥ 200 concurrent tunnels, ≥ 500 Mbps encrypted throughput
3. Mandatory feature:
   a. MFA
   b. TLS 1.3
   c. FIPS cryptography
   d. SIEM integration
   e. HA

C. Functional Requirements
1. Must support site-to-site VPN (OT↔IT, OT↔remote plant) and remote-access VPN (users, vendors).
2. Protocol support: IPsec/IKEv2 and TLS 1.2/1.3.
3. Enforce strong encryption: AES-256-GCM (minimum), SHA-2 hashing, DH Group ≥14.
4. Support multi-factor authentication (MFA) for all remote users.
5. Certificate-based authentication (X.509, PKI integration).
6. Ability to restrict user access based on least privilege and role-based policies (per network zone, protocol, or device).
7. Full support for split tunneling disabled (all traffic forced through VPN, except where explicitly authorized).
8. Must integrate with existing firewall appliances for policy enforcement.
9. Automatic session timeout and re-authentication after inactivity.
10. Centralized monitoring/logging of VPN sessions.

D. Performance & Capacity Requirements
1. Concurrent VPN tunnels (baseline): ≥200
2. Throughput (encrypted traffic): ≥500 Mbps baseline, scalable to ≥2 Gbps for larger sites.

3. Maximum latency overhead: ≤50 ms for SCADA HMI/PLC traffic.
4. High Availability: Support redundant VPN gateways with seamless failover

E. Security & Cryptography
1. VPN must use FIPS 140-2/3 validated cryptographic libraries.
2. Must support TLS 1.3 (preferred) with modern cipher suites only.
3. Session key re-negotiation interval ≤ 8 hours (configurable).
4. Support for hardware security modules (HSM) or TPM for secure key storage.

F. Authentication & Access Control
1. Support for RADIUS/TACACS+ integration.
2. Enforce MFA (smartcard, OTP, or authenticator app).
3. Prohibit shared accounts — unique IDs per user.
4. Ability to restrict vendor VPN accounts to specific times or windows (e.g., maintenance periods only).

G. Monitoring & Logging
1. Log all VPN session activity:
2. Username, IP address, device ID, login/logout time, duration, data volume.
3. Send logs securely to SIEM (Syslog TLS, CEF, LEEF).
4. Support alerting for failed logins, unusual access times, and high traffic anomalies.

H. Device Security
1. VPN client software must support Windows, Linux, and hardened industrial laptops.
2. Ensure endpoint posture check:
   a. Device must have up-to-date patches
   b. AV/EDR running
   c. Disk encryption enabled
3. Restrict connections from unmanaged and non-compliant devices.

I. Integration
1. Must integrate seamlessly with firewall (perimeter/OT segmentation)
2. VPN Gateway should support REST API for configuration and monitoring
3. Centralized management console with role-based admin access.

J. Operational requirements
1. Provide redundant VPN gateways for resilience.
2. Vendor must supply documented hardening guide.
3. Support lifecycle (firmware and patches) ≥ 5 years.

K. Acceptance & Commissioning
1. Verify AES-256/TLS 1.3 encryption in active tunnels
2. Verify MFA enforcement
3. Simulate unauthorized access attempts and validate alerts
4. Validate throughput ≥ 500 Mbps under load
5. Test HA failover (failover time ≤ 5s, session preservation where possible)
6. Verify SIEM logging of VPN sessions.

L. Documentation & Deliverables
1. VPN deployment and configuration guide.
2. Secure baseline configuration guide.

3. Firmware lifecycle and patch support policy.
4. Escalation/support contact information

M. Manufacturers
1. Cisco
2. Fortinet
3. Palo Alto
4. Approved Equal

2.7 PANEL PC

A. General
1. Provide a panel PC as shown in the Drawings and specified herein.
2. Panel PC is referred to as “PPC” on the system architecture drawing.
3. The Panel PC shall be setup as an Ignition Gateway.
4. All Panel PC configuration, networking and setup shall be provided by the PCSS
5. The Panel PC shall interface with all SCADA PLCs and hardware.
6. The Panel PC shall connect to Wilbarger’s existing internet connection via the PCSS furnished firewall.
7. The Panel PC via its HMI Ignition application shall be configured to network with the virtual Cloud-based Ignition Server.
8. The virtual Cloud-based Ignition Server shall be configured by the PCSS to be an Ignition data gateway responsible for interfacing with remote HMI clients.

B. Performance Specifications
1. Processor:
   a. High Performance Intel Core i5/i7 CPU or equal
2. Memory:
   a. Capable of providing multitasking functions and the use of resource intensive applications
   b. 16 to 32GB DDR4 or DDR5 RAM
3. Storage:
   a. Solid State Drives (SSDs) with a minimum of 1TB capacity
4. Operating System:
   a. Windows 11
5. Display
   a. Screen Resolution options shall be provided to automatically scale and adjust as required to satisfy Ignition HMI requirements.
   b. Displays shall be touch-screen compliant and shall respond to operator requests
   c. Screen shall be a minimum 1200 NIT screen.
6. Environmental
   a. Panel PC shall be IP rated for indoor use only
   b. Temperature range: -4DegF to 140DegF
7. Construction
   a. Rugged aluminum or Stainless Steel
   b. Shall be built to withstand vibrations and shocks
8. Connectivity
   a. Panel PC shall be capable of connection via multiple network connections including, Ethernet, Modbus/TCP, RS232, etc.

C. Manufacturers
1. Cisco

2. Fortinet
3. Palo Alto
4. Approved Equal

2.8 SPARE PARTS

A. General requirements for spare parts are specified in section 13300.

B. The following Network and Communications System spare parts shall be furnished
1. One switch of each type provided.
2. One media converter of each type provided
3. Manufacturer's cables - one of each type installed.
4. Five-10ft CAT 6 cables with connectors installed

PART 3 – EXECUTION

3.1 ESTABLISHING COMMUNICATIONS

A. The PCSS is responsible for establishing all Remote site communications, RIO communications, PLC to PLC communications, and PLC to HMI communications and all other network and communication systems shown on the Drawings. The PCSS is shall perform the following tasks in order to ensure this communications is achieved:
1. Coordinating with contractor at beginning of project in order to determine which vendor packages are provided with PLCs. The PCSS shall submit the listing of these PLCs as part of their Hardware Submittal for review by the Engineer.
2. Identifying any additional hardware or software required to ensure communications as part of the PCSS hardware submittal.
3. During factory testing and field testing, the PCSS shall demonstrate communications to the Engineer. Burden of proof of communications is the transfer on 1 analog and 1 discrete register in both directions. The PCSS shall turn over all configuration files and programming to the AESS upon successful testing.
4. Assistance during field testing by being on-site when AESS is testing communications with their software.

END OF SECTION

SECTION 13321
FIBER OPTIC CABLING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Specifications for the fiber optic cables necessary for the data network, as shown on the Drawings and as specified herein.

1.2 RELATED WORK

A. Raceway Systems are included in Section 16120.

1.3 SUBMITTALS

A. Submit, in accordance with Section 01300, the following:
   1. Product Data
      a. Product data shall be provided for the data highway cables, terminations and splices. Product data sheets shall include the manufacturer's name and catalog number for each item, the manufacturer's descriptive literature and catalog cuts and power supply requirements.
   2. Samples
      a. Four samples of each type of cable, splice, and termination kit shall be submitted. Four samples of a completed example of each type of splice and termination shall be submitted.
   3. Manufacturer's Instructions

B. Submit the following administrative requirements:
   1. Test reports.
   2. O&M manuals.

1.4 REFERENCE STANDARDS

A. Underwriters Laboratories (UL)
   1. UL 1581 VW-1 - Vertical Tray Cable Flame Test
   2. UL 1666 - UL Standard for Safety Test for Flame-Propagation Height of Electrical and Optical-Fiber Cables Installed Vertical in Shafts.
   3. UL 910 - UL Standard for Safety Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air.

B. Institute of Electrical and Electronics Engineers (IEEE)

C. National Electrical Code (NEC)

D. National Electrical Manufacturers Association (NEMA)

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

A. The fiber optic cabling system materials furnished under this Section shall be provided by Fiber Optic suppliers who have been providing these types of materials for the past three years. The Fiber Optic suppliers shall provide personnel capable of providing technical assistance during installation.

B. The installation of fiber optic cabling system materials furnished under this Section shall be performed by an installation contractor who has been installing these types of materials for the past 3 years.

1.6 DELIVERY, STORAGE AND HANDLING

Ship cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Reels shall be of the type specified on the data sheets. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Corning Optical Communications, Charlotte, NC

B. Chromatic Technologies, Inc., Franklin, MA

C. Belden (Cooper Industries), Richmond, IN

D. Siecor Corp., Hickory, NC

E. AT&T Network Systems, Norcross, GA

F. A.P.D. Inc., Brooklyn, CT

G. Approved Equal

2.2 FIBER OPTIC CABLE

A. General
   1. Provide multi-mode, buffered, optical glass fiber cores compatible with LED based transmission systems. Maximum attenuation losses shall be 3.5 dB/km or less at a wavelength of 850 nm and 1.5 dB/km or less at a wavelength of 1300 nm. Minimum bandwidth shall be 160 MHz-km at 850 nm and 500 MHz-km at 1300 nm. Fiber core size shall be 62.5 micron unless otherwise directed by the system vendor. Plastic fiber core construction shall not be acceptable.

B. Armor jacketed multi-fiber cable
   1. Heavy duty, gel-filled, loose tube construction with dielectric central member, polyethylene inner jacket, steel tape armor and a medium density, oil, water and chemical resistant, UV stabilized polyethylene outer jacket, suitable for duct installation. Fiber cladding shall be 125 micron and fiber coating shall be 250 micron.

2. Cable Specifications:
   a. Fiber Count: as indicated.
   b. Installation Load: 600 lbs (minimum)
   c. Long Term Application Load: 130 lbs (minimum)
   d. Minimum Crush Resistance: 200 lbs/in
   e. Operating Temperature: minus 40 to plus 70 degrees, C
   f. Outside diameter: 0.50 (maximum)

C. Fiber Optic Non-Breakout Cable
1. Heavy duty, tight buffer construction with additional strength members and an oil, water and chemical resistant, UV stabilized, flame retardant, PVC outer jacket, UL listed OFNR. Fiber cladding shall be 125 micron and fiber buffer shall be 900 micron.
2. Cable Specifications:
   a. Fiber Count: as indicated.
   b. Installation Load: 100 lbs (minimum)
   c. Long Term Application Load: 14 lbs (minimum)
   d. Minimum Crush Resistance: 80 lbs/sq in
   e. Operating Temperature: minus 10 to plus 50 degrees C

D. Fiber Optic Interconnect Cable
1. Commercial duty, tight buffer construction with Kevlar strength member, polyurethane outer jacket.
2. Cable Specifications:
   a. Fiber Count: Single or duplex type as required.
   b. National Electric Code OFNR designation.
   c. Crush Resistance: 128 lbs/sq in
   d. Operating Temperature: minus 20 to plus 70 degrees C

2.3 TERMINAL CONNECTORS

A. Manufacturers
1. 3M Telecom Systems Group, Austin, TX
2. AMP, Inc., Harrisburg, PA
3. AT&T Network Systems, Norcross, GA
4. A.P.D., Inc., Brooklyn, CT
5. Approved Equal

B. Connectors: Type ST2 compatible design with ceramic ferrule and strain relief boot. The epoxy used to attach connectors to the individual fibers shall be a heat cure type featuring an accelerated cure cycle and color change upon cure completion. Connector specifications shall be as follows:
1. Insertion loss (typical): 0.5 dB
2. Durability (mating cycles): 1000 (minimum)
3. Repeatability: Less than 0.2 dB
4. Operating Temperature: minus 40 to plus 80 degrees C

2.4 PATCH PANELS

A. Manufacturers:
1. Siecor Corp., Hickory, NC

2. 3M Telecom Systems Group, Austin, TX
3. AT&T Network Systems, Norcross, GA
4. Approved Equal

B. Patch Panels: Suitable for DIN rail mounting, comprised of internal mounting plate, slack cable take up/organizer blocks, patch block with connectors and ground lugs as indicated. Panels shall be NEMA 12 construction unless otherwise indicated on the Drawings. Patch panels shall be suitable for multimode system operation at 800 and 1300 nanometers.

2.5 SPLICE CLOSURES

A. Manufacturers:
1. Siecor Corp., Hickory, NC
2. 3M Telecom Systems Group, Austin, TX
3. AT&T Network Systems, Norcross, GA
4. Approved Equal

B. Splice Closures: Constructed of thermoplastic, suitable for "butt" or "through" cable entry, moisture tight sealing arrangement, removable splice tray organizer, splice trays for mechanical splices, suitable for multimode system operation at 800 and 1300 nanometers, grounding lugs or equivalent for grounding cable armor.

PART 3 – EXECUTION

3.1 GENERAL

A. Provide all material, equipment and labor to install the fiber optic cables as shown on the Drawings and as specified herein.

B. Installation shall be in accordance with the NEC.

C. Provide delivery, storage, and handling of materials and equipment in accordance with Section 13300.

3.2 INSTALLATION

A. Install cables in the raceway systems as indicated. Inspect raceways prior to pulling in cables. Notify the Engineer of any conditions which would prevent installation of the specified cables, before proceeding with the installation.

B. Install armor jacketed multi-fiber cables in underground ducts. Rod and swab out ducts prior to installing cables.

C. Install non-breakout cables in conduit systems inside buildings and structures.

D. Lubricate cables with lubricants specially formulated for fiber cabling jackets during installation. Do not exceed cable manufacturer's specifications for tensile strength and bending radius. Pulleys used to aid in the installation of the fiber optic cable must be sized according to the minimum bending radius. The pulling tension of all fiber cables during installation shall be recorded using a strip recorder. The printout of the strip recorder shall be submitted to the Engineer.

E. Provide breakout kits, splice closures, signal transceivers, power supplies, patch panels, pigtails and jumpers as required and as indicated to install a complete data highway communications network. Patch panels and splice enclosures shall be wall mounted.

F. Splices: Splices shall be made in designated enclosures above ground only. Provide adequate put-up lengths on cable reels to make termination-to-termination runs without splices. Where splices are indicated provide mechanical splices with attenuation losses of 0.3 dB or less. Make splices watertight and provide mechanical protection equal to the cable jacket, or better.

G. Support cables in riser conduits at intervals as required by the NEC.

H. Installation tools and materials shall be approved by the cable manufacturer.

I. The polishing process of terminal connectors shall be a two stage wet process using 3.0 micron lapping film for an initial polish followed by 0.3 micron lapping film for the final polish.

3.3 IDENTIFICATION

A. Label each termination point.

B. Tag each cable in junction boxes, manholes and handholes. Provide permanent nylon/plastic tie-wrap type tags with waterproof markings.

3.4 PHYSICAL CHECKOUT

A. General Procedures:
1. Conduct physical checkout of the fiber optic data highway network.
2. Physical checkout shall be performed prior to functional testing.

B. Check Procedures:
1. Verify that fiber optic cable reels have been off-loaded from truck carefully and not damaged.
2. Verify that cable construction is the type specified.
3. Verify that fiber optic patch panels have been installed plumb and level at locations indicated.
4. Verify that fiber optic splice closures have been installed at locations indicated.
5. Verify that optical fiber connections or terminations within patch panels and splice closures are in accordance with cable manufacturer's recommendations.

3.5 FIELD AND FUNCTIONAL TESTING

A. Make the following field tests after cable installation:
1. Visually, inspect terminal connectors for out-of-round condition and surface defects such as micro-chips and cracks using a 100X (minimum) inspection microscope.
2. Check optical continuity of each fiber from terminal to terminal.
3. Verify the calculated attenuation power losses of each fiber from the transmit and receive terminals at the source of each data communications loop. The light source and operating wavelength of the test equipment shall be representative of the actual operating equipment.

END OF SECTION

SECTION 13330
CONTROL PANEL ENCLOSURES AND PANEL EQUIPMENT

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Refer to Section 13300.

B. Furnish and install control panels and panel mounted equipment as specified herein and shown on the Drawings.

C. All new panels and panel components shall match existing equipment makes and models wherever possible, so that system additions can be most easily integrated with respect to operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, equipment furnished must be fully compatible with the existing system. Color, size, and material of new panels should conform to that of existing panels.

D. Each panel shall be supplied with full sub-panels with the minimum specified dimensions regardless of the quantity of mounted components inside the panel. All panel mounted components shall be mounted on the 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 shall only be permitted after review and approval of the Engineer.

E. Furnish the following panels
   1. PANEL SCHEDULE
      a. See attachment 13330A – Panel Schedule

1.2 RELATED WORK

A. Refer to Section 13300 “I & C - General Provisions.”

1.3 SUBMITTALS

A. Refer to Section 13300.

B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Spare parts list.

E. Panel Layout Drawings and Wiring Diagrams Submittal
   1. Where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions, the Contractor shall provide to the PCSS the approved submittals in order for the PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings shall be included in the Final O&M submittal. Leaving this information blank on the Final Documentation drawings is not acceptable.

2. Panel Layout Drawings: Drawings shall be furnished for all panels, consoles, and equipment enclosures specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be 11"x17" in size. At a minimum, the panel drawings shall include the following:
   a. Interior and exterior panel elevation drawings to scale.
   b. Nameplate schedule.
   c. Conduit access locations.
   d. Panel construction details.
   e. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
   f. Fabrication and painting specifications including color (or color samples).
   g. 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.
   h. For every control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.
   i. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the Contractor.
3. Panel Wiring Diagrams: Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. 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. Field device wiring shall include the device ISA-tag and a unique numeric identifier. The 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 PCSS. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified and power sources noted. Submit final wire numbering scheme. Panel drawings shall be 11" x17" in size.

1.4 COORDINATION MEETINGS

A. Refer to Section 13300.

1.5 REFERENCE STANDARDS

A. Refer to Section 13300.

1.6 QUALITY ASSURANCE

A. Refer to Section 13300.

1.7 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300.

1.8 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300.

1.9 MAINTENANCE

A. Refer to Section 13300.

B. Test Equipment:
   1. Refer to Section 13300.

1.10 WARRANTY

A. Refer to Section 13300.

PART 2 – PRODUCTS

2.1 GENERAL

A. Refer to Section 13300.

2.2 LIGHTNING/SURGE PROTECTION

A. Refer to Section 13300.

2.3 CONTROL PANEL GENERAL REQUIREMENTS

A. The dimensions within this Section and on the Contract Drawings are for general reference only. Ensure that final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.

B. Each control panel and terminal cabinet shall bear the UL label. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and any other equipment necessary to achieve compliance with UL 508 requirement. The Drawings do not detail all UL 508 requirements.

C. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.

D. The devices designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment. Heat generating devices such as power supplies shall be located at or near the top of the panel.

E. The panels shall be completely fabricated, instruments and devices installed and wired at the PCSS's facility.

F. All components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with manufacturer's recommendations. The internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and PCSS's data.

G. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

H. Nameplates
1. All panels and panel devices shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Unless otherwise indicated, each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Booster Pump No. 1), and the third line containing a functional control description (e.g., Start).
2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. The letters shall be Black against a White background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.
3. Nameplate fasteners and mounting shall be epoxy adhesive or stainless steel screws for cabinet mounted nameplates
4. For every panel, provide a panel nameplate with a minimum of 1-in high letters. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights, and meters.

I. Mounting Elevations
1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.
2. Centerline of indicators and controllers shall be located no lower than 48-inches or higher than 66-inches above the floor on a panel face.
3. Centerline of lights, selector switches, and pushbuttons shall be located no lower than 32-inches or higher than 70-inches above the floor on a panel face.
4. Tops of annunciators shall be located no higher than 86-inches above the floor on a panel face.
5. Installation of panel components shall conform to component manufacturers' guidelines.

2.4 PANEL MATERIALS AND CONSTRUCTION

A. Structure and Enclosure
1. Panels shall be of continuous welded-steel or FRP construction as shown on the Panel Schedule. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

2. Each panel shall be provided with full height, fully gasketed access doors where shown. Doors shall be provided with a three-point stainless steel latch (except for NEMA 4X panels) and heavy duty stainless steel locking handle. Rear access doors (if included) shall be conveniently arranged and sized such that they extend no further than 24-inches beyond the panel when opened to the 90-degree position. Front and side access doors shall be as shown. Panel access doors shall be provided with full length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments.
3. The panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.
4. Top conduit penetrations are NOT allowed for panels unless otherwise indicated on the Drawings.
5. All conduit and cable penetrations shall be provided 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.
6. All panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted. All panels in outdoor, wet, and non-chemically corrosive environments shall be NEMA 4 unless otherwise noted. Panels in chemically corrosive environments shall be NEMA 4X unless otherwise noted. All panels located in a hazardous location shall be rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).
7. All panels located outdoors shall be white painted steel enclosure with a white polyester powder paint finish inside and out to help reduce absorption of solar radiation.

B. Freestanding and Floor-Mounted Vertical Panels
1. Freestanding and floor-mounted vertical panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of 12 gauge sheet steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated panels shall be constructed of Type 316 stainless steel, unless FRP is specifically indicated to be provided. Front panels or panels containing instruments shall be not less than 10 gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.

C. Wall and Unistrut Mounted Panels
1. All wall and Unistrut mounted panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of not less than USS 14 gauge steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated wall mounted panels shall be constructed of Type 316 stainless steel, unless FRP is specifically indicated. FRP panels shall be used in chlorine areas. All FRP panels located in direct sunlight shall be provided with a protective coating and sun shield to prevent discoloration and cracking.

D. Finish Requirements
1. All sections shall be descaled, degreased, filled, ground and finished. The enclosure when fabricated of steel shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.
2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.
3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sand-ing shall be applied to the intermediate exterior coat before top coating.

4. Apply a minimum of two coats of manufacturer's standard, flat light-colored lacquer, on the panel interior after priming.
5. Unless otherwise noted, the finish exterior colors shall be ANSI 61 gray with a textured finish.

E. Print storage pockets shall be provided on the inside of each panel. The storage pockets shall be steel, welded on to the door, and finished to match the interior panel color. The storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5 inch by 11 inch documents without folding.

F. Where specified on the Panel Schedule, a folding shelf shall be provided on the inside of the door on all free-standing and floor-mounted panels. The shelf shall be suitable for a laptop computer and shall be placed such that an open laptop computer does not interfere with any door-mounted devices. The folded shelf shall not interfere with any internal panel components when the door is closed. The folding shelf shall automatically lock in the horizontal position when raised. The folding shelf shall be approximately 18 inches wide by 12 inches deep and shall have a minimum distributed load rating of 100 pounds. All parts shall be made of heavy gauge steel and shall be painted white or finished to match the interior panel color.

2.5 ENVIRONMENTAL CONTROL

A. All panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. The internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel.

B. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.

C. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.

D. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel, and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.

E. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation, an air conditioner shall be provided.

F. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:
1. Sun shields shall be fabricated from minimum 12 gauge Type 316 stainless steel. Units shall be designed, fabricated, installed, and supported 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.
2. 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.
3. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.
4. The top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures the top section shall slope downward towards the back side of the enclosure.

5. The front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.
6. All seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.
7. All exposed corners, edges and projections shall be smooth rounded or chamfered to prevent injury.

G. All outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture shall be provided with an integral heater, fan, and adjustable thermostat to reduce condensation and maintain the minimum internal panel temperature. Mount the unit near the bottom of the enclosure with discharge away from heat-sensitive equipment. Heater shall be Hoffman DAH 100 Watts, 115 Volt, 50/60 HZ or equal.

2.6 CORROSION CONTROL

A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman Model AHCI; or equal.

2.7 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring
1. All interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 14 AWG minimum. Electronic analog circuits shall utilize 16 AWG shielded, twisted pair, cable insulated for not less than 600 volts.
3. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6-inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.
4. Terminations
    a. All wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.
    b. Multi-level terminal blocks or strips are not acceptable unless they are approved by the Engineer in advance of panel wiring diagrams. If approved, they shall be mounted on angled din rail elevated from the back panel.
    c. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares.
    d. Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Contract Drawings or specified elsewhere in Division 13.
    e. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare PLC and controller points shall be wired to terminal blocks.

f. Analog inputs and outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare PLC and controller points shall be wired to terminal blocks.
g. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
h. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not 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.
i. Circuit power from the SCADA cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards shall be isolated with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. Isolation switch block shall be an Allen Bradley Model 1492-H7 or equal. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
j. All PLC discrete outputs to the field shall be isolated with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator. The single circuit fusible terminal block shall be an Allen Bradley 1492-H4 or equal.

5. All wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection, shall be clearly identified as such.
6. All wiring shall be clearly tagged and color coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and loop drawings prepared by the PCSS. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:
   a. Incoming 120 VAC Hot - Black
   b. 120 VAC Hot wiring downstream of panel circuit breaker – Red
   c. 120 VAC Hot wiring derived from a UPS system – Orange with White stripe
   d. Three phase power – (480V/277V) Brown, Orange, Yellow, and Green ground or as specified in Division 16.
   e. 120 VAC neutral – White
   f. 120 VAC Neutral wiring deriving from a UPS system – White with Orange stripe.
   g. Ground – Green, or Green with a Yellow stripe
   h. DC power or control wiring (+) – Blue
   i. DC power or control wiring (-) – White with Blue Stripe
   j. DC analog signal wiring – Black (+), White (-) or Red (+), Black (-)
   k. Foreign voltage (dry contacts) – Yellow
7. Provide surge protectors on all incoming power supply lines at each panel per the requirements of Section 13300.
8. Each field instrument furnished under Division 13 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication. All instruments requiring 120VAC power shall be powered from the UPS source in the panel where the instrument signals lands.
9. Provide redundant 24 VDC power supplies to power field instruments and panel devices. Twenty-four VDC power supplies shall be as specified in this Section.
10. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.
11. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.

12. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.
13. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.
14. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
15. Each panel shall have control, signal, and communication line surge suppression in accordance with Section 13300.
16. All microprocessor-based electronic devices in the panel that are powered by 120VAC shall be powered by the UPS (refer to appropriate Section in Division 13).
17. Each panel shall be provided with a circuit breaker to interrupt incoming power.
18. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 16.

B. Pneumatic Tubing
1. Refer to Section 13300.
2. Pneumatic tubing shall be a minimum of 1/4-inch O.D. Type 316 stainless steel with compression fittings. All tubing shall be rigidly supported and run in horizontal or vertical planes.
3. All pneumatic equipment shall be provided with separate shut-off valves. Flexible polyethylene tubing shall be used on all devices mounted on hinged doors, etc.
4. A screened vent shall be provided on all enclosures using pneumatic instruments.
5. All pneumatic tubing shall be routed in separate bundles or wireways and shall be separated from all electrical wiring by a minimum of 3-inches.

C. Relays not provided under Division 16 and required for properly completing the control function specified in Division 13, Division 16, or shown on the Drawings shall be provided under this Section.

D. The orientation of all devices, including PLC and I/O when installed, shall be per the manufacturer's recommendations. No vertical orientation of PLC racks shall be allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the engineer.

2.8 ELECTRICAL COMPONENTS

A. The main circuit breaker shall be a thermal-magnetic molded case breaker, by Square D Company, or equal. Provide a flange mounted main power disconnect operating handle with mechanical interlock having a bypass that will allow the panel door to open only when the switch is in the OFF position.

B. A mechanical disconnect mechanism, with bypass, shall be installed on each motor circuit protector, capable of being locked in the "OFF" position to provide a means of disconnecting power to the motor.

C. 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 the detailed mechanical equipment requirements, the P&IDs (Division 13, the Control Wiring Diagrams (Division 16) and as shown on the Drawings.

D. All operating control devices and instruments shall be securely mounted on the exterior door. All controls shall be clearly labeled to indicate function and shall be in accordance with the electrical area classification indicated on the Electrical Contract Drawings.

E. A six digit, non-resettable quartz time base elapsed time meter shall be connected to each motor starter. Meter shall be Hobbs 98000 Series, Redington Model 722, Cramer Model ETI-635 G, or equal.

F. The control panel shall be provided with a lightning and surge protection unit on the line side of the main circuit breaker. Unit shall be 600 Volt, 3 Phase, General Electric "Tranquell" Series, or equal.

G. Where required by Specifications, an alternator shall be provided to sequence motors. Alternator shall be Catalog No. 008-120-13SP or 009-120-23AP by Stacon; Square D, Class 9039, Type HG-21 or equal.

H. Panel mounted timers shall be flush mounted, plug-in type, Eagle Signal Bulletin 125 cycle-flex, Idec SR6P-MO8G or equal, with ranges as shown on the Drawings, or as required by the detailed mechanical equipment specifications.

I. Specific control devices, control descriptions and other data are specified under the detailed specification for the mechanical equipment with which the control panel is supplied.

2.9 INDICATOR, BAR GRAPH

A. Type: Electronic bar graph; nominal 4 inch vertical scale and digital indicator.

B. Operation: To accept 4-20 mA DC input signal and provide an indication of measured variable on a vertical scale; microprocessor based with solid state circuitry; 101 segment bar graph and digital readout.

C. Functional:
1. Input: 4-20 mA DC into 250 OHMS maximum.
2. Indication: 4-inch scale graduated in engineering units.

D. Physical:
1. Case size: nominal 1 inch x 6 inch
2. Case type: dust and moisture resistant (NEMA 4X)
3. Mounting: flush panel suitable for high density mounting arrangements.

E. Performance: Accuracy (bar graph) plus or minus 2.0 percent; (digital indicator) plus or minus 0.1 percent of span.

F. Manufacturer(s):
1. Ametek Dixson.
2. Foxboro.
3. Moore Products.
4. Equal.

2.10 PILOT TYPE INDICATING LIGHTS

A. Type: Energy efficient Solid State LED Lamps.

B. Functional:
1. Units shall be provided with low voltage LED lamps suitable for the voltage supplied.
2. Lights supplied with 120V AC power shall have integral reduced voltage transformers.
3. Lamps shall be replaceable from the front of the unit.

C. Manufacturer(s):
1. Schneider Electric (Square D).
2. Eaton (Cutler-Hammer).
3. Allen Bradley.
4. General Electric.
5. Crouse Hinds (NEMA 7).
6. Equal.

2.11 SELECTOR SWITCHES AND PUSHBUTTONS

A. Type:
1. Control devices shall be heavy-duty oil tight type with stackable contact blocks.

B. Functional:
1. Provide contact arrangement and switching action as required for the control system specified.

C. Physical:
1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide silver sliding contacts rated 5 amps at 125 VDC, for electronic (millivolt/ milliamp) switching provide contacts rated lamp at 28 VDC.
2. Pushbuttons shall have flush type operators.
3. Selector switches shall have knob or wing lever operators; NEMA rating - 4X; Provide legend plates denoting switch/pushbutton position/ function.

D. Manufacturer(s):
1. Schneider Electric (Square D)
2. Eaton (Cutler-Hammer)
3. Allen Bradley.
4. General Electric.
5. Crouse Hinds (NEMA 7).
6. Equal.

2.12 POTENTIOMETER

A. Type:
1. Device shall be heavy-duty 30 mm oil tight type.

B. Functional:
1. 270-degree dial
2. Rated for 1,000 ohms.

C. Physical:
1. Mounting: Suitable for panel mounting
2. NEMA 4X rating; escutcheon plates scaled in engineering units.

D. Manufacturer(s):
1. Schneider Electric
2. Allen Bradley Co.
3. Cutler-Hammer.

4. Square D.
5. Equal.

2.13 GENERAL PURPOSE RELAYS AND TIME DELAYS

A. Type:
1. General purpose plug-in type.

B. Functional:
1. Contact arrangement/function shall be as required to meet the specified control function; Mechanical life expectancy shall be in excess of 10 million.
2. Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized.
3. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.
4. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

C. Physical:
1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide contacts rated 5 amps at 28 VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service; relays shall be provided with dust and moisture resistant covers.

D. Options/Accessories Required:
1. Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.
2. Provide mounting rails/holders as required.

E. Manufacturer(s):
1. Schneider Electric
2. Allen Bradley.
3. Potter & Brumfield.
4. Equal.

2.14 SIGNAL RELAY SWITCHES (CURRENT TRIPS)

A. Type:
1. Solid state, ASIC technology, electronic type.

B. Functional:
1. Input: 4-20 mA.
2. Output: Isolated contact output, double pole double throw, rated 5 amps at 120 VAC.
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 shall be adjustable to trip on rising or falling input signal, dual point alarms shall be adjustable to trip on rising and falling input signals.
7. Repeatability: Trip point repeatability shall be at least 0.1 percent of span.

C. Physical:
1. Mounting: DIN rail.

D. Manufacturer(s):
1. Action Instruments Slim Pak.
2. Acromag.
3. Equal.

2.15 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

A. Type:
1. Solid state, ASIC technology; electronic type.

B. Functional:
1. Accuracy: 0.15 percent.
2. Inputs: Current, voltage, frequency, temperature, or resistance as required.
3. Output: Current or voltage as required.
4. Isolation: There shall be complete isolation between input circuitry, output circuitry, and the power supply.
5. Adjustments: Zero and span adjustment shall be provided.
6. Protection: Provide RFI protection.

C. Physical:
1. Mounting: DIN Rail.

D. Manufacturer(s):
1. Action Instruments Slim Pak.
2. Acromag.
3. Equal.

2.16 SIGNAL SELECTORS, COMPUTATION, AND CONDITIONING RELAYS

A. Type:
1. Solid state, ASIC technology, electronic type.

B. Functional:
1. Inputs: 4-20 mA.
2. Outputs: 4-20 mA.
3. Protection: Provide RFI protection.
4. Operation: The relay shall multiply, add, subtract, select, extract the square root, or perform the specified conditioning/ computation function required. All inputs shall be able to be individually rescaled and biased as required.
5. Isolation: All inputs, outputs, and power supplies shall be completely isolated.
6. Accuracy: 0.35 percent of span.
7. Adjustments: Multi turn potentiometer for zero, span, scaling, and biasing.

C. Physical:
1. Mounting: DIN rail.

D. Manufacturer(s):
1. Action Instruments Slim Pak.
2. Acromag.

3. Equal.

2.17 INTRINSIC SAFETY BARRIERS

A. Type:
1. Barriers shall be of the 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.
2. Provide a barrier for instrumentation and equipment transmitting analog or digital signals that originate in a hazardous area as indicated in the design documents.

B. Options Required:
1. Barriers shall match power supply provided.
2. Barriers shall be located in non-hazardous areas.

C. Manufacturer(s):
1. Siemens Water Technologies – IS1 (4-20mA) and IS6 (dry contacts)
2. Gems – 54800 (4-20mA) and 65800 (dry contacts)
3. R. Stahl - Intrinspak
4. Equal.

2.18 EMERGENCY ALARM BEACON AND AUDIBLE HORN

A. Beacon alarm light:
1. Type:
   a. Beacon alarm light.
2. Physical:
   a. Beacon alarm light for building exterior mounting shall be 120 VAC, flush mounted, weatherproof construction.
   b. A 750,000-candle power xenon strobe tube and red polycarbonate lens.
3. Manufacturer(s):
   a. Federal Signal.
   b. Edwards.
   c. Wheelock.
   d. Equal.

B. Alarm Horn:
1. Type:
   a. Alarm horn shall be vibrating type for 120 Volts, 60 Hz.
2. Manufacturer(s):
   a. Federal Signal Corp.
   b. Edwards Co.
   c. Benjamin.
   d. Equal.

2.19 INTRINSIC SAFETY BARRIERS (FOR 2-WIRE TRANSMITTER SYSTEMS)

A. Intrinsic safety barriers shall be passive devices requiring no external voltage supply and 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.

B. Unit shall be Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).

C. Manufacturer(s):
1. P&F.
2. Gems.
3. Unitech.
4. Equal.

2.20 24 VDC POWER SUPPLIES

A. Provide a 24 VDC power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.

B. The 24 VDC power supply shall meet the following requirements:
1. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.
2. Output voltage: 24 VDC.
3. Output voltage adjustment: 5 percent.
4. Line regulation: 0.05 percent for 10 volt line change.
5. Load regulation: 0.15 percent no load to full load.
6. Ripple: 3 mV RMS.
7. Operating temperature: 32 to 140 degrees Fahrenheit.

C. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity.

D. If power supply on/off status signal is shown, provide a relay contact (internal to the power supply or external if the power supply is not so equipped) to indicate on/off status of the power supply.

E. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

F. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

G. Manufacturer(s):
1. Acopian.
2. Lambda.
3. Equal.

2.21 DIGITAL PANEL METER

A. Type:
1. Electronic, 3.5 digit, 0.56 inch high efficiency LED display.

B. Operation:
   1. To accept 4-20 mA DC input signal and provide indication in Engineering Units of measured variable.

C. Functional:
   1. Power supply: 115 VAC, plus or minus 10 percent, 50/60 Hz, 10 VA.
   2. Input: 4-20 mA DC into 100 ohms.
   3. Indication: 0.56 inch LED display.

D. Physical:
   1. Case size nominal 2.5 inch high by 5 inch wide by 6 inch deep.
   2. Case type: watertight and dust-tight (NEMA 4X).
   3. Mounting: flush panel suitable for high density mounting arrangements.
   4. Performance: Linear input accuracy plus or minus 0.05 percent of calibrated span, plus or minus 1 count.

E. Manufacturer(s):
   1. Precision Digital.
   2. Red Lion.
   3. Equal.

2.22 SPARE PARTS

A. General requirements for spare parts are specified in section 13300.

B. The following control panel spare parts shall be furnished:
   1. Timers and sockets - Two of each type installed.
   2. Relays and sockets - Two of each type installed.
   3. Fuses and circuit breakers - 10% (minimum of 10 fuses and 2 circuit breakers) of each type and size installed.
   4. Light bulbs - 10% (minimum of 10) of each type installed. For LED type lights, 5% (minimum of 3) of each color installed.
   5. Panel Mounted power supplies - one of each type installed.
   6. Selector switches/pushbuttons - Two of each type installed including contact blocks.
   7. Provide touch-up paint, of each type and color used for all cabinets, panels, and consoles supplied.

PART 3 – EXECUTION

3.1 INSTALLATION

A. The panels shall be installed at locations as shown on the Contract Drawings.

B. Refer to Section 13300.

3.2 TESTS

A. Refer to Section 13300.

END OF SECTION

CONTROL PANEL SCHEDULE										
Tag No.	**Description**	**Provided By**	**PLC**	**OIT/HMI**	**Minimum Size (in) (H x W x D)**	**Maximum Size (in) (H x W x D)**	**Enclosure Rating & Type**	**Mounting Type**	**Referenced Specifications**	**Referenced P&ID**
CP-01-001	SCADA Panel (Central PLC Panel CP-12-101)	Contractor	YES	YES	24 x 24 x 12	48 x 36 x 12	NEMA 4X S.S. 316	Rack Mounted	13300, 13441	-
CP-02-001	Lift Station PLC Panel	Contractor	YES	NO	36 x 24 x 12	48 x 36 x 12	NEMA 4X S.S. 316	Rack Mounted	11110, 13300, 13441	2-I-1
CP-03-002	Headworks Control Panel No. 2	Vendor	YES	YES	48 x 36 x 12	60 x 48 x 12	NEMA 4X S.S. 316	Floor with 24" Stands	11221, 13300, 13441	3-I-1
CP-04-001	Peak Shaving Basin Control Panel	Contractor	YES	NO	48 x 36 x 12	60 x 48 x 20	NEMA 4X S.S. 316	Floor with 24" Stands	11130, 13300, 13441	4-I-1
CP-06-301	Clarifier Control Panel	Vendor	NO	NO	24 x 24 x 12	36 x 24 x 12	NEMA 4X S.S. 316	Rack Mounted	11320, 13300, 13441	6-I-1
CP-09-601	Blower No. 6 Local Control Panel	Vendor	YES	YES	24 x 24 x 12	36 x 24 x 12	NEMA 4X S.S. 316	Rack Mounted	11171, 13300, 13441	9-I-1
CP-10-001	NPW System Control Panel	Contractor	YES	NO	60 x 48 x 20	72 x 60 x 24	NEMA 4X S.S. 316	Floor Mounted	11130, 13300, 13441	10-I-1
CP-11-001	Chemical Systems PLC Panel	Contractor	YES	NO	48 x 36 x 12	60 x 48 x 20	NEMA 4X S.S. 316	Rack Mounted	11160, 13300, 13441	11C-I-1
CP-11-001	Chemical Fans Control Panel	Contractor	NO	NO	18x18x10	24x24x10	NEMA 4X S.S. 316	Rack Mounted	11160, 13300, 13441	-
CP-14B-001	Dewatering NPW Booster Pumps Control Panel	Contractor	NO	NO	36 x 36 x 12	60 x 48 x 20	NEMA 4X S.S. 316	Floor with 24" Stands	11144, 11445, 13300, 13441	14B-I-1
CP-14B-001	Dewatering Fans Control Panel	Contractor	NO	NO	18x18x10	24x24x10	NEMA 4X S.S. 316	Rack Mounted	11160, 13300, 13441	-
CP-14D-101	Volute Press Control Panel	Vendor	YES	YES	60 x 48 x 12	72 x 60 x 20	NEMA 4X S.S. 316	Floor with 12" Stands	11445, 11540, 13300, 13441	14D-I-1

SECTION 13335
CONTROL PANEL UNINTERRUPTIBLE POWER SUPPLY (SINGLE-PHASE)

GENERAL

SCOPE OF WORK

A. Labor, equipment, supervision and materials for the installation, testing, startup, and training for the uninterruptible power supply (UPS) as shown on the Drawings and as specified herein.

1.2 RELATED WORK

A. Section 16010– Electrical – General Provisions.

B. Section 16140– Wiring Devices.

C. Section 16950– Electrical Acceptance Tests.

1.3 SUBMITTALS

A. Submittals shall be in accordance with Sections 01300 and 13300. Submittals shall include shop drawings and product data, for the following:
   1. Product brochure.
   2. Bill of materials listing all components provided.
   3. Deviation list indicating all proposed exceptions.
   4. Power single line and control schematics drawings. All external connection details and their terminal block locations shall be fully detailed. All internal wiring shall include terminal numbers and color coding.
   5. UPS performance specifications:
      a. kVA rating.
      b. Input and output voltage and phase.
      c. Run time at full and half load.
      d. Voltage (output regulation, input tolerance, unbalance, transfer/retransfer voltage, etc.).
      e. Heat rejection.
   6. Operating Instruction manuals and recommended replacement parts.
   7. Name, address, and telephone number of the nearest service facility.
   8. Training agenda and information per Section 01758.
   9. Battery specifications and warranty.
   10. UPS Loading and battery sizing calculations to support runtimes as specified herein.

1.4 REFERENCE STANDARDS

A. ANSI C62.41/IEEE 587 - Standards for Surge Withstandability.

B. FCC (Federal Communications Commission) Rules and Regulations, Part 15, Subpart B, Class A certified compliance.

C. UL (Underwriters Laboratories) 1778 Listed (Rev. Jan 5, 2000), UL497A

D. CSA 22.2, No. 107.1 M95 AND 107.2.

E. IEC 62040-2 Emission and Immunity.

F. IEC 62040-3 (Uninterruptible Power Systems, Part 3).

G. EN 60529 Equipment Protection.

H. National Electric Code (NFPA-70).

I. ISO 9001.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide delivery, storage and handling in accordance with Section 01600 and per the following:
1. Store the equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install the equipment in its final location until the facilities are permanently weather tight. Furnish, install and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. Protect the equipment at all times from exposure to moisture and chemicals.

1.6 QUALITY ASSURANCE

A. UPS systems shall utilize a field proven design. The UPS manufacturer shall demonstrate at least ten years of continuous field operating experience with equipment of similar size and design.

B. A factory authorized service and parts organization shall be located within 100 miles of the project location. Submit the name and address of the factory authorized service and parts organization. The manufacturer shall have a complete selection of service options that may include onsite service by factory-employed service engineers and factory depot quick-return service plan options.

C. Equipment shall be UL or ETL labeled.

D. The UPS manufacturer shall have ISO 9001 certification.

E. The UPS system shall meet or exceed the theoretical Mean-Time-Between-Failures (MTBF) for a Single module UPS operation (represents UPS module operation only) of 140,000 MTBF hours.

1.7 WARRANTY

A. UPS: In addition to the basic warranty, the UPS manufacturer shall provide a standard warranty for the UPS for a period of one year from the date of purchase. The Contractor shall provide an additional one year extended warranty to cover delays associated with equipment startup or date of receipt by end user, whichever occurs first.

B. Battery: In addition to the basic warranty, the UPS manufacturer shall provide a standard warranty for the batteries for a period of one year from the date of purchase. The Contractor shall provide an additional one year extended warranty to cover delays associated with equipment startup or date of receipt by end user, whichever occurs first.

PART 2 – PRODUCTS

SINGLE-PHASE UPS - EXTERNAL TO CONTROL PANEL

A. SYSTEM DESCRIPTION
1. Provide a continuous-duty, on-line, solid state, dual conversion, single-phase input (using input voltage as shown on the Drawings), single-phase 120VAC true sinewave output uninterruptible power system.
2. The UPS shall provide power conditioning and power backup for computer, communication, and other critical electronic loads as indicated on the Drawings.
3. The UPS system shall consist of the following major components:
   a. Rectifier and battery charger.
   b. Inverter.
   c. Batteries and battery disconnect switch.
   d. Automatic static bypass switch.
   e. External maintenance bypass switch.
   f. Integral control and monitoring panel.
   g. Other features as described in this Section and as indicated on the Drawings.
4. The UPS shall be manufactured by one of the following:
   a. Liebert GXT2 Series.
   b. Eaton Powerware.
   c. Schneider Electric APC Smart-UPS.
   d. Ametek Solid State Controls
   e. Tripp Lite
   f. Or equal.

B. General Requirements
1. External Battery Enclosure: A separate enclosure shall be provided for housing additional batteries if required to provide the minimum run time as specified herein. The battery enclosure shall match the main UPS enclosure in style and color.
2. All cabling required to interconnect all components of the UPS system shall be provided by the UPS manufacturer.
3. Battery protection shall be provided an internal circuit breaker disconnect. Battery cabinets shall be protected by an internal circuit breaker.
4. Current limiting circuitry shall protect the inverter output under any load condition. High speed semiconductor fusing shall protect the static bypass in the event of an output short circuit.
5. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for installation of a bonding connector shall be provided.
6. The UPS shall be suitable for installation at the location as shown on the Drawings.

C. Performance Requirements – Ratings
1. Battery runtime: Provide batteries to support 125% of calculated load for 20 minutes. Provide additional batteries in separate enclosure as required to meet the runtime requirement.
2. Output power: Provide the minimum recommended kVA ratings for the following UPSs in order to supply the control panels and ancillary equipment shown on the Control System Architecture Diagram and the P&IDs. Confirm UPS ratings below per UPS submitted load calculations, spare capacity, and runtime requirements as specified herein.

D. Performance Requirements -Environment:
1. Ambient temperature: 0 to 40 degrees C.
2. Elevation: Project site elevation
3. Relative humidity: 0 to 95 percent non-condensing

E. Electrical Requirements:
1. System Input – Primary source:
a. Single input: Nominal Input Voltage: As shown in the Drawings.
b. Frequency: 60 Hertz plus or minus five percent.
c. Input Power Factor: 0.96 lag minimum, 50 to 100 percent load.
d. Input Current Total Harmonic Distortion (THD) : <33 percent.
e. Input Surge Withstandability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).
f. Input Connection: Coordinate with electrical contractor.
2. System Output:
a. Nominal Output Voltage: As indicated herein and as shown on the Drawings.
b. Frequency: 60 Hertz plus or minus 3 Hertz.
c. 100 percent load with 3:1 Crest Ratio
d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup)
e. Output Connections: (six) NEMA 5-15R receptacles.
3. AC to AC Efficiency: (100 percent load @ rated PF): 91 percent
4. Acoustical Noise: Noise generated by the UPS under normal operation shall not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.
5. EMI Suppression: The UPS shall meet FCC Rules and Regulation 47, Part 15, Subpart B, for Class A devices.

F. Modes of Operation
1. Normal Mode: The UPS shall be a continuous online unit. Power to the critical loads shall be continuously generated by the inverter during normal AC line power. In the event of AC line power failure, power to inverter is supplied by the batteries. Under normal operation, the batteries shall be charged in a manner that optimizes battery life. Simple "trickle charge" of the batteries shall not be acceptable.
2. Bypass Mode: The automatic bypass shall transfer the critical load to the commercial AC source, bypassing the UPS' inverter/rectifier, in the case of an overload, load fault, or internal failure.
3. Maintenance Mode: If a Maintenance Bypass switch is provided, the external manual bypass switch shall be operated to transfer the load to the alternate source when the UPS is taken out of service for maintenance or repair. This transfer shall occur without interruption.

Controls
1. Microprocessor-controlled circuitry: Fully automatic operation of the UPS shall be provided through the use of a microprocessor-based controller. All operating and protection parameters shall be firmware-controlled. The logic shall include system test capability to facilitate maintenance and troubleshooting. Startup, battery charging, and transfers shall be automatic functions.
2. Graphical Display: The UPS control panel shall utilize an LED graphical display for all UPS control, monitoring, alarming, configuration and diagnostic functions. The following operational controls and indicators shall be provided on the UPS control panel per the following KVA ranges:

H. to 3 KVA Controls:
1. UPS On/Alarm Silence/Manual Battery Test control
2. Standby/Manual Bypass control.

I. to 3 KVA Indicators
   1. LED Battery Meter
   2. Battery in operation status
   3. Load on Inverter status
   4. Load on By-Pass status
   5. AC input status
   6. UPS malfunction alarm
   7. 3 to 6 KVA Controls:
      a. UPS On/Alarm Silence/Manual Battery Test control
      b. Off/ Bypass control
   8. 3 to 6 KVA Indicators:
      a. Battery in operation status
      b. Load on Inverter status
      c. Load on By-Pass status
      d. AC input status
      e. UPS malfunction alarm
      f. LED AC Input Meter
      g. LED Battery Meter
      h. AC input voltage (line to line)
      i. AC input current (each phase)
      j. AC input power (kW, KVA and power factor)
      k. DC battery voltage
      l. Battery current (charge and discharge)
      m. AC output current (each phase)
      n. AC output frequency
      o. AC output power (kW, KVA and power factor)
      p. Diagnostic Alarms: Specific details for all UPS alarms and status parameters shall be indicated on the graphical panel for diagnosis.

J. Remote alarm and status indication: Isolated SPDT Form C dry contacts shall be provided to indicate UPS status for remote monitoring. Contacts shall be rated for 250VAC @ 5A or 30VDC @ 5A. Individual contacts shall be provided for separate annunciation of the following alarm and status conditions:

K. RECTIFIER/CHARGER
   1. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.

L. INVERTER
   1. The inverter shall include all solid-state equipment and controls to convert DC power from the rectifier/charger or battery to a regulated AC power for powering the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.
   2. The inverter shall be capable of supplying current and voltage for overloads exceeding 100 percent. The inverter is to provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.
   3. The output voltage shall be maintained to within plus or minus 4 percent.

4. The output voltage total harmonic distortion (THD) shall not be greater than 5 percent for all loads. For 100 percent rated load of 3:1 crest factor nonlinear loads, the output voltage total harmonic distortion shall not be greater than 4 percent. The output rating shall not be derated in kVA or kW due to the 100 percent nonlinear load with 3:1 crest factor.
5. The inverter shall use software control to adjust the output voltage from plus or minus 5 percent of the nominal value.

M. BATTERIES
1. The batteries shall be VRLA (valve-regulated lead-acid), sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no off-gassing or water addition requirements. Batteries shall not require special ventilation. The battery shall consist of one or more battery banks with the number of cells required to meet the requirements of the rest of these specifications.
2. Battery Design Life: five years
3. Run time operation of the UPS shall be accomplished using batteries mounted within the UPS enclosure and supplemented as required with an external battery enclosure to provide the battery runtime specified.

N. EXTERNAL MAINTENANCE BYPASS
1. Each UPS shall be provided with a "two-position" external bypass switch system to permits the UPS to be removed for repair or maintenance without causing power disruption to the connected power loads. The external bypass switch shall be snap-action type with switching speed approximately 10ms or less independent of operator action. External bypass switch positions shall be labeled UPS and UTILITY.
2. For UPS units up to and including 3 KVA, furnish Liebert MicroPOD, Eaton PowerWare HotSwap MBP, or equal.
3. Substitution of standalone switches, such as Electroswitch series 103 snap action switch (or equal), along with custom plugs, receptacles, and appropriate wiring to achieve the specified functionality is acceptable.
4. For UPS units above 3 KVA, substitute standard manufacturers Maintenance Bypass switch offering or standalone switches as indicated above.
5. NOTE: Prefabricated vendor furnished external maintenance bypass switches do not provide a dry contact for remote monitoring of the BYPASS/NORMAL switch (See N.2 above). Recommend eliminating this requirement as impractical. Note: When the UPS is removed after the external switch bypasses it, none of the other UPS onboard statuses are available either. Electroswitch will provide you with a dry contact and if above 3KVA check with manufacturer for units specifying around. Edit below as required.
6. Provide a dry contact to indicate when bypass switch is in “Maintenance” position. Contact shall be rated for 250VAC @ 5A or 30VDC @ 5A.

O. ENCLOSURES
1. All UPS equipment shall be housed in a free standing NEMA 1 enclosure(s). The enclosures shall line up and match in style and appearance.

SINGLE PHASE UPS - INTERNAL TO CONTROL PANELS

A. SYSTEM DESCRIPTION
1. Provide an industrially rated continuous-duty, on-line, solid state, line interactive, single-phase uninterruptible power system.
2. The UPS shall provide power conditioning and power backup for PLC, communications hardware, and other critical electronic loads as indicated on the Drawings.
3. The UPS system shall consist of the following major components:

4. Rectifier and battery charger.
5. Inverter.
6. Batteries.
7. Other features as described in this Section and as indicated on the Drawings.
8. The UPS shall be
   a. Allen Bradley 1609-U UPS
   b. Sola Hevi Duty SDU UPS
   c. Or equal

B. GENERAL REQUIREMENTS
1. Battery protection shall be provided an internal circuit breaker disconnect.
2. Current limiting circuitry shall protect the inverter output under any load condition.
3. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for installation of a bonding connector shall be provided.
4. The UPS shall be suitable for installation in a UL508A listed panel.
5. The UPS shall be DIN rail mountable.
6. UL recognized components for industrial applications in accordance with UL508 without de-rating.

C. PERFORMANCE REQUIREMENTS
1. Ratings
   a. Output power: 350VA – 800VA
   b. Battery runtime: 14 minutes at full-load, 34 minutes at half-load
2. Environment:
   a. Ambient temperature: 0 to 40 degrees C.
   b. Elevation: Up to 500-ft above mean sea level
   c. Relative humidity: 1 to 95 percent non-condensing
3. System Input – Primary source:
   a. Single input: Nominal Input Voltage: 120 VAC
   b. Frequency: 45 to 65 Hz.
   c. Input Power Factor: 0.95 lag minimum, 50 to 100 percent load.
   d. Input Surge Withstandability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).
4. System Output:
   a. Nominal Output Voltage:120 VAC
   b. Frequency: 60 Hertz plus or minus 3 Hertz.
   c. 100 percent load with 3:1 Crest Ratio
   d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup)
5. AC to AC Efficiency: (100 percent load @ rated PF): 88 percent online, 86 percent on battery.
6. Acoustical Noise: Noise generated by the UPS under normal operation shall not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.
7. EMI Suppression: The UPS shall meet FCC Rules and Regulation 47, Part 15, Subpart J, for Class A devices.

D. MODES OF OPERATION
1. The UPS shall operate as a line interactive on-line, fully automatic system in the following modes:
   a. Normal: The critical load shall be continuously supplied with filtered and regulated AC power by the inverter. The rectifier/battery chargers shall derive power from the preferred AC source and supply DC power to the inverter while simultaneously floats charging the batteries.

b. Emergency: Upon failure of the preferred ac power source, the critical load shall continue to be supplied by the inverter. Inverter power shall be supplied without switching from the storage battery. There shall be no interruption to the critical load upon failure or restoration of the preferred ac sources. If the AC source cannot be restored before the battery discharges to its low voltage dropout value, the UPS shall automatically shut itself down in an orderly manner.

c. Recharge: Upon restoration of the AC source, the rectifier/battery charger shall power the inverter and simultaneously recharges the batteries. This shall be an automatic function causing no interruption to the critical load.

E. RECTIFIER/CHARGER

1. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.

F. INVERTER

1. The inverter shall include all solid-state equipment and controls to convert DC power from the rectifier/charger or battery to a regulated AC power for powering the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.
2. The inverter shall be capable of supplying current and voltage for overloads exceeding 100 percent. The inverter is to provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes. A status indicator and audible alarm shall indicate overload operation.
3. The output voltage shall be maintained to within plus or minus 5 percent.
4. The output voltage total harmonic distortion (THD) shall not be greater than 5 percent at full load.

G. BATTERIES

1. The batteries shall be High Temperature sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no off gassing, or water addition requirements. Batteries shall not require special ventilation. The battery shall consist of one or more battery banks with the number of cells required to meet the requirements of the rest of these specifications.
2. Battery Design Life: two-four years.

H. CONTROLS AND MONITORING

1. Microprocessor-controlled circuitry: Fully automatic operation of the UPS shall be provided through the use of a microprocessor-based controller. All operating and protection parameters shall be firmware-controlled. The logic shall include system test capability to facilitate maintenance and troubleshooting. Startup, battery charging, and transfers shall be automatic functions.
2. Front Indicators: As a minimum, the following indicators shall be provided on the UPS control panel:
   a. On-line (UPS is using utility power to power the load)
   b. In bypass mode
   c. On battery
   d. Overload
   e. Replace battery / battery disconnected
   f. Fault
   g. Bar graph for utility voltage
   h. Bar graph for battery

3. Front Panel Controls: As a minimum, the following controls shall be provided on the UPS control panel
   a. Power On/Off
   b. Self-test
   c. Alarm silence
   d. Cold start
   e. Load off
4. Remote alarm and status indication: Isolated SPDT dry contacts shall be provided to indicate UPS status for remote monitoring. Contacts shall be rated for 250VAC @ 5A or 30VDC @ 5A Individual contacts shall be provided for separate annunciation of the following alarm and status conditions:

24VDC UNINTERRUPTIBLE POWER SUPPLY

A. Type:
   1. 24 VDC uninterruptible primary switched mode power supply unit.

B. Operation:
   1. To provide uninterrupted 24VDC power to the output upon loss of input power.
   2. When the 24 V supply voltage is applied, the connected battery module is charged.
   3. In the event of a supply voltage failure, the battery module is connected to the output, and the stored power ensures that all connected devices continue to operate without interruption. The UPS supplies a 24V DC voltage with a load current up to 10 A.

C. Functional:
   1. Input voltage range: 22.5-30 VDC
   2. Nominal Output Voltage: 24VDC
   3. Output Current: 10A

D. CONTROLS
   1. Dry contacts shall be provided for remote monitoring of UPS conditions:
      a. UPS on battery
      b. Fault

E. Physical:
   1. Mounting: horizontal DIN rail mounting
   2. Operating temperature range: 0-50 C
   3. Degree of protection: IP20

F. Performance: The UPS shall provide a minimum of 15 minutes of run time for the calculated full load. The unit may have either internal or external batteries as necessary to support the runtime requirements.

G. Manufacturer(s):
   1. Phoenix Contact Quint Series
   2. Siemens SITOP Series with signaling contact module
   3. Sola HD Series
   4. Or equal

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install and connect the equipment in accordance with the manufacturer's instructions.

B. Remove temporary lifting angles, lugs, and shipping braces.

C. Touch up damaged paint finishes.

3.2 FACTORY TESTING

A. Prior to shipment, the complete UPS system shall undergo the manufacturer's standard factory test.

3.3 FIELD TESTING

A. Perform the following minimum test and checks:
1. Verify that all connections are completed in accordance with shop drawings.
2. Verify supply voltage and phase sequence are correct.
3. Check mechanical interlocks for proper operation.
4. Test ground connections for continuity and resistance.
5. Check control circuit interlocking and continuity.

B. Submit the test plan for review and approval.

C. For UPSs rated 3-6kVA, the manufacturer's field service technician shall perform startup and adjustment of the UPS in accordance with the manufacturer's written instructions. Submit a copy of the field report containing verification of all startup tests and adjustments performed.

D. The Contractor shall include testing of battery runtime under full load with loss of AC power.

E. Perform all additional tests required by Section 16950 Electrical Acceptance Testing.

F. In the event of an equipment fault, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, the Engineer and the equipment manufacturer's factory service technician. Repair or replace the equipment as directed by the Engineer.

3.4 ADJUSTMENT

A. Make all UPS adjustments necessary for manual and automatic operation of the entire system.

3.5 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.6 TRAINING

A. Provide training of staff in accordance with Section 01758 and Section 13303.

END OF SECTION

SECTION 13340
INSTRUMENTS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. This Section covers the furnishing, installation, and services for instruments.

1.2 RELATED WORK

A. Refer to Section 13300 “I & C - General Provisions.”

1.3 SUBMITTALS

A. Submit complete documentation of all field instruments using ISA-TR20.00.01-2001 (updated in 2004-2006) data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment. The list shall be sorted by Loop Number.

B. Submit separate data sheets for each instrument including:
1. Plant Equipment Number and ISA tag number per the Drawings.
2. Product (item) name used herein and on the Drawings.
3. Manufacturer's complete model number.
4. Location of the device.
5. Input - output characteristics.
6. Range, size, and graduations in engineering units.
7. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with requirements.
8. Materials of construction for enclosure and wetted parts.
9. Instrument or control device sizing calculations where applicable.
10. Certified calibration data for all flow metering devices.
11. Two-wire or four-wire device type as applicable.

C. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

D. Submit index and data sheets in electronic format as well as hard copies on 8-1/2" x 11" formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on CD-ROM or DVD disk.

1.4 MAINTENANCE

A. Refer to Section 13300.

1.5 INSTRUMENT TAGS

A. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section and related sections. Equipment shall be tagged before shipping to the site.

B. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.

C. All supplied instrument transmitters and instrument transmitter elements shall have a stainless steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24 gauge min) to a non-removable part of the device. The tag size shall be a minimum of 1.5 square inches. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

1.6 MANUFACTURERS' START-UP AND TRAINING SERVICES

A. If indicated in the individual instrumentation paragraphs, the instrument manufacturer or manufacturer's certified service representative shall provide start-up and training services. This work shall not be done by the PCSS or AESS contractor.

B. The start-up services shall be to calibrate, oversee the installations of the sensor, and start-up the sensor/transmitter in order to provide reliable measurement at the instrument and to a remote system. The vendor shall work with the PCSS and AESS to verify the transmitter sends correct information to the remote system (i.e., that the scaling and units are the same at the instrument and on the remote operator interface).

C. While the instrument manufacturer or manufacturer's certified service representative is starting up the instrumentation, training shall be provided to the Owner's instrumentation technicians. The training shall be in how to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

PART 2 – PRODUCTS

2.1 MAGNETIC FLOWMETER

A. Flow Element
   1. Type:
      a. Pulsed DC type.
   2. Function/Performance:
      a. Operating Temperature: Process liquid temperatures of 0 to 140 degrees F or greater dependent upon liner and an ambient of minus 30 to 150 degrees F.
      b. Radio Frequency Interference (RFI) protection: RFI protection shall be provided as recommended by the manufacturer.
      c. Pressure rating: Equal to piping system where meter is installed.
      d. Additional: Meter shall be capable of running empty indefinitely without damage to any component.
   3. Physical:
      a. Flanges: ANSI 150 lb. or DIN PN 16 carbon steel, as required by the piping system, unless otherwise indicated.
      b. Liner: Polyurethane or composite elastomer unless otherwise indicated on the Drawings or in the Instrument Device Schedule.
      c. Electrodes: Type 316 stainless steel standard minimum requirements. All electrodes to be compatible with process fluid as indicated on the Drawings or electrodes to be supplied as listed in the Instrument Device Schedule.
      d. For sludge, polymer, or any slurry application where the electrodes will be coated, a self-cleaning or a removable electrode option must be provided with that meter.

e. Housing: For meters with remote mounted transmitters, meters below grade shall be suitable for submergence for up to 48 hours to a depth of 30 ft. (9m). Meters above grade shall be NEMA 4X (IP65). Where hazardous areas are indicated on the Drawings, the equipment shall be rated for that area.

f. Finish: All external surfaces shall have a chemical and corrosion resistant finish.

4. Power Requirements:
   a. Meter shall be 24 VDC powered instrument, receiving its power from transmitter.
5. Accessories/Documentation Required:
   a. Factory calibration: All meters shall be factory calibrated. A copy of the calibration report shall be included in the O&M manual.
   b. Grounding: Meter shall be grounded in accordance with the manufacturer's recommendation. Provide ground ring, ground wires, gaskets, etc., as required. All materials shall be suitable for the liquid being measured and must be compatible with process fluid and with the process pipe.
   c. For meters with remote mounted transmitters, signal cable for installation between the flow tube and the transmitter. Length shall be as required by installation as indicated on the Drawings.

B. Flow Converter/Transmitter
1. Type:
   a. Micro-processor based, intelligent transmitter compatible with flow tube provided.
   b. Integral mount or mounted remote from the flow tube as shown on the drawings or as required by the physical location.
2. Functional/Performance:
   a. Accuracy (including flow tube): Plus/minus 0.5 percent of flow rate or better.
   b. Operating Temperature: –20 to 140 degrees F.
   c. 4-20mA and Ethernet/IP communication.
   d. Output: Isolated 4-20 mA with HART protocol. Current output adjustable over the full range of the instrument. Provide a dry contact to indicate reverse flow.
   e. Diagnostics: Self diagnostics with on screen display of faults.
   f. Display: Digital indicator displaying flow in engineering units indicated in the Instrument Device Schedule.
   g. Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.
   h. Empty Tube Zero: The transmitter shall include a feature that will lock the output at zero when no flow is detected. The empty tube zero feature shall be enabled automatically when the transmitter detects no flow or manually through a contact input.
   i. Provide electrode cleaning unit to match flow element requirements.
3. Physical:
   a. Transmitter shall be suitable for surface or pipe stand mounting.
   b. Enclosure shall be NEMA 4X (IP65).
   c. Transmitter shall include protective screen cover to shield against solar damage.
4. Power Requirements:
   a. The transmitter shall be 120 VAC powered instrument.
5. Accessories/ Required:
   a. Keypad where required for transmitter configuration.
6. Manufacturer:
   a. Endress + Hauser Promag W 400 (EtherNet/IP)
   b. ABB Instruments WaterMaster.

c. Rosemount Series 8705W Meter and 8732E Transmitter for remote mounted transmitter, or 8700M meter/transmitter for integral mounted. NOTE: Copy and paste instrument paragraphs you need from [Section 13341] through [section 13346] or refer back to listing in [13300] of listing of individual instrumentation specifications used on your project.

2.1 THERMAL DISPERSION MASS FLOWMETER

Flow Element

Type:

Thermal dispersion sensor with integral electronics enclosure.
In line with flow body type as indicated on the Drawings.

Function/Performance:

Flow Velocity Range: 200 ft/s (60.96 m/s) maximum.
Process Operating Temperature: -40-to-350-degree F.
Operating Temperature for Electronics: 0 to 140 degree F.

Physical:

Inline flow bodies to be flanged and fabricated of Type 316 stainless steel. Sensor to be factory mounted in the flow body. Flanges shall be compatible with flanges of the piping system where the meters are installed.
Wetted parts to be Type 316 stainless steel.
Electronics head to be NEMA 4X (IP65) for non-hazardous process gases and explosion proof approved for Class 1, Division 1, Groups C and D (EEx d IIC) for hazardous process gases or where located in a hazardous area.

Power Requirements:

Transducer shall receive its power from the remote transmitter

Accessories Required:

Cable as supplied or recommended by the manufacturer for connection of sensor to transmitter. Length as required by installation indicated on the Drawings.
For insertion type flow elements a hot tap assembly including a ball valve and packing gland that will allow removal of the sensor without shutdown of the process, shall be provided. The hot tap assembly shall be installed in a welded fitting on the pipe.

Transmitter

Type:

Remotely mounted micro-processor based, intelligent transmitter compatible with flow element provided.

Function/Performance:

Accuracy (including flow element): ±1.5 percent of reading, +0.5 percent of full scale.
Repeatability (including flow element): ±0.5 percent of reading.
Turn Down: 100:1 within specified flow range.
Operating Temperature: 0 to 140 degrees F.
Output: One isolated 4-20 mA output and two alarm contacts rated 2 A at 230 VAC, adjustable over the full instrument range.
Diagnostics: On screen instructions and display of self-diagnostics.
Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.
Display: Digital indicator displaying flow in engineering units indicated on the Drawings or in the Instrument Device Schedule.

Physical:

Transmitter shall be suitable for surface mounting.
Enclosure shall be NEMA 4X (IP65) when installed in non-hazardous areas and explosion proof approved for Class 1, Division 1, Groups C and D (EEx d IIC) when installed in hazardous areas.

Power Requirements:

Transmitter shall be 120 VAC powered instrument. Power supply for the instrument shall be from the PLC.

Manufacturer(s):

Fluid Components International ST80L.
approved equal.

2.2 VANE ACTUATED FLOW SWITCH

Type:

Vane or disc actuated flow switch.
Switch magnetically linked to vane or disc actuated mechanism.

Function/Performance:

Output: Form 2C (DPDT) snap action, hermetically sealed switch, rated for 10 amps, 125/250 volts AC.

Physical:

Switches for pipe sizes of 3/4 to 1-1/2 inches (19 to 40 mm) shall be provided with a flow body. Switches for pipe sizes greater than 1-1/2 inches (40 mm) shall be for installation directly in the field piping.
Flow body and all wetted parts shall be Type 316 stainless steel.
Switch housing shall be NEMA 4X (IP65) and where installed in hazardous areas, shall be approved for Class I, Division 1, Groups C and D (EEx d IIC T6).

Manufacturer(s):

Magnetrol F50 and F10.
Dwyer Series V4
Equal.

2.3 ULTRASONIC LEVEL/DIFFERENTIAL LEVEL METER

A. Transducer
1. Type
   a. Non-contact, ultrasonic level transducer.
2. Function/Performance
   a. Measuring Range: Transducer range shall be suitable for the installation indicated on the Drawings, up to 50 ft. (15m).
   b. Temperature Range: –20 to 60 degrees C.
   c. Relative Humidity: Zero to 100 percent.
   d. Temperature Compensation: Transducers shall be provided with integral temperature sensors for temperature compensation at above temperature ranges.
3. Physical
   a. Transducers shall be potted/encapsulated in a Kynar or other chemical and corrosion-resistant housing. Where indicated on the Drawings, transducers shall be approved for installation in Class I, Division 1, Groups C and D (Zone 0) environments.

b. The surface of transducers shall be Teflon-coated where mounted on chemical tanks and exposed to vapors in the tanks that are not compatible with the transducer material.
c. Transducers shall be capable of being completely submerged without damage.
d. Transducers shall be suitable for surface, pipe, or flange mounting as indicated on the Drawings or Instrument Device Schedule. Appropriate mounting hardwired shall be provided. Flanges shall be six inch (150 mm) and resistant to attack by the medium being metered or, where required, shall be protected by corrosion- resistant coatings and facings.

4. Options/Accessories Required
   a. Transducers located in areas where freezing condensation may occur shall be provided with special heaters or other type of transducer protection designed to prevent sensor icing.
   b. Signal cable as recommended by the manufacturer, for installation between the transducer(s) and the transmitter. Length, up to 1000 feet (300 m), shall be as required by installation indicated on the Drawings.
5. Manufacturer(s)
   a. Siemens XPS-10
   b. Endress+Hauser Prosonic
   c. Or Equal.

B. Transmitter/Converter
1. Type
   a. Microprocessor based compatible with the transducer(s) provided.
2. Functional/Performance
   a. Resolution (including transducer): Plus or minus 0.1 percent of range or 0.08 inches (2 mm), whichever is greater.
   b. Accuracy (including transducer): Plus or minus 0.25 percent of range or 0.24 inches (6 mm).
   c. Range: As required by the installation indicated on the Drawings.
   d. Temperature Range: -20 to 50 degrees C.
   e. Output: Minimum one isolated 4-20 mA output and minimum four alarm contacts (number of contacts above 4 required of each device to be determined by signals required as shown on the drawings adjustable to trip at any point in the instrument range. Output contacts shall be rated 5 A at 230 VAC.
   f. Temperature Compensation: Compensation over the temperature range of the sensor.
   g. Display: Digital indicator displaying level/differential level or volume in engineering units or percent as indicated on the Drawings or in the Instrument Device Schedule.
   h. Diagnostics: On-screen instructions and display of self-diagnostics.
   i. Loss of Signal: Transmitter shall ignore momentary loss-of-echo signals and shall indicate loss of echo on the transmitter unit.
   j. Configuration Protection: Programmable parameters shall be protected using E2PROM. Battery backup protection is not acceptable.
3. Physical
   a. Transmitter shall be suitable for surface or pipe stand mounting.
   b. Enclosure shall be NEMA 4X (IP65).
   c. A/C power will be as specified in Section 13300.
4. Accessories Required
   a. Hand-held programmer where required for configuration and calibration of the instrument.
5. Manufacturer(s)
   a. Siemens Echomax Transducers and HydroRanger/MultiRanger 200.
   b. Endress & Hauser Micropilot FMU series Transducers and Prosonics FMA90
   c. Equal.

2.4 LEVEL SWITCHES (FLOATS)

A. Type
1. Mercury free ball float switch.

B. Function/Performance
1. Differential: Less than 8 inch.
2. Switch Rating: 1 amps at 120 VAC or 100 VA @ 120 VAC
3. Provide NO or NC type contact for fail-safe operation per Section 13300, Paragraph 2.01.F or as shown on the Drawings.

C. Physical
1. Float: Type 316 stainless steel, Teflon or non-stick coating, minimum 5 in diameter.
2. Totally encapsulated switch.
3. Cable shall be heavy-duty, PVC or equivalent jacketed integral to float.
4. Provide stainless cable hanger for proper installation

D. Options/Accessories Required
1. Provide stainless steel hardware.
2. Lead wire shall be a 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.

E. Manufacturer(s)
1. Siemens Water Technologies Model 9G-EF.
2. Contegra FS 90
3. Or equal.

2.5 FLOOD LEVEL SWITCH

A. Type: Float operated, liquid level control for floor level sumps or troughs. Single snap-action dry contact switch mechanism.

B. Performance Requirements:
1. Single-Pole Double-Throw contact rated @120VAC.
2. 3/4" level differential for off-on control/alarm.

C. Construction Features:
1. NEMA 4X, 6, 7/9 cast aluminum submersible enclosure.
2. +250°F maximum ambient temperature.

D. Manufacturers:
1. Magnetrol Model FLS.
2. Or equal.

2.6 PROCESS TAPS, SENSING LINES, AND ACCESSORIES

A. Water Pressure Sensing Lines and Accessories for Flow and Pressure Transmitters:

1. Material: Copper Water Tube, ASTM B-88, Type L, drawn temper or annealed.
2. Pressure Rating: 150 psi.
3. Size: 1/2-inch O.D. for water.
4. Connections: Brass Compression Type, "Swagelok" by Crawford, or equal.
5. Shut-off Valves:
   a. Type: Ball.
   b. Pressure Rating: 150 psi.
   c. Body, Ball and Stern: Brass.
   d. Packing: High Density TFE.
   e. Handle: Nylon with metal travel stops.
   f. Support Rings: TFE coated brass.
   g. End Connections: Removable "Swagelok", or equal.
   h. Model: Whitey 45 Series for water, or equal.
6. Manifolds:
   a. Type: 5-valve and 3-valve meter manifolds.
   b. Materials: Type 316 stainless steel body, bonnets and stems; delrin seats; teflon packing.
   c. Products and Manufacturers: Provide one of the following:
      i. Anderson-Greenwood.
      ii. Or equal.

B. Air Pressure Sensing Lines and Accessories for Air Flow/Pressure Transmitters:
1. Material: Type 316 stainless steel tubing, ASTM A269, medium wall thickness.
2. Pressure Rating: 150 psi.
3. Size: 3/8-inch O.D. for air.
4. Connections: Type 316 stainless steel compression type, “Swagelok" by Crawford or equal.
5. Shut-off Valves:
   a. Type: Ball.
   b. Pressure Rating: 150 psi.
   c. Body, Ball and Stem: Type 316 stainless steel.
   d. Packing: High density TFE.
   e. Handle: Nylon with metal travel stops.
   f. Support Rings: TFE coated Type 316 stainless steel.
   g. End Connections: Removable "Swagelok", or equal.
   h. Products and Manufacturers: Provide one of the following:
      i. 43 Series, as manufactured by Whitey.
      ii. Or equal.
6. Manifolds:
   a. Type: 5-valve and 3-valve meter manifolds.
   b. Materials: Type 316 stainless steel body, bonnets and stems; delrin seats; Teflon packing.
   c. Products and Manufacturers: Provide one of the following:
      i. Anderson-Greenwood.
      ii. Or equal.

C. Pressure Tap Sensing Lines and Accessories for Pressure Gauges and Pressure Switches:
1. For Process Sensing Taps in Ductile Iron, Steel and Stainless Steel Piping Systems:
   a. Material and Fittings: Type 304 stainless steel pipe (ASTM A 312) and threaded fittings and adapters (ASTM A 403).
   b. Sizes: 1/2-inch minimum for main sensing piping and 1/4-inch gauge and switch connections.
   c. Pressure Rating: Equal to or greater than the applicable system test pressure as specified in

the Piping Schedule in Section 15600.

d. Accessories:
   i. For applications not requiring diaphragm seals, provide separate 1/2-inch Type 316 stainless steel threaded ball valve for each gauge and switch.
   ii. For applications requiring diaphragm seals, provide a separate 1/2- inch threaded Type 316 stainless steel ball valve for seal process side shutoff.

2. For Process Sensing Taps in Copper and Thermoplastic Piping Systems:
   a. Pipe Material and Fittings: Use same type of pipe material and fittings as that used in the process piping system. PVC pipe and fittings shall be provided in accordance with the requirements of Section 15600, Plant Piping.
   b. Sizes: 1/2-inch minimum for main process sensing piping and 1/4-inch for gauge and switch connections.
   c. Pressure Rating: Equal to or greater than the applicable system test pressure as specified in Section 15600, Plant Piping.
   d. Accessories:
      i. For copper piping system taps with or without seals, provide a separate 1/2-inch minimum threaded brass or bronze ball valve for each gauge and switch.
      ii. For PVC piping systems with or without diaphragm seals, provide a separate 1/2-inch threaded ball valve for process sensing line shutoff.

2.7 PRESSURE GAUGES

A. Type: Bourdon Tube Pressure Element Type, Liquid Filled Gauge (for pressure ranges of 15 psi and greater and vacuum ranges to 30-inches Hg):

B. Performance Requirements:
   1. Range: As specified in the Instrument Index.
   2. Accuracy: ±0.5 percent of span (ANSI B40.1 Grade 2A).

C. Construction Features:
   1. Case:
      a. Solid front design constructed of glass filled polyester.
      b. Color: Black.
   2. Size: 4-1/2-inch.
   3. Ring: Threaded, glass filled polyester.
   4. Window: Glass.
   5. Dial: White with black markings.
   6. Filling Liquid: See Article 1.8.
   7. Overpressure protection: Full blowout back.
   8. Bourdon Tube and Socket:
      a. Type 316 stainless steel.
      b. Heliarc welded, unless otherwise specified.
   9. Movement:
      a. Type 300 series stainless steel.
      b. Rotary geared with Teflon S coating, or cam and roller type.
      c. Built-in overload and underload movement stops.
   10. Connection: 1/4-inch male NPT, bottom.
   11. Mounting: Stem Mount.
   12. Calibration:

a. Adjustable pointer.
b. Externally accessible zero adjustment.

D. Accessories:
1. Pressure Snubber: Sintered stainless steel snubber threaded into gauge socket or in external stainless steel housing with 1/4-inch NPT male and female connections.
2. Process Isolation: Provide ball valves for process isolation in accordance with the requirements of Article 2.1, above.
3. Process Isolation: Wetted parts that might come in contact with sewage, sludge, or any other wastewater shall have a stainless steel diaphragm or be provided an isolation ring to prevent corrosion and damage to the gauge's internals.

E. Products and Manufacturers: Provide one of the following:
1. Ashcroft, Duragage 1279 Series.
2. Helicoid, Series 900.
3. Wika EN 837.
4. Or equal.

2.8 PRESSURE INDICATING TRANSMITTER

1. Type:
a. Microprocessor based, intelligent type.

2. Function/Performance:
a. Range: Range of the transmitter shall be the standard range of the manufacturer closest to the pressure range to be metered.
b. Accuracy: 0.075 percent of span.
c. Operating Temperature: -20 to 80 degrees C.
d. Temperature Effect: Combined temperature effects shall be less than 0.2 percent of maximum span per 28 degrees C temperature change.
e. Output: 4-20 mA DC linear with pressure or level, with HART protocol. Zero adjustable over the range of the instrument provided calibrated span is greater than the minimum calibrated span.
f. Stability: 0.05 percent of upper range limit for 1 year.
g. Display: Digital indicator displaying pressure or level in the engineering units indicated in the Instrument Device Schedule.
h. Diagnostics:
i. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
ii. Simulation capability for inputs and loop outputs.
iii. Test terminals available to ease connection for test equipment without opening the loop.
iv. Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to shall be available.
v. Run-time clock available to determine usage for warranty purposes. 5-year warranty on this clock reading is included.
vi. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored by the instrument.

i. If required to meet the range or suppression/elevation requirements, a differential pressure transmitter shall be provided.

3. Physical:
   a. Enclosure: NEMA 4X (IP66), explosion proof, approved for Class I, Division 1, Groups C and D (EEx d IIC T5).
   b. Process Wetted Parts: Isolating diaphragm and other wetted metal parts shall be Type 316L stainless steel, unless otherwise indicated in the device schedule. Gaskets and O rings shall be Teflon.
   c. Power Supply: 24 VDC loop power.
   d. Sensor Fill Fluid: Silicone.

4. Accessories Required:
   a. Provide span and zero adjustment at each transmitter and through the handheld programming unit.
      i. Configuration of the transmitter may be accomplished using the local display and pushbuttons without the use of an external programming device.
   b. For each transmitter provide a Type 316 stainless steel block & bleed shut off valve. Valves may be mounted directly to the instrument or separately mounted. Valves shall be by the instrument manufacturer or by D/A Manufacturing or Anderson Greenwood.

5. Manufacturer(s):
   a. Rosemount 3051TG Series.
   b. Siemens Sitrans P
   c. Foxboro IAP05S.
   d. Pre-approved equal.

2.9 PRESSURE SWITCH

A. Type:
   1. Diaphragm actuated, dual-setpoint.

B. Function/Performance:
   1. Repeatability: Better than 1 percent of full scale.
   2. Setpoints: Field adjustable dual setpoints, capable of being set anywhere within adjustable range.
   3. Dead Band: Fixed unless adjustable dead band requirement is noted in the Instrument Device Schedule.
   4. Reset: Unit shall be of the automatic reset type unless noted otherwise in the Instrument Device Schedule.
   5. Over Range Protection: Over range protection to 150 percent of the maximum process line pressure.
   6. Output: Dual single pole double throw (SPDT) or dual double pole double throw (DPDT) switches as shown on the instrument device schedule. Switch rating shall be min 10 A at 230 VAC.

C. Physical:
   1. Housing: NEMA 4X (IP65) for non-hazardous areas. For installation in hazardous areas, housing shall be explosion proof approved for Class 1, Division 1, Groups C and D (EEx d IIB).
   2. Switch Assemblies: Hermetically sealed switches.

3. Wetted Parts: Type 316L stainless steel diaphragm, viton seals, Type 316 stainless steel connection port.

D. Accessories/Options Required:
1. Shutoff Valve: Provide a Type 316 stainless steel shutoff valve. Valve shall be by D/A Manufacturing, Anderson Greenwood, or Equal.
2. Where indicate on the instrument device schedule, provide a Type 316 stainless steel snubber for pulsation dampening.

E. Manufacturer(s):
1. Ashcroft
2. DwyerOmega
3. Wika
4. Pre-approved equal.

2.10 DO/MLSS SENSOR

A. Dissolved Oxygen Sensor
1. Type
   a. Polymetron amperometric sensor and cable.

2. Function/Performance
   a. Measurement range
      i. 0 to 2,000 ppb DO
   b. Repeatability
      i. ± 0.5 ppb or ± 5%, whichever is greater
   c. Sensitivity
      i. < 0.5 ppb
   d. Detection Limit
      i. <1 ppb
   e. Temperature range
      i. 0–45 °C (32–113 °F)
   f. Temperature accuracy
      i. ± 0.5 °C
   g. Temperature repeatability
      i. ±0.2 °C
3. Environmental Requirements
   a. Operating Temperature: -4.0 to 140.0 °F (-20.0 to 60.0 °C)
   b. Storage Temperature: 32 to 140 °F (0 to 60°C)
   c. Relative humidity: 10 to 95%, non-condensing
4. Physical
   a. Sensor consists of a sensor contained in stainless steel or PVC, depending on model, with a silicon wiper blade and integral cable.
   b. 10-meter integral cable.
5. Options/Accessories Required
   a. Compatibility with Hach Model sc4500 controllers.
6. Manufacturer(s)
   a. Hach Model LDO Dissolved Oxygen Sensor

B. Mixed Liquor Suspended Solid Sensor

1. Type
   a. Probe with a dual-beam infrared/scattered light photometer. Infrared Duo scattered light technique for color-independent turbidity measurement. Turbidity in accordance with DIN EN ISO 7027 / TSS equivalent DIN 38414
2. Function/Performance
   a. Measurement range
      i. Turbidity: 0.001 to 4000 NTU
      ii. Suspended solids: 0.001 to 5000.0 mg/L or 0.001 to 50.0 g/L (ts-line or inline), or 0.001 to 500.000 mg/L or 0.000001 to 500 g/L (hs line or highline)
   b. Accuracy
      i. Turbidity: Less than 1% of reading or ±0.001 NTU, whichever is greater
      ii. Suspended solids: Less than 5% of reading (depends on homogeneity of municipal activated sludge)
   c. Repeatability
      i. Turbidity: Less than 1% of reading
      ii. Suspended solids: Less than 3% of reading (depends on homogeneity of municipal activated sludge)
   d. Detection limit
      i. Turbidity: 0.001 NTU
      ii. Suspended solids: 0.001 mg/L
   e. Response time: Initial response 1 second
   f. Signal Averaging Time: User selectable ranging from 1 to 300 seconds
   g. Units of measure:
      i. Turbidity: User Selectable NTU, FNU, EBC, FTU and TE/F
      ii. Suspended Solids: User Selectable g/L, mg/L, ppm, or % solids
3. Environmental Requirements
   a. Sample flow velocity: 3 m/s (9.8 ft./s) maximum
   b. Sample pressure: 6 bar (87 psi) maximum
   c. Sample temperature: 0 to 40 degrees C
   d. Operating temperature: 0 to 40 degrees C
4. Physical
   a. Sensor consists of a sensor contained in stainless steel or PVC, depending on model, with a silicon wiper blade and integral cable.10-meter integral cable.
5. Options/Accessories Required
   a. Compatibility with Hach Model sc4500 controllers.
6. Manufacturer(s)
   a. Hach Solitax Series

2.11 DO/MLSS ANALYZER

A. Probe/Sensor Controller
1. Type:
   a. Microprocessor-based sensor controller that works with digital sensors.
   b. The controller accepts up to eight (8) sensor inputs.
2. Functional/Performance:
   a. The controller is equipped with a real-time clock.
   b. The controller is equipped with two security levels.
   c. The controller is equipped with a data logger that can output to a storage card or directly to a computer hard drive.

d. The controller can be equipped with an SD card reader for data download and controller software upload.
e. The controller can have software updated through a direct network connection
f. Four electromechanical, UL rated, SPDT relays (Form C) can be installed for user-configurable contacts rated 100 to 250 Vac, 5 Amp at 30 VDC resistive maximum.
g. The following can be programmed:
h. The controller can be equipped with up to twelve 0/4-20mA outputs with a maximum impedance of 500 ohms per probe module.
i. The probe module can be equipped with the following forms of communication:
   i. Ethernet

3. Physical:
   a. Controller enclosure shall be IP65 rated. The controller shall be installed in a NEMA 4X enclosure with a view window and Shade Aide attachment for UV protection. The Shade Aide shall be sized accordingly in respect to the view window.
4. Environmental Requirements
   a. Operational Criteria
      i. Operating temperature: -4 to 131 °F (-20 to 55°C)
      ii. Storage Temperature: -4 to 158 °F (-20 to 70°C)
      iii. Humidity Requirements: 0 to 95% relative humidity, non-condensing
5. Power Requirements:
   a. The transmitter shall be 120 VAC powered instrument.
6. Manufacturer:
   a. Hach Model SC4500 Controller

2.12 SOLENOID VALVES

A. Solenoid valves shall be electrically operated, have a 304 stainless steel body and bonnet, ¾" NPT connection (modify per vendor supplied equipment package), and packless construction, without packing box or sliding seal.

B. Solenoid coils shall be either 24 VDC or 120 VAC dependent on control wiring characteristics, normally closed, encapsulated, Class H, for continuous duty at rated voltage and 40 degrees Celsius ambient in a NEMA 4 enclosure.

C. Solenoid valves shall be ASCO Redhat General Service 8210 series valves. Coordinate with manufacturer or vendor packaged system on size and type of valve needed. Provide manual bypass valves and piping for all solenoid valves installed.

2.13 SPARE PARTS AND ACCESSORIES

A. General requirements for spare parts are specified in Section 13300.

B. Furnish following field Instrument related Spare Parts:
1. One flow indicating transmitter for each type of flow element provided.
2. One level indicating transmitter for each type of level element provided.
3. One temperature transmitter for each type provided.
4. One pressure transmitter for each type provided.
5. One spare ultrasonic level switch for each type provided.
6. One spare float type level switch for each type provided.
7. One spare gas detection system sample pump module for each type provided.

8. Miscellaneous: One year supply of items recommended by the manufacturer of the equipment including all reagents, pH probes, batteries, chart paper, calibration standards as needed to operate and maintain the furnished equipment.

C. Furnish following Accessories:
1. All mounting hardware required for pipe stand, surface, or other mounting.
2. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

PART 3 – EXECUTION

3.1 GENERAL

A. See execution requirements in Section 13300.

B. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for calibration, testing and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

END OF SECTION

WILBARGER WWTP Expansion to 1.5 MGD - Instrumentation List							
Tag No.	**Description**	**Type**	**P&ID Sheet Ref.**	**Range/Setpoint**	**Units**	**Spec. Reference**	**Provider**
HEADWORKS							
LIT-03-301	MCS-03-301 Differential Level	Transducer Transmitter	3-I-1	0-36	in.	11221	Vendor
LE-03-301	MCS-03-301 Upstream Level	Ultrasonic Transducer	3-I-1	0-72	in.		
LE-03-302	MCS-03-301 Downstream Level	Ultrasonic Transducer	3-I-1	0-72	in.		
LSH-03-301	MCS-03-301 High Level Alarm	Level Switch	3-I-1	Refer to Drawings	N/A	13340	Contractor
PEAK SHAVING BASIN							
PI-04-001	Peak Shaving Basin Air Header Pressure	Pressure Gauge	4-I-1	0-15	psig	13340	Contractor
AERATION BASIN							
FIT-05-301	Aeration Basin No. 3 Air Lift Flow No. 1	Thermal Mass Flow Meter	5-I-1	0-250	scfm	13340	Contractor
FIT-05-302	Aeration Basin No. 3 Air Lift Flow No. 2	Thermal Mass Flow Meter	5-I-1	0-250	scfm		
AIT-05-101	Aeration Basin No. 1 Analytic Transmitter	Analytic Transmitter	5-I-1		-		
AE-05-101	Aeration Basin No.1 Dissolved Oxygen Probe	Analytic Element	5-I-1	0-15	mg/L		
AE-05-102	Aeration Basin No.1 Mixed Liquor Suspended Solids Probe	Analytic Element	5-I-1	0-50000	mg/L		
AIT-05-201	Aeration Basin No. 2 Analytic Transmitter	Analytic Transmitter	5-I-1		-		
AE-05-201	Aeration Basin No.1 Dissolved Oxygen Probe	Analytic Element	5-I-1	0-15	mg/L		
AE-05-202	Aeration Basin No.1 Mixed Liquor Suspended Solids Probe	Analytic Element	5-I-1	0-50000	mg/L		
AIT-05-301	Aeration Basin No. 3 Analytic Transmitter	Analytic Transmitter	5-I-1		-		
AE-05-301	Aeration Basin No.1 Dissolved Oxygen Probe	Analytic Element	5-I-1	0-15	mg/L		
AE-05-302	Aeration Basin No.1 Mixed Liquor Suspended Solids Probe	Analytic Element	5-I-1	0-50000	mg/L		
PI-05-301	Aeration Basin No. 3 Pressure Gauge No. 1	Pressure Gauge	5-I-1	0-15	psig		
PI-05-302	Aeration Basin No. 3 Pressure Gauge No. 2	Pressure Gauge	5-I-1	0-15	psig		
PI-05-303	Aeration Basin No. 3 Pressure Gauge No. 3	Pressure Gauge	5-I-1	0-15	psig		
BLOWER							
PI-09-601	MSB-09-601 Suction Pressure Gauge	Differential Pressure Gauge	9-I-1	0-25	inH20	13340	Contractor
PI-09-602	MSB-09-601 Discharge Pressure Gauge	Pressure Gauge	9-I-1	0-15	psig		
PSL-09-003	Blower Header Low Pressure No. 3	Pressure Switch	9-I-1	5	psig		
NPW SYSTEM							
PIT-10-001	NPW System Pressure	Pressure Transmitter	10-I-1	0-150	psig	13340	Contractor
FIT-10-001	NPW System Flow	Flow Transmitter: Provide Sun Shield Cover	10-I-1	Existing	Existing	13340	Contractor to supply a sun shield cover for transmitter display
SODIUM HYPOCHLORITE SYSTEM							
LE-11A-101	Sodium Hypochlorite Tank No. 1 Level	Ultrasonic Transducer	11A-I-1		ft-in	13340	Contractor
LIT-11A-101	Sodium Hypochlorite Tank No. 1 Level Transmitter	Transducer Transmitter	11A-I-1		ft-in		Contractor
LE-11A-201	Sodium Hypochlorite Tank No. 2 Level	Ultrasonic Transducer	11A-I-1		ft-in	13340	Contractor
LIT-11A-201	Sodium Hypochlorite Tank No. 2 Level Transmitter	Transducer Transmitter	11A-I-1		ft-in		Contractor
PI-11A-101	PSP-11A-101 Pressure Gauge	Pressure Gauge	11A-I-1		psig	13340	Contractor
PI-11A-201	PSP-11A-201 Pressure Gauge	Pressure Gauge	11A-I-1		psig	13340	Contractor
PSH-11A-101	PSP-11A-101 High Pressure	Pressure Switch	11A-I-1		psig	13340	Contractor
PSH-11A-201	PSP-11A-201 High Pressure	Pressure Switch	11A-I-1		psig		Contractor
FS-11A-001	Emergency Eyewash Station (EWS-11A-001) Flow Confirmation	Flow Switch	11A-I-1		-	15413	Vendor
LSL-11A-001	Sodium Hypochlorite Leak Detected Level Switch	Level Switch	11A-I-1		-	13340	Contractor
SODIUM BISULFITE SYSTEM							
LE-11B-101	Sodium Bisulfite Tank No. 1 Level	Ultrasonic Transducer	11A-I-1		ft-in	13340	Contractor
LIT-11B-101	Sodium Bisulfite Tank No. 1 Level Transmitter	Transducer Transmitter	11A-I-1		ft-in		Contractor
LE-11B-201	Sodium Bisulfite Tank No. 2 Level	Ultrasonic Transducer	11A-I-1		ft-in	13340	Contractor
LIT-11B-201	Sodium Bisulfite Tank No. 2 Level Transmitter	Transducer Transmitter	11A-I-1		ft-in		Contractor
PI-11B-101	PSP-11B-101 Pressure Gauge	Pressure Gauge	11B-I-1		psig	13340	Contractor
PI-11B-201	PSP-11B-201 Pressure Gauge	Pressure Gauge	11B-I-1		psig	13340	Contractor
PSH-11B-101	PSP-11B-101 High Pressure	Pressure Switch	11B-I-1		psig	13340	Contractor
PSH-11B-102	PSP-11B-201 High Pressure	Pressure Switch	11B-I-1		psig		Contractor
FS-11B-001	Emergency Eyewash Station (EWS-11B-001) Flow Confirmation	Flow Switch	11B-I-1		-	15413	Vendor
LSL-11B-001	Sodium Bisulfite Leak Detected Level Switch	Level Switch	11B-I-1		-	13340	Contractor
ALUM SYSTEM							
LE-11C-101	Alum Tank No. 1 Level	Ultrasonic Transducer	11C-I-1		ft-in	13340	Contractor
LIT-11C-101	Alum Tank No. 1 Level Transmitter	Transducer Transmitter	11C-I-1		ft-in	13340	Contractor
LE-11C-201	Alum Tank No. 2 Level	Ultrasonic Transducer	11C-I-1		ft-in	13340	Contractor
LIT-11C-201	Alum Tank No. 2 Level Transmitter	Transducer Transmitter	11C-I-1		ft-in	13340	Contractor
LE-11C-301	Alum Tank No. 3 Level	Ultrasonic Transducer	11C-I-1		ft-in	13340	Contractor
LIT-11C-301	Alum Tank No. 3 Level Transmitter	Transducer Transmitter	11C-I-1		ft-in	13340	Contractor
PI-11C-101	PSP-11C-101 Pressure Gauge	Pressure Gauge	11C-I-1		psig		Contractor
PSH-11C-101	PSP-11C-101 High Pressure	Pressure Switch	11C-I-1		psig	13340	Contractor
PI-11C-201	PSP-11C-201 Pressure Gauge	Pressure Gauge	11C-I-1		psig	13340	Contractor
PSH-11C-201	PSP-11C-201 High Pressure	Pressure Switch	11C-I-1		psig	13340	Contractor
PI-11C-301	PSP-11C-301 Pressure Gauge	Pressure Gauge	11C-I-1		psig	13340	Contractor
PSH-11C-301	PSP-11C-301 High Pressure	Pressure Switch	11C-I-1		psig	13340	Contractor
FS-11C-101	Emergency Eyewash Station (EWS-11C-101) Flow Confirmation	Flow Switch	11C-I-1		-	15413	Vendor
FS-11C-201	Emergency Eyewash Station (EWS-11C-201) Flow Confirmation	Flow Switch	11C-I-1		-		Vendor
LSL-11C-001	Alum Feed Leak Detected Level Switch	Level Switch	11C-I-1		-	13340	Contractor
LSL-11C-002	Alum Feed Leak Detected Level Switch	Level Switch	11C-I-1		-		Contractor
SLUDGE HOLDING TANK							
FIT-13-301	Sludge Holding Tank No. 3 WAS Flow No. 1	Thermal Mass Flow Meter	13-I-1	0-250	scfm	13340	Contractor
FIT-13-302	Sludge Holding Tank No. 3 WAS Flow No. 2	Thermal Mass Flow Meter	13-I-1	0-250	scfm		
SV-13-301	Train No. 3 WAS Air Lift Solenoid Valve	Solenoid Valve	13-I-1	N/A	-		
LSL-13-001	Sludge Holding Tank Low Level Alarm	Level Switch	13-I-1	Refer to Drawings	-		
LSL-13-002	Sludge Holding Tank Low Level Alarm	Level Switch	13-I-1		-		

DEWATERING PRESS FEED PUMP							
FIT-14A-101	WAS Flow	Flow Transmitter	14A-I-1		gpm	13340	Contractor
PI-14A-101	DDP-14A-101 Pressure Gauge	Pressure Gauge	14A-I-1	0-100	psig	13340	Contractor
PI-14A-201	DDP-14A-201 Pressure Gauge	Pressure Gauge	14A-I-1	0-100	psig		
VSH-14A-101	DDP-14A-101 High Vacuum	Vacuum Switch	14A-I-1		psia		
VSH-14A-201	DDP-14A-201 High Vacuum	Vacuum Switch	14A-I-1		psia		
PSL-14A-101	DDP-14A-101 Low Pressure Alarm	Pressure Switch	14A-I-1		psig		
PSL-14A-201	DDP-14A-201 Low Pressure Alarm	Pressure Switch	14A-I-1		psig		
PSH-14A-101	DDP-14A-101 High Pressure Alarm	Pressure Switch	14A-I-1		psig		
PSH-14A-201	DDP-14A-201 High Pressure Alarm	Pressure Switch	14A-I-1		psig		
DEWATERING NPW BOOSTER PUMPS							
PI-14B-001	NPW System Pressure Gauge	Pressure Gauge	14B-I-1	0-100	psig	13340	Contractor
PI-14B-101	VMP-14B-101 Pressure Gauge	Pressure Gauge	14B-I-1	0-100	psig		
PI-14B-201	VMP-14B-201 Pressure Gauge	Pressure Gauge	14B-I-1	0-100	psig		
PS-14B-101	VMP-14B-101 Low/High Pressure Alarm	Pressure Switch	14B-I-1		psig		
PS-14B-201	VMP-14B-201 Low/High Pressure Alarm	Pressure Switch	14B-I-1		psig		
POLYMER SYSTEM							
PI-14C-101	NPW System Pressure Gauge	Pressure Gauge	14C-I-1	0-100	psig	13340	Contractor
VOLUTE PRESS							
SV-14D-101	Washwater Solenoid Valve No. 1	Solenoid Valve	14D-I-1	N/A	-	-	Vendor
SV-14D-102	Washwater Solenoid Valve No. 2	Solenoid Valve	14D-I-1	N/A	-	-	
SV-14D-104	Washwater Solenoid Valve No. 3	Solenoid Valve	14D-I-1	N/A	-	-	
SV-14D-105	Washwater Solenoid Valve No. 4	Solenoid Valve	14D-I-1	N/A	-	-	
SV-14D-106	Washwater Solenoid Valve No. 5	Solenoid Valve	14D-I-1	N/A	-	-	
LIT-14D-101	Flocculation Tank Level Transmitter	Level Transmitter	14D-I-1		ft-in	13340	Contractor
LSH-14D-101	Flocculation Tank High Level Alarm	Level Switch	14D-I-1		ft-in	13340	Contractor
FIRE RESPONSE SYSTEM							
LI-15-001	Fire Tank Altitude Gauge	Level Gauge	N/A	0-14.25	ft	Div 11.	Vendor

SECTION 13441
PROCESS CONTROL NARRATIVES

PART 1 - GENERAL

1.1 SCOPE

This section includes process control narratives including all functions, interlocks, and required alarms, for all proposed equipment, components, and controls at the facility.

1.2 RELATED WORK

A. Division 1 – General Requirements.

B. Division 15 - Mechanical.

C. Division 16 - Electrical.

1.3 SUBMITTALS

A. Shop Drawings. Submit all shop drawings in accordance with the requirements in Division 1, General Requirements. For each piece of equipment, submit for review, detailed drawings and descriptive literature on the associated components, signals, controls and alarms including the source and destination of each signal and alarm. The submittal can be made for the facility as a whole in lieu of with each piece of equipment if preferred by the Contractor. The process and instrumentation diagrams in the construction drawings may not be replicated for shop files.

B. Operation and Maintenance Instructions. Submit operating and maintenance instructions and service manuals in accordance with specification 01300, as a condition of substantial completion.

C. Start-Up Report. Upon completion of installation, the Contractor shall provide a test of all signals, controls and alarms in the presence of the Engineer to show all systems functioning properly. All systems must operate in manual and automatic modes as specified. This shall be complete and a signed written report submitted to the Engineer for approval as a condition of substantial completion.

1.4 QUALITY ASSURANCE

A. Reference Standard – WEF Manual of Practice No. 21 – Automation of Wastewater Treatment Facilities.

B. Provide a qualified technical representative of the manufacturer to inspect the completed equipment and controls installation, make all the adjustments necessary to place the equipment and controls in trouble-free operation, and to instruct operating personnel in the proper care and operation of the equipment furnished.

1.5 GUARANTEE

For a period of 12 months from substantial completion, the Contractor shall warrant that the controls and programming shall operate as specified and be free of defects and operating deficiencies under normal use and service and when properly installed. The Contractor shall provide repair, modify, or replace controls and associated components and provide programming corrections from a qualified programmer during this period.

1.6 CONTROL FUNCTION DEFINITIONS AND GENERAL CRITERIA

A. The control narratives in the following sections shall be used in conjunction with all project drawings. Logic descriptions are provided for both the HMI and PLC software required under this contract.

B. For all controlled devices such as pumps, valves, etc., if the device is commanded to Start or Stop, Raise or Lower, or Open or Close) by the PLC, and the device feedback state does not match the commanded state within a preset time, an Equipment Discrepancy Alarm shall be generated by the PLC for display and alarming at the HMI and the device shall be commanded to Stop (valves and gates shall remain in the last state unless otherwise noted in the control description). If a duty pump, or system, is commanded to start and does not start within the preset time, an alarm shall be generated at the PLC and annunciated at the HMI. The operator shall then determine whether or not to start the standby pump or system unless otherwise noted in the control description. Also, if a device feedback state does not match the commanded state at any time, excluding the change of state described above, an equipment Failure Alarm is generated by the PLC for display and alarming at the HMI and the device is commanded to Stop (valves and gates shall remain in the last state unless otherwise noted in the control description). After a Discrepancy Alarm occurs the device cannot be started again until the Operator at the HMI has issued a Reset. All controlled devices with feedback shall indicate Failure alarms on the associated process graphic displays even if not shown on the loop drawings.

C. For all controlled devices such as pumps, valves, etc. if the device is shut down due to an interlock such as high discharge pressure, an alarm shall be generated at the PLC and annunciated at the HMI. Certain critical device failures, stated in control description or set at a later time during a coordination meeting between the Owner/Operator and the PCSS, shall generator an automatic call out to the operator.

D. All analog alarms generated (such as a high level alarm) shall be generated as follows. If the analog point's value exceeds or drops below the alarm limit value, then an alarm shall be generated. To eliminate excessive alarm reporting, the analog point shall remain in alarm until the analog point's value returns beyond the limit set by the analog limit deadband.

E. For all analog points (such as level, flow, pressure, etc.), if the value of the analog point is below a value of 2 mA since the last time the analog point was scanned, a Loss-of-Signal shall be alarmed at the HMI. The alarms shall remain in effect until it is logged at the HMI and the value is within the normal signal range (4-20 mA) the next time the analog point is scanned. All analog points shall indicate a Loss-of-Signal Alarm on the associated process graphic displays even if not shown on the loop drawings.

F. For all analog points (such as level, flow, pressure, etc.), if the value of the analog point is above or below the transmitter range, Out-Of-Range shall be alarmed at the HMI (if applicable).

G. For all analog points such as level, flow, pressure, etc. there shall be Low-Low, Low, High, and High-High alarm setpoints entered by the Operator for each instrument measurement. All process analog inputs are displayed historically collected and trended. Alarms shall be generated as follows: If the analog point value exceeds or drops below the alarm limit value then an alarm shall be generated. To eliminate excessive alarm reporting the analog point shall remain in alarm until the analog points value returns beyond the limit set by the analog limit deadband setpoint. Nuisance alarms such as low turbidity shall be inhibited. Authorized supervisors shall have the capability to turn off alarm functions when not needed. When valve is closed or pump is not running an analog flow signal associated with that valve or pump shall not generator low flow alarm and it shall be forced to zero value.

H. All alarm and control setpoints shall be adjustable by the Operator at the HMI unless specifically stated otherwise, even if not shown on the drawings. These setpoints shall be password protected to allow access by only the Operators who are given clearance by the Owner. Some alarms and/or setpoints shall be hard coded in the PLC and not adjustable by the Operator. Generally, hard coded values will be alarms and/or set points that are not anticipated to change.

I. Preclusion logic shall be added to all applicable alarms. This logic will prevent secondary alarms that are a direct result of a primary alarm from being annunciated. For example, station power failure should not cause a circuit breaker-tripped alarm to be annunciated.

J. Runtimes for all motorized equipment shall be totalized in the PLC and indicated at the HMI with 0.1 tenth hour resolution even if not shown on the drawings. Two runtimes shall be calculated. One shall be an overall accumulated runtime and the other shall have the capability to be reset by the user via the HMI. Security will be configured such that only supervisory level user will be able to perform this reset function.

K. All RAS/WAS and combined effluent (including NPW) flows shall be totalized in the PLC as daily totals or cumulative totals even if not shown on the loop drawings. Daily totals will be reset at midnight and then displayed as "Yesterday's Total Flow" at the HMI. Flow rates and flow totals shall be indicated and recorded at the HMI. When a valve is closed or a pump is not running, the flow totalizer shall not accumulate values caused by noise or errors in calibration.

L. All software adjustable alarm set points accessible from the HMI shall have adjustable deadbands unless specifically noted otherwise.

M. Plant personnel must acknowledge all alarms before they can be cleared. No alarm shall clear automatically until it has been acknowledged.

N. For all variable speed pumps if the pump is commanded to run at specific speed and the speed feedback signal deviates from the commanded speed by preset deadband for preset time period speed deviation alarm is generated by the PLC for display and alarming at the HMI.

O. For all analog modulating valves if the valve is commanded to open or close to specific position and the position feedback signal deviates from the commanded position by preset deadband for preset time period, a valve deviation alarm is generated by the PLC for display and alarming at the HMI.

P. All tuning parameters for each PLC software PID controller are entered at the HMI Tuning trends are provided to tune and monitor each PID operation. Tuning parameters settings are password protected.

Q. All HMI to PLC communications paths shall be monitored by the PLC and HMI for disruptions in communication. In the event that PLC communications path is lost the HMI communications alarm shall be generated. Data collected from the PLCs shall be attributed as having bad quality. When the communications path is restored and the data is updated it shall be attributed as valid.

R. All PLC-to-PLC communications paths shall be monitored by each participating PLC for disruptions in communication. In the event that communications path is lost, Software failure or hardware failure and data shared between the PLCs shall be attributed as having bad quality. When the communications path is restored and the data is updated it shall be attributed as valid.

S. All communications paths between facilities shall be monitored by the PLC for disruptions in communication. In the event that communications path is lost, Software failure or hardware failure communications alarm shall be generated. Any data shared between the PLCs from the facility shall be attributed as having bad quality. When the communications path is restored and the data is updated it shall be attributed as valid.

T. All alarms shall remain in effect until it is logged at the HMI Historian.

U. All process system areas shall have a graphical overhead layout similar as shown on the P&IDs. Vendor supplied systems shall be shown similarly to vendor submitted screens while conforming to overall Facility standard scheme.

PART 2 - PROCESS CONTROL NARRATIVES

2.1 LIFT STATION

Process Description:	**General** Four (4) submersible pumps shall be installed in the existing lift station wet well to provide raw sewage flow to the peak shaving basin and the existing headworks.

- Under normal operation (normal mode):
  - One (1) pump (SP-02-101) shall be dedicated to pump raw sewage to the existing peak shaving basin.
  - Three (3) pumps (SP-02-201, SP-02-301, and SP-02-401) shall be dedicated to pumping raw sewage to the existing headworks. Pumps will operate based on an alternating lead/lag level scheme.
- For peak shaving basin operations when SP-02-101 is out of service (backup mode):
  - HS-02-001E located on Lift Station Control Panel (CP-02-101) should be set to assign SP-02-201. Once ON, the PLC will remove this pump from the HW pump lead/lag alternation.
  - Manually position PV-02-002 and PV-02-003, located on the lift station discharge header, divert SP-02-201 to the Peak Shaving Basin. Operators are required to ensure the valves are manually set for the common spare to flow to the peak shaving basin.
- Full peak shaving basin conveyance operations (all four (4) pumps convey flow to the peak shaving basin – all pumps mode):
  - HS-02-001F located on Lift Station Control Panel (CP-02-101) should be set by operations to assign all pumps to the peak shaving basin.
  - Once HS-02-001F is enabled, the PLC will automatically command valve PV-03-006 to close to the headworks and command valve PV-03-005 to open to the peak shaving basin.
    - PV-03-005 and PV-03-006 are automatic control valves located on the raw sewage discharge piping at the headworks. These valves shall be electrically interlocked such that neither valve can be opened unless the other valve is closed.
    - Peak shaving basin High Level (LSH-04-001) shall generate an alarm and interlock these valves, diverting flow back to the headworks returning the system to normal operation. Lift station pumps SP-02-101 and SP-02-201 will be commanded to stop as well should a high peak shaving basin level be present.

Pump Control Modes

Mode	Normal	Backup	All Pumps
Description	Normal Operation	Backup Operation: *SP-02-101 as not in service*	All four wet well pumps to peak shaving basin
SP-02-101	Peak Shaving	Peak Shaving	Peak Shaving
SP-02-201	Headworks	Peak Shaving	Peak Shaving
SP-02-301	Headworks	Headworks	Peak Shaving
SP-02-401	Headworks	Headworks	Peak Shaving
PV-02-002	Opened	Closed	Opened
PV-02-003	Closed	Opened	Opened
HS-02-001E	OFF	ON	OFF
HS-02-001F	OFF	OFF	ON
PV-03-005	Closed	Closed	Opened
PV-03-006	Opened	Opened	Closed

Level Control

The pumps shall be operated based on the wet well level received by the existing level instrumentation LIT-02-001.

- The pumps shall alternate which pump is the lead and which pumps are the lag pumps.
- Seven (7) new float switches shall be utilized as backup for measuring water levels for the pump operation.
- A high level detected by High Level Float LSH-02-001 will latch control into float backup mode.
    - Float backup will have to be manually reset once the alarm condition has cleared.
- LSL-02-001 shall be set at a very low level, beyond the OFF-Float point, and shall interlock all pumps to prevent cavitation from pumping below the pumps' suction.
- The pumps shall be called based on the pump elevations listed on sheet 2-M-4

P&ID:	1-I-1 Lift Station P&ID
Controlled Devices:	SP-01-101 Lift Pump No. 1 SP-01-201 Lift Pump No. 2 (Common Spare) SP-01-301 Lift Pump No. 3 SP-01-401 Lift Pump No. 4

Instrumentation Devices:	Existing LIT-02-001 Level Indicating Transmitter Proposed: LSL-02-001 Low Level Float (All Pumps Off Float) LS-02-001 Off Float LS-02-002 Lead Pump Float LS-02-003 Lag Pump No. 1 Float LS-02-004 Lag Pump No. 2 Float (Common Spare) LS-02-005 Lag Pump No. 3 Float (Peak Shaving Basin Float) LSH-02-001 High Level Alarm
Local Functions:	Local Control Panel: The existing local control panel contains the following for each pump: • H-O-A Switch o Provide pump control • Green Pilot Light o Indicate the pump running status. • Red Pilot Lights o Indicate Overload, Overtemp, and Seal Fail conditions • Elapsed Time Meter o Indicate pump runtime • Reset Push Button o Reset Pump Monitor Relay The local control panel shall be modified to accommodate the following: • Lift Station/Peak Shaving Selector o Place the common spare in lift station rotation o Select the common spare as the peak shaving basin pump • Headworks/Peak Shaving Basin Valve Selector o Divert flow from Headworks to Peak Shaving Basin o Return flow from the Peak Shaving Basin to Headworks In the HAND position, each pump shall operate continuously if the interlocks for the pump listed in the INTERLOCKS section below are not active. PCSS shall install a nameplate on CP-02-001 next to HS-02-001E instructing operations to open/close plug valve associated with flow to the Peak Shaving Basin.
MCC Functions:	Each MCC section has a motor starter and solid-state overloads that provide status and fault indication to the PLC.
HMI Functions:	None
PLC Functions:	PLC Control Panel: A PLC Control Panel shall be installed for the primary control of the lift station. In the AUTO position, the PLC shall call the pumps to run if the interlocks for the pump listed in the INTERLOCKS section below are not active.

	The signal from the existing submersible wet well level transmitter shall be sent to the PLC and the lift station pumps shall operate based on operator adjustable level setpoints. PLC functions shall be, at minimum, the following: • Level monitoring: o Display real-time wet well levels o adjustable High Level alarm o adjustable Low Level alarm • Pump operation: o Call the pumps based on lead-lag sequence o Alternate pumps after each pump off cycle. o All pump call setpoints shall be operator adjustable. o The PLC shall receive the following pump statuses: ▪ In Hand ▪ In Auto, ▪ Running, ▪ Overload ▪ Overtemperature ▪ Seal Fail o If an alarm is active, the PLC shall inhibit the corresponding pump and exclude it from the call sequence until the alarm is reset. • Headworks/Peak Shaving Basin Selection o Remove SP-02-201 (Common Spare) from the headworks pump rotation when Peak Shaving Basin Mode has been selected. o Display Headworks/Peak Shaving Basin Valve status o When valve is diverted to Peak Shaving Basin, all four pumps will be under lead/lag PLC control and four pump alternation. o On Peak Shaving Basin High Level Alarm, or upon switching the valve selection back to Headworks, SP-02-301 and SP-02-401 shall be returned to normal lead/lag operation and pump rotation. If the common spare, SP-02-301, is not selected to run on Peak Shaving Basin pump control, it will be placed in the rotation pumping to the Headworks. • PLC/Backup control: o A physical selector on the local control panel allows the operator to switch between PLC control and Backup control. In PLC control (Primary), the lift stations shall be operated by the PLC as a single lift station system. In Backup control, the lift station shall be operated by float control, and the PLC call signals shall be bypassed.
SCADA Functions	Lift Station Overview: SCADA screen shall show the Lift Station in a graphical layout similar to the P&IDs. The Lift Station shall show the current water level and setpoints for the lead and lag pump calls. Lift Station Alarms: The SCADA alarm screen shall list all Lift Station alarms with red/green indication for each alarm activity. Each alarm shall display a timestamp and date of the most recent activity.
Interlocks:	Interlocks below are hardwired:

	CP-02-001 Phase Failure/Control Power Failure SP-02-101 Over Temp SP-02-201 Over Temp SP-02-301 Over Temp SP-02-401 Over Temp SP-02-101 Seal Failure SP-02-201 Seal Failure SP-02-301 Seal Failure SP-02-401 Seal Failure SP-02-101 Overload SP-02-201 Overload SP-02-301 Overload SP-02-401 Overload LSL-02-001 Wet Well Low-Level Lockout LSH-04-001 Peak Shaving Basin High Level <u>Interlocks below are programmed:</u> CP-02-001 Phase Failure/Control Power Failure SP-02-101 Over Temp SP-02-201 Over Temp SP-02-301 Over Temp SP-02-401 Over Temp SP-02-101 Seal Failure SP-02-201 Seal Failure SP-02-301 Seal Failure SP-02-401 Seal Failure LSL-02-001 Wet Well Low-Level Lockout LSH-04-001 Peak Shaving Basin High Level
Alarms and Indications:	<u>Alarms Indicated on SCADA:</u> CP-02-001 Phase Failure/Control Power Failure CP-02-001 Pumps on Float Backup SP-02-101 Temp Failure SP-02-101 Seal Failure SP-02-101 Overload Fail SP-02-201 Temp Failure SP-02-201 Seal Failure SP-02-201 Overload Fail SP-02-301 Temp Failure SP-02-301 Seal Failure SP-02-301 Overload Fail SP-02-401 Temp Failure SP-02-401 Seal Failure SP-02-401 Overload Fail LSH-02-001 Wet Well High Level Alarm LSL-02-001 Wet Well Low Level Alarm LSH-04-001 Peak Shaving Basin High Level Alarm See IO list for a complete list of alarms and status indications

2.2 MECHANICAL SCREEN & WASH PRESS

Process Description:	One (1) in-channel mechanical perforated plate screen and one (1) washer compactor shall be installed in the existing headworks alongside one (1) existing mechanical perforated plate screen and a bypass channel containing a manual bar screen. The proposed and existing mechanical perforated plate screens shall screen raw influent and discharge screenings to the proposed washer compactor. The washer compactor shall collect and compact the screenings and convey the compacted screenings into a dumpster at the base of the existing headworks. The proposed screen shall be operated through a proposed vendor supplied local control panel. The system shall monitor the liquid levels in the screen channel via ultrasonic transducers located on the upstream and downstream sides of the channel and operate the screen based on differential level setpoints. A proposed high-level float switch shall be installed to serve as backup, operating the screen and sending an alarm, should the transducer fail. Additionally, the screen shall operate when a user-adjustable time has passed without operation. The washer compactor shall be called from the existing control panel and operated on a time delay based on the screen's operation. The existing panel shall also provide washer compacter running and fault status. The proposed control panel shall send a run call to the NPW booster pump controls, located in the existing panel. The existing panel controls shall call the NPW Booster Pump motor starter to run and energize (open) solenoid valves at the Wash water connections providing wash water for the mechanical screen and the washer compactor while the equipment is running. The existing panel shall also provide the NPW booster pump running and fault status. A high level alarm shall be triggered when either of the ultrasonic transducers detects that the level in the channel has reached the high level setpoint, or the high-level float switch is activated. A high level alarm in either channel shall call both systems to begin their cycle. The mechanical perforated plate screen and washer compactor shall be vendor supplied and controlled by the vendor supplied control panel (CP-03-002 Secondary Headworks Control Panel). See Specification Sections 11221 – Perforated Plate Screen and 11700 – Screenings Washer Compactor.
P&ID:	3-I-1 Elevated Headworks P&ID
Controlled Devices:	<u>Existing</u> VMP-03-001 Headworks Wash Water Pump No. 1 MFS-03-101 Mechanical Screen No. 1 <u>Proposed</u> MFS-03-301 Mechanical Screen No. 2 WC-03-001 Washer Compactor No. 1

Instrumentation Devices:	Existing LE-03-101 MFS-03-101 Upstream Level Element LE-03-102 MFS-03-101 Downstream Level Element LIT-03-101 MFS-03-101 Differential Level Indicating Transmitter LSH-03-001 Headworks Level High SV-03-101 Wash Water Solenoid Valve No. 1 Proposed LE-03-301 MFS-03-301 Upstream Level Element LE-03-302 MFS-03-301 Downstream Level Element LIT-03-301 MFS-03-301- Differential Level Indicating Transmitter SV-03-001 Wash Water Solenoid Valve No. 1 SV-03-302 Wash Water Solenoid Valve No. 2 LSH-03-301 Headworks Level High ZS-03-301 Inspection Door Safety Lockout
Local Functions:	Manufacturer Supplied Local Control Panel, Reference Section 11221 – Perforated Plate Screen. The PCSS shall supply a single local hand station that provides the following at a minimum. MFS-03-101 HOA MFS-03-301 HOA WC-03-001 HOA WC-02-001 F/O/R All equipment E-Stop
MCC Functions:	None
HMI Functions:	None
PLC Functions:	None
SCADA Functions:	Mechanical Screen and Wash Press Overview: The SCADA screens shall show the mechanical screens and wash compactors in a graphical overhead layout similar to the P&IDs. This screen shall show at a minimum, screen running, forward/reverse status, and fault status, the current upstream, downstream, and differential water level for each channel and provide adjustable setpoints for the screen call and system timers. This screen shall also show the Headworks NPW booster pump and Wash Compactor running and fail statuses The PCSS shall coordinate with the vendor for I/O tags and IP addresses. Mechanical Screen and Wash Press Alarms: SCADA alarm screen shall list all alarms with red/green indication for each alarm activity. Each alarm shall display a timestamp and date of the most recent activity
Interlocks:	Refer to Manufacturer Specification 11221 – Perforated Plate Screen for interlock details

Alarms and Indications:	Alarms Indicated on SCADA: CP-03-001 Control Power Fail CP-03-001 Phase Failure CP-03-002 Control Power Fail CP-03-002 Phase Failure MFS-03-101 Brush Overload MFS-03-101 Screen Overload MFS-03-101 Fault Headworks Level High Alarm MFS-03-301 Brush Overload MFS-03-301 Screen Overload MFS-03-301 Fault WC-03-001 Motor Overload VMP-03-001 Motor Overload VMP-03-001 Fault See IO list and specification 11221 – Perforated Plate Screen for a complete list of alarms and status indications

2.3 PEAK SHAVING BASIN SELF PRIMING PUMPS

Process Description:	Three (3) self-priming pumps (two existing, one proposed) shall pump raw sewage from the peak shaving basin to the elevated headworks. The pumps (two duty, one spare) shall operate based on a PLC control to allow the pumps to only operate at nighttime. A new photocell located at the peak shaving basin control panel shall provide backup control in the event of PLC failure. One (1) existing float switch (LSH-04-001) shall be used to lock out the lift station submersible pumps sending flow to the peak shaving basin. A second existing float (LSL-04-001) shall be utilized to lock out the self-priming pumps sending flow from the peak shaving basin to the elevated headworks. A user adjustable time delay shall allow the peak shaving basin pumps to operate after the low level float has been activated.
P&ID:	4-I-1 Peak Shaving Basin P&ID
Controlled Devices:	Existing SPP-04-101 Peak Shaving Basin Pump No. 1 SPP-04-201 Peak Shaving Basin Pump No. 2 Proposed SPP-04-301 Peak Shaving Basin Pump No. 3
Instrumentation Devices:	Proposed PI-04-001 - Peak Shaving Basin Air Header Pressure Existing LSL-04-001 – Low Level (All Pumps Off) Float LSH-04-001 – High Level Float

Local Functions:	<u>Local Control Panel:</u> One (1) Proposed peak shaving basin pump control panel shall be installed at the peak shaving basin to replace the existing pump control panel. This proposed panel shall house all local pump control, monitoring and pump alternation. The supplied control panel shall house the controls for all three (3) peak shaving basin pumps and provide at a minimum: • Hand-Off-Auto Switch: o Provides control of the pumps. • Phase Failure Bypass switch: o Allow operators to bypass Phase Fail relay. • White Pilot Light: o Control Power On status. • Pilot Lights: o pilot light shall indicate a pump running and fault status. • Elapsed Time Meter: o An elapsed time meter shall measure pump runtime. • Push Button: o An Alarm Test pushbutton shall allow testing of panel and SCADA alarms. • Reset pushbutton shall send a reset signal to the PLC and reset the solid-state overloads on the motor contactors as well as any fault relays. In the Hand position, the pump shall operate continuously if the interlocks for the pump listed in the INTERLOCKS section below are not active. In the Off position, the local control panel shall not call the pump to run.
MCC Functions:	None
HMI Functions:	None
PLC Functions:	In the AUTO position, the peak shaving basin pumps shall operate upon receiving a call signal from the PLC. PLC logic shall alternate the peak shaving basin pump operations to maintain equal runtime on all three pumps. The PLC shall call the pumps based on an operator adjustable time, set through SCADA. A backup photocell indicator shall only allow the pumps to operate at night in the event of PLC failure. User adjustable timers shall provide operators with the ability to delay the backup system start of the peak shaving basin pumps as required. Peak shaving basin Low Level (LSL-04-101) shall interlock SPP-04-101, SPP-04-201 and SPP-04-301 from pumping to the headworks. Peak shaving basin High Level (LSH-04-101) shall interlock lift station pumps SP-02-301 and SP-02-401 from pumping to the peak shaving basin. Lift station pumps SP-02-101 and SP-02-102 do not pump to the peak shaving basin.

SCADA Functions:	Peak Shaving Basin Overview: SCADA screen(s) shall show the Peak Shaving Basin system in a graphical layout similar to the P&IDs. The screen shall show the running and fault status of three pumps, float switch status, and shall provide setpoints for the pump call and system timers. Peak Shaving Basin Alarms: The SCADA alarm screen shall list all alarms with red/green indication for each alarm activity. Each alarm shall display a timestamp and date of the most recent activation.
Interlocks:	All interlocks below are hardwired: SPP-04-101 Overload SPP-04-201 Overload SPP-04-301 Overload LSL-04-001 Peak Shaving Basin Low Level – Peak shaving basin self-priming pumps lockout LSH-04-001 Peak Shaving Basin High Level – Lift station submersible pump (SP-02-301 and SP-02-401) lockout
Alarms and Indications:	Alarms Indicated on SCADA: SPP-04-101 Overload SPP-04-201 Overload SPP-04-301 Overload LSL-04-001 Peak Shaving Basin Low Level Alarm LSH-04-001 Peak Shaving Basin High Level Alarm See IO list for a complete list of alarms and status indications.

2.4 RAS AIR LIFTS

Process Description:	Four (4) existing RAS air lift pumps and two (2) proposed RAS air lift pumps shall be operated continuously with only manual control adjustments made through turning a ball valve on the air supply line. Air flow to each air lift shall be totalized using thermal mass flowmeters and a flow totalizing PLC panel programmed to calculate the RAS flow rate based on the manufacturer provided pump curves. Each air lift shall have a dedicated air flow measurement system. Flow meters shall provide read outs from each air lift pump to the operator.
P&ID:	5-I-1 Aeration Basin No. 3 P&ID

Controlled Devices:	Existing AL-05-101 RAS Air Lift No. 1 AL-05-102 RAS Air Lift No. 2 AL-05-201 RAS Air Lift No. 3 AL-05-202 RAS Air Lift No. 4 Proposed AL-05-301 RAS Air Lift No. 5 AL-05-302 RAS Air Lift No. 6 Manual valves shall be provided to isolate each airlift pump along with its thermal flow meter and shall be used to throttle the air supply to control the RAS pumping rate.
Instrumentation Devices:	Existing FIT-05-101 Air Lift No. 1 Flow Meter FIT-0-5102 Air Lift No. 2 Flow Meter FIT-05-201 Air Lift No. 3 Flow Meter FIT-05-202 Air Lift No. 4 Flow Meter Proposed FIT-05-301 Air Lift No. 5 Flow Meter FIT-05-302 Air Lift No. 6 Flow Meter
Local Functions:	Air Lift Flow Monitoring
MCC Functions:	None
HMI Functions:	None
PLC Functions:	Air Lift vendor shall provide Air Lift flow calculations curve (SCFM vs GPM). PLC shall use the curve for instantaneous calculation of RAS flow. Flow signals from each of the thermal mass flow measurement systems on each air lift shall be sent to the PLC for calculation and totalization. Each air lift shall have a dedicated air flow measurement system.
SCADA Functions:	RAS System Overview: SCADA screen shall show Rapid Mix Basins in a graphical layout similar to the P&IDs. The RAS screen shall show all RAS individual flows and totalized flows. Air flow rates shall be displayed in SCFM. The calculated instantaneous RAS flow rates shall be displayed in GPM for each air lift. This screen shall also display the total RAS flow rate for each treatment train, and the totalized flows for the day, rolling total, and all-time totals for the entire treatment unit. SCADA shall also indicate RAS Flowmeter's loss of signal. RAS System Alarms: All alarms shall have red/green indication for each alarm activity. Each alarm shall display a timestamp and date of most recent activation.
Interlocks:	None

Alarms and Indications:	Alarms and Indications on SCADA: FIT-05-101 Loss of Signal FIT-05-102 Loss of Signal FIT-05-201 Loss of Signal FIT-05-202 Loss of Signal FIT-05-301 Loss of Signal FIT-05-302 Loss of Signal See IO list for a complete list of alarms and status indications

2.5 AERATION BASINS

Process Description:	Dissolved Oxygen (DO) and Mixed Liquor Suspended Solids (MLSS) probes shall be installed at the two existing aeration basins and the proposed aeration basin. The probes shall transmit to SCADA.
P&ID:	5-I-1 Aeration Basin No. 3 P&ID
Controlled Devices:	None
Instrumentation Devices:	AIT-05-101 Analytical Indicating Transmitter AIT-05-201 Analytical Indicating Transmitter AIT-05-301 Analytical Indicating Transmitter AE-05-101 Dissolved Oxygen Probe AE-05-201 Dissolved Oxygen Probe AE-05-301 Dissolved Oxygen Probe AE-05-102 Mixed Liquor Suspended Solids Probe AE-05-202 Mixed Liquor Suspended Solids Probe AE-05-302 Mixed Liquor Suspended Solids Probe
Local Functions:	Dissolved Oxygen Monitoring MLSS Monitoring
MCC Functions:	None
PLC Functions:	None
SCADA Functions:	Aeration Basin Overview: This SCADA screen shall display each aeration basin in a graphical layout similar to the P&ID. Indication shall be provided for Dissolved Oxygen values and Mixed Liquor Suspended Solids values for monitoring and historical trending. Aeration Basin Alarms: All alarms shall have red/green indication for each alarm activity. Each alarm shall display a timestamp and date of most recent activation.
Interlocks:	None
Alarms and Indications:	See IO list for a complete list of alarms and status indications

2.6 WAS AIR LIFTS (SLUDGE HOLDING TANK)

Process Description:	Four (4) existing WAS air lift pumps and two (2) proposed WAS air lift pumps shall be operated continuously with automatic control provided by solenoid valves, or by opening proposed solenoid valves on the bypass air supply line. Timers set by the Operator shall operate one (1) solenoid valve that controls the air flow to the air lift pumps. The solenoid valve shall also be utilized to shut off air flow to the air lift pumps in the event of a high-level alarm, determined by the existing float switch. Two (2) additional float switches shall be added to Sludge Holding Tank No. 1 and Sludge Holding Tank No. 2 with signals routed to the Dewatering System Control Panel controlling the press feed pumps, that draw from the sludge tanks. Air flow to each air lift pump shall be totalized using thermal mass flowmeters and a flow totalizing PLC panel programmed to calculate the WAS flow rate based on the manufacturer provided pump curves. Flow meters shall provide read outs from each air lift pump to the Operator.
P&ID:	13-I-1 Sludge Holding Tank P&ID
Controlled Devices:	<u>Existing</u> SV-13-101 WAS Pit No. 1 Solenoid Valve SV-13-201 WAS Pit No. 2 Solenoid Valve <u>Proposed</u> SV-13-301 WAS Pit No. 3 Solenoid Valve SV-13-102 – WAS Pit No. 1 Bypass Solenoid Valve SV-13-202 – WAS Pit No. 2 Bypass Solenoid Valve SV-13-302 – WAS Pit No. 3 Bypass Solenoid Valve
Instrumentation Devices:	<u>Existing</u> FIT-13-101 WAS Train No. 1 Air Lift No. 1 Flow Meter FIT-13-102 WAS Train No. 1 Air Lift No. 2 Flow Meter FIT-13-201 WAS Train No. 2 Air Lift No. 1 Flow Meter FIT-13-202 WAS Train No. 2 Air Lift No. 2 Flow Meter LSH-13-001 Sludge Holding Tank High Level Float Switch <u>Proposed</u> FIT-13-301 – Train No. 3 Air Lift No. 1 Flow Meter FIT-13-302 – Train No. 3 Air Lift No. 2 Flow Meter LSL-13-001 – Sludge Holding Tank No. 1 Low Level Float Switch LSL-13-002 – Sludge Holding Tank No. 2 Low Level Float Switch
Local Functions:	Air Lift Flow Monitoring A proposed control panel shall be installed to provide an operator interface for the solenoid valve bypass controls. Each WAS train will have an individual selector switch to bypass its respective flow to the air lifts pumps.
MCC Functions:	None

PLC Functions:	The solenoid valves shall open/close based on a user adjustable timer programmed at the PLC if the interlocks in the INTERLOCKS section below are not active. Sludge Flow Calculation: Air lift vendor shall provide air lift flow calculations curve (SCFM vs GPM). PLC shall use the curve for instantaneous calculation of sludge flow. Flow signals from each of the thermal mass flow measurement systems on each air lift shall be sent to the PLC for calculation and totalization. Each air lift shall have a dedicated air flow measurement system.
SCADA Functions:	Sludge Holding Tank Overview: This screen shall show the Sludge Holding Tank in a graphical layout similar to the P&IDs. The screen shall show all WAS individual flows and totalized flows. Air flow rates shall be displayed in SCFM. The calculated instantaneous WAS flow rates shall be displayed in GPM for each air lift. This screen shall also display the total WAS flow rate, and the totalized flows for the day, rolling total, and all-time totals for the entire treatment unit. SCADA shall also indicate WAS Flowmeter's loss of signal. Sludge Holding Tank Alarms: All alarms shall have red/green indication for each alarm activity. Each alarm shall display a timestamp and date of most recent activation.
Interlocks:	Interlocks below are hardwired: LSH-13-001 – Existing Sludge Holding Tank High Level Float Switch LSL-13-001 – Sludge Holding Tank No. 1 Low Level Float Switch LSL-13-002 – Sludge Holding Tank No. 2 Low Level Float Switch
Alarms and Indications:	Alarms Indicated on SCADA: LSH-13-001 Existing Sludge Holding Tank Level Switch High LSL-13-001 Sludge Holding Tank No. 1 Level Switch Low LSL-13-002 Sludge Holding Tank No. 2 Level Switch Low FIT-13-101 Loss of Signal FIT-13-102 Loss of Signal FIT-13-201 Loss of Signal FIT-13-202 Loss of Signal FIT-13-301 Loss of Signal FIT-13-302 Loss of Signal See IO list for a complete list of alarms and status indications

2.7 SECONDARY CLARIFIERS

Process Description:	Two (2) existing and one (1) proposed secondary clarifiers shall be utilized to separate clear water from solids. The clarifiers shall be operated continuously at a constant speed. The clarifier system shall be vendor supplied and controlled by the vendor supplied control panel. See Specification Section 11320 – Clarifier.
P&ID:	6-I-1 Secondary Clarifier No. 3 P&ID
Controlled Devices:	Existing SC-06-101 Clarifier No. 1 SC-06-201 Clarifier No. 2 Proposed SC-06-301 Clarifier No. 3
Instrumentation Devices:	Existing SC-06-101 Clarifier No. 1 Torque Limit Switch SC-06-201 Clarifier No. 2 Torque Limit Switch Proposed SC-06-301 Clarifier No. 3 Torque Limit Switch
Local Functions:	See Specification Section 11320 – Clarifier.
MCC Functions:	None
PLC Functions:	None
HMI Functions:	None
SCADA Functions:	Secondary Clarifiers Overview: SCADA screen shall show the secondary clarifiers in a graphical layout similar to the P&IDs. This screen shall show the clarifiers ON/OFF and fault status. . Secondary Clarifiers Alarms: All alarms shall have red/green indication for each alarm activity. Each alarm shall display a timestamp and date of most recent activation.

Interlocks:	Interlocks below are hardwired: SC-06-101 Phase Fail SC-06-201 Phase Fail SC-06-301 Phase Fail SC-06-101 Overload SC-06-201 Overload SC-06-301 Overload SC-06-101 Motor Protection Relay SC-06-201 Motor Protection Relay SC-06-301 Motor Protection Relay SC-06-101 High Torque Alarm SC-06-201 High Torque Alarm SC-06-301 High Torque Alarm SC-06-101 High Torque Shutdown SC-06-201 High Torque Shutdown SC-06-301 High Torque Shutdown SC-06-101 Shear Pin Fail Shutdown SC-06-201 Shear Pin Fail Shutdown SC-06-301 Shear Pin Fail Shutdown
Alarms and Indications:	Alarms Indicated on SCADA CP-06-101 Control Power Fail CP-06-101 Phase Fail SC-06-101 Not Running SC-06-101 Shear Pin Fail Shutdown SC-06-101 High Torque Alarm SC-06-101 High Torque Shutdown SC-06-101 Motor Overload SC-06-101 Motor Protection Relay CP-06-201 Control Power Fail CP-06-201 Phase Fail SC-06-201 Not Running SC-06-201 Shear Pin Fail Shutdown SC-06-201 High Torque Alarm SC-06-201 High Torque Shutdown SC-06-201 Motor Overload SC-06-201 Motor Protection Relay CP-06-301 Control Power Fail CP-06-301 Phase Fail SC-06-301 Not Running SC-06-301 Shear Pin Fail Shutdown SC-06-301 High Torque Alarm SC-06-301 High Torque Shutdown SC-06-301 Motor Overload SC-06-301 Motor Protection Relay See IO list for a complete list of alarms and status indications

2.8 CHLORINE CONTACT BASIN

Process Description:	Flow information collected from the proposed 12" Parshall Flume shall be sent to the chemical system PLC. The summed total of the Parshall Flume and NPW flows shall then be used in calculations to determine the dosing rate and output a signal to pace the operation speed of the chemical pumps.
P&ID:	8-I-1 Chlorine Contact Basin P&ID
Controlled Devices:	Existing: SM-08-101 Sodium Hypochlorite Mixer 101 SM-08-102 Sodium Hypochlorite Mixer 102 SM-08-201 Sodium Bisulfite Mixer 201 SM-08-202 Sodium Bisulfite Mixer 202 Proposed: PF-08-001 12" Parshall Flume
Instrumentation Devices:	Existing: FIT-08-001 12" Parshall Flume Flow Indication LSL-08-001 Basin Low Level Switch
Local Functions:	The existing FIT-08-001 shall send Parshall flume flow information to SCADA via the proposed PLC-11-001, located in CP-11C-001. CP-08-101 Existing Sodium Hypochlorite Mixer control panel shall provide local control and monitoring of mixers SM-08-101 and SM-08-102. CP-08-201 Existing Sodium Bisulfite Mixer control panel shall provide local control and monitoring of mixers SM-08-201 and SM-08-202.
MCC Functions:	None
HMI Functions:	None
PLC Functions:	The chemical system PLC shall use the Parshall Flume flow and NPW flows in its calculations to determine the chemical feed rates for Sodium Hypochlorite, Sodium Bisulfite, and Alum.
SCADA Functions:	Current flow, single day total, 30-day rolling total, and all-time totals shall be shown on the Plant SCADA system for display and historical trending.
Interlocks:	None
Alarms and Indications:	Alarms on SCADA: FIT-08-001 Loss of Signal CP-08-101 Control Power Fail CP-08-101 Phase Fail SM-08-101 Not Running SM-08-102 Not Running SM-08-101 Seal Fail SM-08-102 Seal Fail

	SM-08-101 Overload SM-08-102 Overload SM-08-101 Pump Monitor Fail SM-08-102 Pump Monitor Fail CP-08-201 Control Power Fail CP-08-201 Phase Fail SM-08-201 Not Running SM-08-202 Not Running SM-08-201 Seal Fail SM-08-202 Seal Fail SM-08-201 Pump Monitor Fail SM-08-202 Pump Monitor Fail SM-08-201 Overload SM-08-202 Overload See IO list for a complete list of alarms and status indications

2.9 MULTI-STAGE CENTRIFUGAL BLOWERS

Process Description:	Five (5) existing and one (1) proposed multistage centrifugal blowers shall supply air from the to a common air header and air system at the blower slab. Three blowers supply air to the secondary processes, chlorine contact basin, scum pump stations, and RAS/WAS pump stations (Air Header No. 2), Two blowers shall be dedicated to the sludge holding tanks (Air Header No. 1), and one blower shall be a common spare. The blowers shall be operated continuously at a constant speed. Each blower shall have a local protection panel (Vendor Provided) and local padlock-able Lock-Stop Switch (By Contractor). Three low pressure switches, one on each branch of the air header, shall send an alarm when the pressure drops below a set point. See Specification Section - 11171 – Multi-Stage Centrifugal Blowers
P&ID:	9-I-1 Blowers P&ID
Controlled Devices:	<u>Existing</u> MSB-09-101 Multistage Blower No. 1 MSB-09-201 Multistage Blower No. 2 MSB-09-301 Multistage Blower No. 3 MSB-09-401 Multistage Blower No. 4 MSB-09-501 Multistage Blower No. 5 <u>Proposed</u> MSB-09-601 Multistage Blower No. 6

Instrumentation Devices:	Existing PSL-09-001 Blower Header Low Pressure No. 1 PSL-09-002 Blower Header Low Pressure No. 2 Proposed PSL-09-003 Blower Header Low Pressure No. 3
Local Functions:	See Specification Section - 11171 – Multi-Stage Centrifugal Blowers
MCC Functions:	See Specification Section - 11171 – Multi-Stage Centrifugal Blowers
HMI Functions:	See Specification Section - 11171 – Multi-Stage Centrifugal Blowers
PLC Functions:	See Specification Section - 11171 – Multi-Stage Centrifugal Blowers
SCADA Functions:	Blowers Overview: SCADA screen shall show the blowers in a graphical layout similar to the P&IDs. This screen shall show the blowers' ON/OFF and fault status. The operator interface allows to start/stop blowers from SCADA. Blower Surge Panels are vendor provided panels, PCSS shall coordinate with the vendor for I/O tags and IP addresses. At minimum the Blowers screen shall display equipment running status, fault status, current (A), air flow (cfm), and any other relevant data that could be utilized by operations in running the plant. Blowers Alarms: All alarms shall have red/green indication for each alarm activity. Each alarm shall display a timestamp and date of most recent activation.
Interlocks:	Interlocks below are hardwired: Existing MSB-09-101 Phase Failure MSB-09-201 Phase Failure MSB-09-301 Phase Failure MSB-09-401 Phase Failure MSB-09-501 Phase Failure MSB-09-101 E-Stop MSB-09-201 E-Stop MSB-09-301 E-Stop MSB-09-401 E-Stop MSB-09-501 E-Stop MSB-09-101 SSRV Fail MSB-09-201 SSRV Fail MSB-09-301 SSRV Fail MSB-09-401 SSRV Fail MSB-09-501 SSRV Fail MSB-09-101 Surge MSB-09-201 Surge MSB-09-301 Surge MSB-09-401 Surge MSB-09-501 Surge MSB-09-101 Overload MSB-09-201 Overload

	MSB-09-301 Overload MSB-09-401 Overload MSB-09-501 Overload MSB-09-101 Lock Stop Switch MSB-09-201 Lock Stop Switch MSB-09-301 Lock Stop Switch MSB-09-401 Lock Stop Switch MSB-09-501 Lock Stop Switch MSB-09-101 Standby Power Lockout MSB-09-201 Standby Power Lockout MSB-09-301 Standby Power Lockout MSB-09-401 Standby Power Lockout MSB-09-501 Standby Power Lockout <u>Proposed</u> MSB-09-601 Phase Failure MSB-09-601 E-Stop MSB-09-601 SSRV Fail MSB-09-601 Surge MSB-09-601 Overload MSB-09-601 Lock Stop Switch MSB-09-601 Standby Power Lockout
Alarms and Indications:	<u>Alarms Indicated on SCADA</u> MSB-09-101 Phase Failure MSB-09-201 Phase Failure MSB-09-301 Phase Failure MSB-09-401 Phase Failure MSB-09-501 Phase Failure MSB-09-601 Phase Failure MSB-09-101 E-Stop MSB-09-201 E-Stop MSB-09-301 E-Stop MSB-09-401 E-Stop MSB-09-501 E-Stop MSB-09-601 E-Stop MSB-09-101 SSRV Fail MSB-09-201 SSRV Fail MSB-09-301 SSRV Fail MSB-09-401 SSRV Fail MSB-09-501 SSRV Fail MSB-09-601 SSRV Fail MSB-09-101 Surge MSB-09-201 Surge MSB-09-301 Surge MSB-09-401 Surge MSB-09-501 Surge MSB-09-601 Surge MSB-09-101 Overload

	MSB-09-201 Overload MSB-09-301 Overload MSB-09-401 Overload MSB-09-501 Overload MSB-09-601 Overload PSL-09-001 Low Header Pressure No. 1 Alarm PSL-09-002 Low Header Pressure No. 2 Alarm PSL-09-003 Low Header Pressure No. 3 Alarm See IO list for a complete list of alarms and status indications

2.10 ALUM FEED SYSTEM

Process Description:	Two (2) existing and one (1) proposed peristaltic pumps shall discharge alum from three storage tanks to the existing and proposed rapid mix basins. All three alum tanks, including two (2) existing and one (1) proposed, shall be used to provide alum discharge for said rapid mix basins. Proposed manual valves shall be used to direct flow between the two basins and the three (3) total tanks based on need as determined by operators. Two pumps shall be operated continuously and the other shall be standby, if the INTERLOCKS below are not active. The pumps speed shall be based on the flow paced 4-20mA signal from the PLC based on the combined Non-Potable Water System flow and the Plant Final Effluent Flow. The dosage of the pumps shall be controlled based on the calculated dosage utilizing the formula listed in the PLC Functions section below. A pressure switch on the discharge of each pump shall shut off and alarm the respective pump in the event the pressure in the discharge line increases to high pressure setpoint. In the event of a pump interlock due to high pressure, flow verification, or tube failure alarms the standby pump shall become duty. A level instrument on each tank shall provide local indication, as well as display level and alarms on SCADA. A Leak Senor provides leak detection for the system. A flow switch shall be installed on the potable water supply line to the eyewash stations in the containment area which shall alarm if an emergency shower or eyewash has been engaged. Leak sensors shall be installed in the sumps within the containment wall to alarm operations of a chemical leak. Two (2) proposed supply fans shall be installed in the chemical building to provide required ventilation. A small supply fan control panel shall be provided to operate the fans and shall contain all of the necessary breakers and starters to run these fans continuously. Hand-Off-Auto switches shall allow operators to designate which fans will be controlled by the chemical area PLC (PLC-11-001). A switch mounted to the wall shall allow the operator to call all supply fans that are in Auto to run continuously until they are shut off by the operator. When not in continuous function, the PLC shall call the supply fans to run for five min. every hour.
P&ID:	11C-I-1 Alum Feed System P&ID
Controlled Devices:	<u>Existing</u> PSP-11C-101 Alum Peristaltic Pump No. 1

	PSP-11C-201 Alum Peristaltic Pump No. 2 <u>Proposed</u> PSP-11C-301 Alum Peristaltic Pump No. 3 SFAN-11-001 Supply Fan No. 1 SFAN-11-002 Supply Fan No. 2
Instrumentation Devices:	<u>Existing</u> LIT-11C-101 Existing Alum Bulk Tank No. 1 Level LIT-11C-201 Existing Alum Bulk Tank No. 2 Level <u>Proposed</u> LIT-11C-301 Alum Bulk Tank No. 3 Level PSH-11C-101 Alum Peristaltic Pump No. 1 High Pressure PSH-11C-201 Alum Peristaltic Pump No. 2 High Pressure PSH-11C-301 Alum Peristaltic Pump No. 3 High Pressure LS-11C-001 Chemical Containment Leak Sensor LS-11C-002 Chemical Containment Leak Sensor FS-11C-001 Eyewash #1 Flow Switch TIT-11D-001 Heat Tracing Panel Temperature
Local Functions:	<u>Peristaltic Pumps:</u> The pump shall be controlled by its integrated pump control system. See Specification 11160 – Peristaltic Pumps Heat Trace Panel: Heat tracing local control and monitoring shall be provided via dedicated panel. <u>Supply Fans:</u> Two (2) supply fans shall be controlled by the Supply Fan Control Panel. When place in Hand, the supply fan shall run continuously unless the interlocks listed in the Interlock section below are active. See Specification 15831 – Fans.
MCC Functions:	None
HMI Functions:	None
PLC Functions:	<u>Alum Feed:</u> In Remote mode, the PLC shall receive pump run confirmation and alarms from the pumps. The pumps speed shall be based on the combined NPW flow and effluent flow. The PLC shall automatically calculate the desired usage rate using the following algorithm and adjust the metering pump speed to reach the desired chemical feed rate (mg/L). • Usage Rate (lbs/day) = (Flow (MGD) x (Influent – Effluent Phosphorus Concentration (mg/L)) x Dosage ((lbs Alum/lbs Phosphrus) / Day) / (Alum Solution Concentration (% as decimal) x 1.33 (Specific Gravity of Alum)) x 9.59 (correction factor) • Usage Rate (gal/hour) = Usage Rate (lbs/day) / 24 (hours/day) o Note: Dosage and Alum Solution Concentration are user adjustable values. <u>Alum Feed System:</u>

	• Standby Pump Selector: Pump No. 1 / Pump No. 2 / Pump No. 3. In the event of a pump interlock due to high pressure, flow verification, or tube failure alarms the standby pump shall become duty • Chemical tank levels • Chemical pump Run status • Chemical pump speeds (%) • Chemical pump Flowrates (gph) • Combined Final Effluent Flow (Total flow of FIT-08-001 WWTP Chlorinated Effluent and FIT-10-001 NPW System Flow) • Chemical pump Alarms, see below • Emergency Shower & Eyewash Flow Detected • Chemical Leak Detected Supply Fans: Two (2) supply fans shall be controlled by the PLC when the Supply Fan Control Panel controls are placed in Auto. When placed in Auto, the supply fan shall run continuously when called by the operator using the wall mounted switch, unless the interlocks listed in the Interlock section below are active. When not in continuous use, the PLC shall call any fans placed in Auto to run for five min. every hour as long as the interlocks listed in the Interlock section below are not active.
SCADA Functions:	Alum Overview: SCADA screen shall show the Alum Feed System in a graphical layout similar to the P&IDs. This screen shall show at a minimum, the status of the pumps, pump speed (%), dosing request, and flowrate (gph). This screen shall have a user-adjustable input for concentration that is incorporated in the equation mentioned in the PLC functions section. This screen shall display the Alum tank levels both in inches and in gallons. The PCSS shall coordinate with the vendor for I/O tags and IP addresses. Alum Feed System Alarms: This screen shall list all available alarms with red/green indication for each alarm activity. Each alarm shall display a timestamp and date of the most recent activation.
Interlocks:	Interlocks below are hardwired: SWT-11C-101 Alum Tank No. 1 Low Level SWT-11C-201 Alum Tank No. 2 Low Level SWT-11C-301 Alum Tank No. 3 Low Level PSP-11C-101 Alum Peristaltic Pump No. 1 Tube Failure PSP-11C-101 Alum Peristaltic Pump No. 1 High Discharge Pressure PSP-11C-101 Alum Peristaltic Pump No. 1 Failure PSP-11C-201 Alum Peristaltic Pump No. 2 Tube Failure PSP-11C-201 Alum Peristaltic Pump No. 2 Discharge High Pressure PSP-11C-201 Alum Peristaltic Pump No. 2 Failure PSP-11C-301 Alum Peristaltic Pump No. 3 Tube Failure PSP-11C-301 Alum Peristaltic Pump No. 3 High Discharge Pressure PSP-11C-301 Alum Peristaltic Pump No. 3 Failure SFAN-11-001 Supply Fan No. 1 Overload SFAN-11-002 Supply Fan No. 2 Overload

Alarms and Indications:	Alarms Indicated on SCADA LIT-11C-101 Alum Tank No. 1 Low Level LIT-11C-201 Alum Tank No. 2 Low Level LIT-11C-301 Alum Tank No. 3 Low Level PSP-11C-101 Alum Peristaltic Pump No. 1 Failure PSP-11C-201 Alum Peristaltic Pump No. 2 Failure PSP-11C-301 Alum Peristaltic Pump No. 3 Failure PSP-11C-101 Alum Peristaltic Pump No. 1 High Discharge Pressure PSP-11C-201 Alum Peristaltic Pump No. 2 High Discharge Pressure PSP-11C-301 Alum Peristaltic Pump No. 3 High Discharge Pressure PSP-11C-101 Alum Peristaltic Pump No. 1 Tube Failure PSP-11C-201 Alum Peristaltic Pump No. 2 Tube Failure PSP-11C-301 Alum Peristaltic Pump No. 3 Tube Failure PSP-11C-101 Alum Peristaltic Pump No. 1 Flow Verification Failure PSP-11C-201 Alum Peristaltic Pump No. 2 Flow Verification Failure PSP-11C-301 Alum Peristaltic Pump No. 3 Flow Verification Failure LS-11C-001 Chemical Containment Leak Detected LS-11C-002 Chemical Containment Leak Detected FS-11C-001 Eyewash #1 In-Use SFAN-11-001 Failure SFAN-11-002 Failure See IO list for a complete list of alarms and status indications

2.11 SODIUM HYPOCHLORITE FEED SYSTEM

Process Description:	Two (2) proposed peristaltic pumps shall be provided under the chemical feed system canopy. The pumps shall be utilized to pump sodium hypochlorite from two (2) existing bulk tanks to the existing tertiary filter basins and disinfection basin. One pump shall be operated continuously, and the other shall be standby, if the INTERLOCKS below are not active. The pumps speed shall be based on the flow paced 4-20mA signal from the PLC based on the combined Non-Potable Water System flow and the Plant Final Effluent Flow. The dosage of the pumps shall be either manually adjusted at the pump in local mode or controlled based on the calculated dosage utilizing the formula below. A pressure switch on the discharge of each pump shall shut off and alarm the respective pump in the event the pressure in the discharge line increases to high pressure setpoint. In the event of a pump interlock due to high pressure, flow verification, or tube failure alarms the standby pump shall become duty. A level instrument on each tank shall provide local indication, as well as display level and alarms on SCADA. A Leak Senor provides leak detection for the system. A flow switch shall be installed on the potable water supply line to the eyewash in the containment area which shall alarm if the emergency shower or eyewash have been engaged. Leak sensors shall be installed in the sumps within the containment wall to alarm operations of a chemical leak.

P&ID:	11A-I-1 Sodium Hypochlorite Feed System P&ID
Controlled Devices:	PSP-11A-101 Sodium Hypochlorite Peristaltic Pump No. 1 PSP-11A-201 Sodium Hypochlorite Peristaltic Pump No. 2
Instrumentation Devices:	LIT-11A-101 Sodium Hypochlorite Bulk Tank No. 1 Level LIT-11A-201 Sodium Hypochlorite Bulk Tank No. 2 Level PSH-11A-101 Sodium Hypochlorite Peristaltic Pump No. 1 High Pressure PSH-11A-201 Sodium Hypochlorite Peristaltic Pump No. 2 High Pressure LSL-11A-001 Chemical Containment Leak Sensor FS-11A-001 Eyewash #1 Flow Switch
Local Functions:	Peristaltic Pumps: The pump shall be controlled by its integrated pump control system. See Specification 11160 – Peristaltic Pumps.
MCC Functions:	None
HMI Functions:	None
PLC Functions:	Sodium Hypochlorite Feed: In Remote mode, the PLC shall receive pump run confirmation and alarms from the pumps. The pumps speed shall be based on the combined NPW flow and effluent flow. The PLC shall automatically calculate the desired usage rate using the following algorithm and adjust the metering pump speed to reach the desired chemical feed rate (mg/L). • Chlorine Available per Gallon of Fresh Commercial Solution (lbs/gal) = Available Chlorine (gram/L) x (3.785/453.6 (unit conversion grams to lbs and L to gal)) • Usage Rate (gal/day) = (Flow (MGD) x Dosage (ppm) x 8.34 (lbs/gal)) / Chlorine Available per Gallon of Fresh Commercial Solution (lbs/gal) • Usage Rate (gal/hr) = Usage Rate (gal/day) / 24 (hours/day) o Note: Available Chlorine will be a value provided by the supplier. As the bleach degrades over time, adjust the Dosage to correct the Usage Rate. o Note: Available Chlorine and Dosage are user adjustable values. Sodium Hypochlorite System: • Duty Pump Selector: Pump No. 1 / Pump No. 2. In the event of a pump interlock due to high pressure, flow verification, or tube failure alarms the standby pump shall become duty • Chemical tank levels • Chemical pump Run status • Chemical pump speeds (%) • Chemical pump Flowrates (gph) • Combined Final Effluent Flow (Total flow of FIT-08-001 WWTP Chlorinated Effluent • and FIT-10-001 NPW System Flow) • Chemical pump Alarms, see below • Emergency Shower & Eyewash Flow Detected • Chemical Leak Detected

SCADA Functions:	Sodium Hypochlorite Disinfection Overview: SCADA screen shall show the Sodium Hypochlorite Feed System in a graphical layout similar to the P&IDs. This screen shall show at a minimum, the status of the pumps, pump speed (%), dosing request, and flowrate (gph). This screen shall have a user-adjustable input for concentration that is incorporated in the equation mentioned in the PLC functions section. This screen shall display the Sodium Hypochlorite tank levels both in inches and in gallons. The PCSS shall coordinate with the vendor for I/O tags and IP addresses. Sodium Hypochlorite Feed System Alarms: This screen shall list all available alarms with red/green indication for each alarm activity. Each alarm shall display a timestamp and date of the most recent activation.
Interlocks:	Interlocks below are hardwired: SWT-11A-101 Sodium Hypochlorite Tank No. 1 Low Level SWT-11A-201 Sodium Hypochlorite Tank No. 2 Low Level PSP-11A-101 Sodium Hypochlorite Peristaltic Pump No. 1 Tube Failure PSP-11A-101 Sodium Hypochlorite Pump No. 1 High Discharge Pressure PSP-11A-101 Sodium Hypochlorite Peristaltic Pump No. 1 Failure PSP-11A-201 Sodium Hypochlorite Peristaltic Pump No. 2 Tube Failure PSP-11A-201 Sodium Hypochlorite Pump No. 2 High Discharge Pressure PSP-11A-201 Sodium Hypochlorite Peristaltic Pump No. 2 Failure
Alarms and Indications:	Alarms Indicated on SCADA PSP-11A-101 Sodium Hypochlorite Peristaltic Pump No. 1 Failure PSP-11A-201 Sodium Hypochlorite Peristaltic Pump No. 2 Failure PSH-11A-101 Sodium Hypochlorite Peristaltic Pump No. 1 High Discharge Pressure PSH-11A-201 Sodium Hypochlorite Peristaltic Pump No. 2 High Discharge Pressure PSP-11A-101 Sodium Hypochlorite Peristaltic Pump No. 1 Tube Failure PSP-11A-201 Sodium Hypochlorite Peristaltic Pump No. 2 Tube Failure PSP-11A-101 Sodium Hypochlorite Peristaltic Pump No. 1 Flow Verification Failure PSP-11A-201 Sodium Hypochlorite Peristaltic Pump No. 2 Flow Verification Failure LSL-11A-001 Chemical Leak Detected FS-11A-001 Eyewash #1 In-Use See IO list for a complete list of alarms and status indications

2.12 SODIUM BISULFITE SYSTEM

Process Description:	Two (2) proposed peristaltic pumps shall be provided under the chemical feed system canopy. The pumps shall be utilized to pump sodium Bisulfite from two (2) existing bulk tanks to the existing dechlorination chamber. One pump shall be operated continuously, and the other shall be standby, if the INTERLOCKS below are not active. The pumps speed shall be based on the flow paced 4-20mA signal from the PLC based on the combined Non-Potable Water System flow and the Plant Final Effluent Flow. The dosage of the pumps shall be either manually adjusted at the pump in local mode or controlled based on the calculated dosage utilizing the formula below. A pressure switch on the discharge of each pump shall shut off and alarm the respective pump in the event the pressure in the discharge line increases to high pressure setpoint. In the event of a pump interlock due to high pressure, flow verification, or tube failure alarms the standby pump shall become duty. A level instrument on each tank shall provide local indication, as well as display level and alarms on SCADA. A Leak Senor provides leak detection for the system. A flow switch shall be installed on the potable water supply line to the eyewash in the containment area which shall alarm if the emergency shower or eyewash have been engaged. Leak sensors shall be installed in the sumps within the containment wall to alarm operations of a chemical leak.
P&ID:	11B-I-1 Sodium Bisulfite Feed System P&ID
Controlled Devices:	PSP-11B-201 Sodium Bisulfite Peristaltic Pump No. 1 PSP-11B-202 Sodium Bisulfite Peristaltic Pump No. 2
Instrumentation Devices:	LIT-11B-101 Sodium Bisulfite Bulk Tank No. 1 Level LIT-11B-201 Sodium Bisulfite Bulk Tank No. 2 Level PSH-11B-101 Sodium Bisulfite Peristaltic Pump No. 1 High Pressure PSH-11B-201 Sodium Bisulfite Peristaltic Pump No. 2 High Pressure LSL-11B-001 Chemical Containment Leak Sensor FS-11B-001 Eyewash #1 Flow Switch
Local Functions:	Peristaltic Pumps: The pump shall be controlled by its integrated pump control system. See Specification 11160 – Peristaltic Pumps.
MCC Functions:	None
HMI Functions:	None

PLC Functions:	Sodium Bisulfite Feed: In Remote mode, the PLC shall receive pump run confirmation and alarms from the pumps. The pumps speed shall be based on the combined NPW flow and effluent flow. The PLC shall automatically calculate the desired usage rate using the following algorithm and adjust the metering pump speed to reach the desired chemical feed rate (mg/L). • Usage Rate (lbs/day) = Flow (MGD) x Dosage (ppm) x 8.34 (lbs/gal) x 1.465 (parts SBS Dose/ 1 part Chlorine Dose) • Usage Rate (gal/day) = (Usage Rate (lbs/day) / 10.90 (lbs of SBS/gal of SBS)) * (1 / SBS Solution Concentration (% as decimal)) • Usage Rate (gal/hour) = Usage Rate (gal/day) / 24 (hours/day) o Note: Dosage and SBS Solution Concentration are user adjustable values. Sodium Bisulfite System: • Duty Pump Selector: Pump No. 1 / Pump No. 2. In the event of a pump interlock due to high pressure, flow verification, or tube failure alarms the standby pump shall become duty • Chemical tank levels • Chemical pump run status • Chemical pump speeds (%) • Chemical pump flowrates (gph) • Combined Final Effluent Flow (Total flow of FIT-08-001 WWTP Chlorinated Effluent and FIT-10-001 NPW System Flow) • Chemical pump Alarms, see below • Emergency Shower & Eyewash Flow Detected • Chemical Leak Detected
SCADA Functions:	Sodium Bisulfite Feed System Overview: SCADA screen shall show the Sodium Bisulfite Feed System in a graphical layout similar to the P&IDs. This screen shall show at a minimum, the status of the pumps, pump speed (%), dosing request, and flowrate (gph). This screen shall have a user-adjustable input for concentration that is incorporated in the equation mentioned in the PLC functions section. This screen shall display the Sodium Bisulfite tank levels both in inches and in gallons. The PCSS shall coordinate with the vendor for I/O tags and IP addresses. Sodium Bisulfite Feed System Alarms: This screen shall list all available alarms with red/green indication for each alarm activity. Each alarm shall display a timestamp and date of the most recent activation.
Interlocks:	Interlocks below are hardwired: SWT-11B-101 Sodium Bisulfite Tank No. 1 Low Level SWT-11B-201 Sodium Bisulfite Tank No. 2 Low Level PSP-11B-101 Sodium Bisulfite Peristaltic Pump No. 1 Tube Failure PSP-11B-101 Sodium Bisulfite Pump No. 1 High Discharge Pressure PSP-11B-101 Sodium Bisulfite Peristaltic Pump No. 1 Failure PSP-11B-201 Sodium Bisulfite Peristaltic Pump No. 2 Tube Failure PSP-11B-201 Sodium Bisulfite Pump No. 2 High Discharge Pressure PSP-11B-201 Sodium Bisulfite Peristaltic Pump No. 2 Failure

Alarms and Indications:	Alarms Indicated on SCADA SWT-11B-101 Sodium Bisulfite Tank No. 1 Low Level SWT-11B-201 Sodium Bisulfite Tank No. 2 Low Level PSP-11B-101 Sodium Bisulfite Peristaltic Pump No. 1 Failure PSP-11B-201 Sodium Bisulfite Peristaltic Pump No. 2 Failure PSP-11B-101 Sodium Bisulfite Peristaltic Pump No. 1 High Discharge Pressure PSP-11B-201 Sodium Bisulfite Peristaltic Pump No. 2 High Discharge Pressure PSP-11B-101 Sodium Bisulfite Peristaltic Pump No. 1 Tube Failure PSP-11B-201 Sodium Bisulfite Peristaltic Pump No. 2 Tube Failure PSP-11B-101 Sodium Bisulfite Peristaltic Pump No. 1 Flow Verification Failure PSP-11B-201 Sodium Bisulfite Peristaltic Pump No. 2 Flow Verification Failure LSL-11B-001 Chemical Leak Detected FS-11B-001 Eyewash #1 In-Use See IO list for a complete list of alarms and status indications

2.13 TERTIARY FILTERS

Process Description:	Two (2) cloth-media disk filters shall be provided alongside the four (4) existing cloth-media disk filters in each of two (2) existing tertiary filtration basins to filter the clarified effluent from the clarifiers before discharging to the disinfection basin. Two (2) existing backwash pumps per basin shall clean the filter disks and pump the backwash waste back to the head of the plant. Two existing control panels (one per basin) shall control their corresponding backwash valves and backwash pumps. The backwash sequence shall be initiated once the water level reaches the manufacturer defined backwash level set-point. The solids removal process shall remain as currently programmed. An existing submersible transducer in each filter basin shall measure the liquid level in the filter basin. An existing float provides a backup to the transducers. See Specification Section - 11340 - Cloth Media Disk Filter
P&ID:	7-I-1 Tertiary Filters P&ID
Alarms and Indications:	Alarms Indicated on SCADA: Basin No. 1 Fail Basin No. 1 Backwash Pump No. 1 Fail Basin No. 1 Backwash Pump No. 2 Fail Basin No. 1 High Level Alarm Basin No. 1 Turbidimeter High Pressure Alarm Basin No. 2 Fail Basin No. 2 Backwash Pump Fail Basin No. 2 Backwash Pump No. 1 Fail Basin No. 2 Backwash Pump No. 2 Fail Basin No. 2 High Level Alarm Basin No. 2 Turbidimeter High Pressure Alarm

2.14 NON-POTABLE WATER PUMP STATION

Process Description:	Two (2) proposed self-priming non-potable water (NPW) pumps (one duty, one spare) rated for variable frequency drive (VFD) service shall be controlled by the central PLC. The NPW pumps shall operate to maintain the system at the normal operating pressure setpoint. A flow meter shall measure and transmit the NPW flow to the chemical system PLC, where it shall be summed with the Parshall Flume flow measurement to dictate the speed of the chemical pumps.
P&ID:	10-I-1 Non-Potable Water System P&ID
Controlled Devices:	Proposed: SPP-10-101 NPW Pump No. 1 SPP-10-201 NPW Pump No. 2 (Spare)
Instrumentation Devices:	Existing: FIT-10-001 NPW System Flow PS-10-001 NPW Pressure Switch Low/High PS-10-002 NPW Pressure Switch Low/High Proposed: PIT-10-001 NPW System Pressure
Local Functions:	The existing local control panel contains the following for each pump: • H-O-A Switch • A green light to indicate the pumps running status • Elapsed Time Meter • Reset Push Button • Pump Speed Control In the HAND position, each pump shall operate continuously, with the speed adjustable via panel mounted speed control, if the interlocks for the pump listed in the INTERLOCKS section below are not active.
MCC Functions:	None.
Remote Functions:	None.
HMI Functions:	None.

PLC Functions:	In the AUTO position, the NPW pumps shall operate upon receiving a call signal from the PLC. The Central PLC Control Panel shall be utilized for the primary control of the non-potable water station. The signal from the proposed pressure indicating transmitter shall be sent to the PLC as the Primary Variable for the PID control loop that sets the speed of the pump VFDs. Pump operation: Call the pumps based on pressure setpoints and alternate pump after each pump off cycle or after an operator adjustable time period. All pump call setpoints shall be operator adjustable. The PLC shall maintain the pressure setpoint, setting the VFD speed based on a PID control loop. The PLC shall receive pump statuses (Pump in Auto, Running, Overload) from the local control panel. If an alarm is active, the PLC shall exclude the corresponding pump from the call sequence until the alarm is reset. NPW Flow: PLC shall use the NPW flow in its calculations to determine the chemical feed rates for Sodium Hypochlorite, Sodium Bisulfite, and Alum. Dewatering Building Exhaust Fan Flow Verification In addition to the NPW system controls, the NPW PLC shall will provide all monitoring of the dewatering building exhaust fans. Each exhaust fan will be equipped with a 4-20mA differential pressure monitor capable of verifying exhaust fan flow. At a minimum, logic for the exhaust fans should be developed to include: 1. Should all four exhaust fans not be running during normal operation, the PLC should generate an alarm to be notified at SCADA 2. PCSS and/or System integrator shall coordinate with the exhaust fan vendor to determine the alarm and reset values for the exhaust fan differential pressure flow verification. Should the differential pressure be satisfied, the flow verification alarm will automatically be reset by the PLC. 3. Should all four exhaust fans be running but the required flow pressure differential not be satisfied, the PLC should generate an alarm to be notified at SCADA and via a strobe light on the dewatering building.
SCADA Functions:	NPW System Overview: This screen shall show the NPW System graphical layout similar to the P&IDs. A graphical representation of the selector switches, lights, and ETMs shall be shown. The non-potable water system pressure and operational set points for the lead and lag pumps shall be indicated on the screen. NPW system flow shall also be displayed, in addition to the combined effluent. NPW System Alarms: All alarms shall have red/green indication for each alarm activity. Each alarm shall display a timestamp and date of most recent activation.
Interlocks:	All interlocks below are hardwired: LSL-08-001 Chlorine Contact Basin Low Level CP-10-001 Phase Failure SPP-10-101 Fail SPP-10-201 Fail PSH-10-101 NPW Pump No. 1 High Pressure PSH-10-201 NPW Pump No. 2 High Pressure

Alarms and Indications:	Alarms Indicated on SCADA: CPP-10-001 Control Power CPP-10-001 Phase Fail SPP-10-101 in Auto SPP-10-101 Run SPP-10 -101 Fail SPP-10-201 in Auto SPP-10-201 Run SPP-10 -201 Fail PSL-10-101 NPW Pump No. 1 Low Pressure PSH-10-101 NPW Pump No. 1 High Pressure PSL-10-201 NPW Pump. No. 2 Low Pressure PSH-10-201 NPW Pump No. 2 High Pressure SFAN-14-01 Run Status SFAN-14-02 Run Status SFAN-14-03 Run Status SFAN-14-04 Run Status SFAN-14-01 Overload SFAN-14-02 Overload SFAN-14-03 Overload SFAN-14-04 Overload Loss of Exhaust Fan Flow See IO list for a complete list of alarms and status indications

2.15 DEWATERING PRESS FEED PUMPS

Process Description:	Two (2) Double Disk Diaphragm pumps (one duty, one spare) shall be provided to pump Waste Activated Sludge (WAS) from the existing Sludge Holding Tank to feed the Volute Press at the Dewatering Facility. Each pump shall be operated by a VFD to regulate the flow. WAS flow shall be monitored via proposed flow meter FM-14A-101, outside the press feed pumps at the Dewatering building. The operator shall be able to set the desired flow rate, and the feed pumps shall operate to maintain that flow via a PID control loop. Any variations from the preset flow shall cause the dewatering system to shut down and alarm. The Double Disc Diaphragm Pumps form part of the dewatering PCS system. See Specification Section - 11152 – Double Disc Diaphragm Pump and Section 11445 – Volute Press for process control narrative.
P&ID:	14A-I-1 Dewatering Press Feed Pumps P&ID 14D-I-1 Volute Dewatering Press P&ID
Controlled Devices:	DDP-14A-101 Dewatering Press Feed Pump No. 1 DDP-14A-201 Dewatering Press Feed Pump No. 2
Instrumentation Devices:	PS-14A-101 Dewatering Press Feed Pump No. 1 Low/High Pressure Alarm PS-14A-201 Dewatering Press Feed Pump No. 2 Low/High Pressure Alarm VSH-14A-101 Dewatering Press Feed Pump No.1 High Vacuum Alarm

	VSH-14A-201 Dewatering Press Feed Pump No.2 High Vacuum Alarm FIT-14A-101 Sludge Flow
Local Functions:	None
MCC Functions:	None
HMI Functions:	None
PLC Functions:	Double Disc Diaphragm Pumps shall be controlled from panel CP-14D-001. HOA, speed control, and pump status shall be accessed using the Volute Dewatering System OIT. In HAND, the pump shall run continuously, if the interlocks in the INTERLOCKS section below are not active. Pump speed shall be set from the Volute Dewatering System OIT. In AUTO, Dewatering Press Feed Pumps shall be called at the start of the dewatering sequence from panel CP-14D-101 if the Interlocks in the INTERLOCKS section below are not active. WAS flow shall be monitored via a proposed flow meter outside the press feed pumps at the Dewatering building. The operator shall be able to set the desired flow, and the Dewatering Press Feed Pumps shall operate to maintain that flow via a PID control loop. Any variations from the preset flow shall cause the dewatering system to shut down and alarm. Each pump shall alternate which pump is the LEAD pump and LAG pump upon each successive pump call from the Volute Dewatering System. Dewatering Press Feed Pumps shall shut off either based on an operator adjustable internal flow totalizer setpoint or using the timers set by the PLC during the dewatering shutdown sequence from CP-14D-101, any clock settings that are set, by manual pushbutton selection from the OIT screen, remote SCADA stop signal, or any shutdown alarm per the manufacturer's Alarm Shutdown Table. Any E-Stop being pressed shall immediately stop ALL equipment. The Double Disc Diaphragm Pumps form part of the dewatering PCS system. For startup sequence see Specification 13441 Section 2.18 – Volute Dewatering.
SCADA Functions:	Dewatering Press Feed Pumps Overview: This screen shall show the Dewatering Press Feed Pump system with a graphical layout similar to the P&IDs. A graphical representation of the selector switches, lights, and ETMs shall be shown. Sludge Flow, target speeds and operational set points

	for the lead and lag pumps shall be indicated on the screen. The screen shall show at a minimum, the PID flow control setpoint, pumps running, and any faults or alarms. Dewatering Press Feed Pumps Alarms: All alarms shall have red/green indication for each alarm activity. Each alarm shall display a timestamp and date of most recent activation.
Interlocks:	Interlocks below are hardwired: LSH-14D-101 Volute Press High Level Lockout PSH-14A-101 Dewatering Press Feed Pump No. 1 Pressure Switch High PSH-14A-201 Dewatering Press Feed Pump No. 2 Pressure Switch High VSH-14A-101 Dewatering Press Feed Pump No.1 High Vacuum Alarm VSH-14A-201 Dewatering Press Feed Pump No.2 High Vacuum Alarm LSL-13-001 Sludge Holding Tank Low Level Alarm LSL-13-002 Sludge Holding Tank Low Level Alarm ES-14D-100 E-Stop Activated ES-14D-101 E-Stop Activated ES-14D-102 E-Stop Activated FIT-14A-101 Low Sludge Flow Cutoff
Alarms and Indications:	Alarms Indicated on SCADA: DDP-14A-101 Dewatering Press Feed Pump No. 1 VFD Fail DDP-14A-201 Dewatering Press Feed Pump No. 2 VFD Fail PSL-14A-101 Dewatering Press Feed Pump No. 1 Pressure Switch Low PSH-14A-101 Dewatering Press Feed Pump No. 1 Pressure Switch High PSL-14A-201 Dewatering Press Feed Pump No. 2 Pressure Switch Low PSH-14A-201 Dewatering Press Feed Pump No. 2 Pressure Switch High LSL-13-001 Sludge Holding Tank Low Level Alarm LSL-13-002 Sludge Holding Tank Low Level Alarm FIT-14A-101 Low Sludge Flow Cutoff See IO list for a complete list of alarms and status indications

2.16 DEWATERING NPW BOOSTER PUMPS

Process Description:	Two (2) Dewatering NPW booster pumps (one duty, one spare) shall be provided to meet water pressure requirements of the dewatering system. The Dewatering NPW Booster Pumps shall begin startup following the initiation of start operations on the Dewatering Press Feed Pumps. The Dewatering NPW Booster Pumps shall be stopped following the Dewatering Press Feed Pumps being stopped. The Dewatering NPW Booster Pumps form part of the dewatering PCS system. See Specification Section - 11144 – Multi-Stage Vertical Turbine Pump and Section 11445 – Volute Press for process control narrative.

P&ID:	14B-I-1 Dewatering NPW Booster Pumps P&ID
Controlled Devices:	VMP-14B-101 – Dewatering NPW Booster Pump No. 1 VMP-14B-201 – Dewatering NPW Booster Pump No. 2
Instrumentation Devices:	PS-14B-101 – Dewatering NPW Pump No. 1 Low/High Pressure Switch PS-14B-201 – Dewatering NPW Pump No. 2 Low/High Pressure Switch
Local Functions:	Local Control Panel: The proposed local control panel shall contain the following for each pump. • H-O-A Switch. • A green light shall indicate the pumps running status. • Red lights to indicate the pump fault status, and low and high discharge pressure alarms. • Elapsed Time Meter. • Reset Push Button. In the HAND position, each pump shall operate if the interlocks for the pump listed in the INTERLOCKS section below are not active.
MCC Functions:	None
HMI Functions:	None
PLC Functions:	In the AUTO position, each pump shall alternate which pump is the LEAD pump and LAG pump upon each successive pump call from the Volute Dewatering System. Dewatering NPW Booster Pumps are called as part of the Dewatering sequence.
SCADA Functions:	Dewatering NPW Booster Pumps Overview: This screen shall show the Dewatering NPW Booster Pump system with a graphical layout similar to the P&IDs. A graphical representation of the selector switches, lights, and ETMs shall be shown. The screen shall show at a minimum, pumps running and any faults or alarms. Dewatering NPW Booster Pumps Alarms: All alarms shall have red/green indication for each alarm activity. Each alarm shall display a timestamp and date of most recent activation.
Interlocks:	Interlocks below are hardwired: LSL-08-001 Chlorine Contact Basin Low Level PSH-14B-101 – Dewatering NPW Booster Pump No. 1 Pressure Switch High PSH-14B-201 – Dewatering NPW Booster Pump No. 2 Pressure Switch High ES-14D-100 E-Stop Activated ES-14D-101 E-Stop Activated ES-14D-102 E-Stop Activated
Alarms and Indications:	Alarms Indicated on SCADA: VMP-14B-101 - Dewatering NPW Booster Pump No. 1 Fail VMP-14B-201 - Dewatering NPW Booster Pump No. 2 Fail PSL-14B-101 – Dewatering NPW Booster Pump No. 1 Pressure Switch Low

	PSH-14B-101 – Dewatering NPW Booster Pump No. 1 Pressure Switch High PSL-14B-201 – Dewatering NPW Booster Pump No. 2 Pressure Switch Low PSH-14B-201 – Dewatering NPW Booster Pump No. 2 Pressure Switch High See IO list for a complete list of alarms and status indications

2.17 POLYMER SYSTEM

Process Description:	Two (2) Polymer Blending Units (one duty, one spare) shall be provided for the proposed Volute Press. The polymer blending units shall startup following the initiation of start operations on the Dewatering Press Feed Pumps. The Polymer Blending Unit shall be stopped following the Dewatering Press Feed Pumps being stopped. The Dewatering Press Feed Pumps shall pump WAS from the existing sludge holding tank to proposed Volute Press, based on control signals from the Dewatering Control Panel (CP-14D-101). The Polymer Blending Unit shall receive the feed start signal and flow pacing speed signals from the Dewatering Control Panel. Dewatering Control panel OIT allows operator input of desired sludge feed rate and polymer dose. The Polymer Blending Units form part of the dewatering PCS system. See Specification Section 11540 – Liquid Polymer Blending Unit and Section 11445 – Volute Press for process control narrative.
P&ID:	14C-I-1 Polymer System P&ID
Controlled Devices:	PBU-14C-101 Polymer Blending Unit No. 1 PBU-14C-201 Polymer Blending Unit No. 2
Instrumentation Devices:	Control system is part of vendor supplied package. See specification 11540 – Liquid Polymer Blending Unit
Local Functions:	See specification 11540 – Liquid Polymer Blending Unit
MCC Functions:	None
HMI Functions:	Polymer Blending Unit system shall be vendor supplied and controlled by the vendor supplied control panel.
PLC Functions:	See specification 11540 – Liquid Polymer Blending Unit
SCADA Functions:	<u>Polymer Blending Unit Overview</u>: This screen shall show the Polymer Blending Unit skids with a graphical layout similar to the P&IDs. The screen shall show at a minimum, pumps running and any faults or alarms. Polymer pumps are vendor provided. The PCSS shall coordinate with the vendor for I/O tags and IP addresses. <u>Polymer Blending Unit Alarms:</u> All alarms shall have red/green indication for each alarm activity. Each alarm shall display a timestamp and date of most recent activation

Interlocks:	ES-14D-100 E-Stop Activated ES-14D-101 E-Stop Activated ES-14D-102 E-Stop Activated
Alarms and Indications:	Alarms Indicated on SCADA: PBU-14C-101 Fail PBU-14C-201 Fail PBU-14C-101 Loss of Dilution Water Flow Alarm PBU-14C-201 Loss of Dilution Water Flow Alarm PSL-14C-101 Low Water Pressure PSL-14C-201 Low Water Pressure

2.18 VOLUTE DEWATERING

Process Description:	One (1) Volute Press shall be installed in the proposed Dewatering facility. The volute press shall be utilized to dewater sludge from the existing Sludge Holding Tank. Dewatering Press Feed Pumps shall pump waste activated sludge (WAS) from the Sludge Holding Tank to the Volute Press flocculation tank. The Dewatering Control Panel shall send and receive signals from Press Feed Pumps. Polymer solution shall be injected into the Volute press flocculation tank from two (2) polymer blend units (one duty, one spare) at a rate based on the WAS flow rate. Variable speed mixers in the flocculation tanks can be adjusted at the Dewatering Control Panel. Flocculated WAS shall discharge directly into the Volute Press for dewatering. Dewatered sludge (cake) from Volute Press shall discharge into the screw conveyors, which discharge for off-site disposal. The Volute Press forms part of the dewatering PCS system. See Specification Section 11152 – Double Disc Diaphragm Pump, Section 11144 – Multi-Stage Vertical Turbine Pump, Section 11733 – Screw Conveyors, and Section 11540 – Liquid Polymer Blending Unit for process control narrative. The Volute Press system shall be vendor supplied and controlled by the vendor supplied control panel. See Specification Section - 11445 - Volute Press.
P&ID:	14D-I-1 Volute Press P&ID
Controlled Devices:	VP-14D-101 Volute Press No. 1 FCT-14D-101 Flocculation Tank Mixer No. 1 FCT-14D-102 Flocculation Tank Mixer No. 2 FCT-14D-103 Flocculation Tank Mixer No. 3 SCC-14D-101 Screw Conveyor No. 1 SCC-14D-102 Screw Conveyor No. 2 DDP-14A-101 Dewatering Press Feed Pump No. 1 DDP-14A-201 Dewatering Press Feed Pump No. 2 VMP-14B-101 Dewatering NPW Booster Pump No. 1 VMP-14B-201 Dewatering NPW Booster Pump No. 2 PBU-14C-101 Polymer Blending Unit No. 1 PBU-14C-201 Polymer Blending Unit No. 2
Instrumentation Devices:	LSH-14D-101 Flocculation Tank No. 1 Level Switch High LT-14D-101 Flocculation Tank No. 2 Level Transmitter LT-14D-102 Flocculation Tank No. 3 Level Transmitter MS-14D-101A Volute Press No. 1 Motion Sensor No. 1 MS-14D-101B Volute Press No. 1 Motion Sensor No. 2 MS-14D-101C Volute Press No. 1 Motion Sensor No. 3 MS-14D-101D Volute Press No. 1 Motion Sensor No. 4 MS-14D-101E Volute Press No. 1 Motion Sensor No. 5 MS-14D-101F Volute Press No. 1 Motion Sensor No. 6 ES-14D-100 Volute Press No. 1 E-Stop ES-14D-101 Screw Conveyor No. 1 E-Stop ES-14D-201 Screw Conveyor No. 2 E-Stop SV-14D-101 Solenoid Valve SV-14D-102 Solenoid Valve SV-14D-103 Solenoid Valve

	SV-14D-104 Solenoid Valve SV-14D-105 Solenoid Valve SV-14D-106 Solenoid Valve
Local Functions:	The Volute Press system shall be vendor supplied and controlled by the vendor supplied control panel. See Specification Section - 11445 - Volute Press.
MCC Functions:	None
HMI Functions:	The Volute Press system shall be vendor supplied and controlled by the vendor supplied control panel. See Specification Section - 11445 - Volute Press.
PLC Functions:	In AUTO mode, PLC shall provide for the operational control of all components of the Volute Thickener- system including the ability to set times and operating speeds for any feed pump installed, solids conveyor, dewatering drums, mixers, polymer dosing system and wash-down sprays. PLC shall allow suitably qualified operators to adjust operating parameters such as delay timers for fault alarms and system calibration constants. PLC shall allow the operator to inspect the operation of all the components including indicators such as output frequency, current draw, thermal condition, elapsed operating times, and any faults present. Operator shall be able to view approximated readouts of all operational speeds and flowrates relevant to the operation of the system. Operator shall be able to manually operate each item of equipment from the OIT for inspection and maintenance reasons. Operator shall be able to set the unit to operate at a specific time or on specific days with no operators present. When set to AUTO, all items of equipment shall work as per the following descriptions. • Clock Operation o The clock function shall be controlled by the PLC in the control panel. Two clock functions shall be allowed for in the program. The clock may be set to either “On” or “Auto/timer” via the OIT. ▪ If the clock is set to “On” the plant shall run for as long as the main switch is set to “Auto”. ▪ When the clock is set to “Auto/Timer” the plant shall operate in accordance with the clock settings. o Clock function settings shall allow the operator to set the dewatering press and all associated equipment to switch on and off, at pre-designated times on pre-designated days with no operators being present. o A minimum of two (2) different “clock programs” shall be allowed for in the PLC program. Control Sequence: 1. In AUTO, Operation of the volute press shall be initiated by engaging the following sequence: a. Run Permissives enable automatic control b. Prompt input of desired sludge feed rate and polymer dose. c. Sequence Start 1. System shall begin sequence start by OIT pushbutton 2. System Time Clock scheduled sequence start

3. SCADA run signal

d. System shall begin Auto Start Delay Timer

e. Volute press shall initiate system start operations (Optional start delay timers for all equipment):
   1. Dewatering Press Feed Pumps shall be started
   2. Polymer Blending Unit shall be started
   3. Dewatering NPW Booster Pumps shall be started
   4. Flocculation Mixers shall be started
   5. Dewatering Drums shall be started
   6. Screw Conveyors shall be started
      a. Conveyor No. 2 shall be started and rotation confirmed.
      b. Conveyors No. 1 shall be started and rotation confirmed.

f. System Stop shall be initiated by
   1. Run Flow Total Stop On
      a. System shall begin stop operation when Totalizer setpoint is achieved
   2. Run Flow Total Stop Off
      a. Runs Continuously until the system receives a system stop signal initiated by any of the following:
         i. Local operator pushbutton from the control panel OIT
         ii. Local Time Clock stop setpoint
         iii. Remote stop signal from the operator over SCADA
         iv. Alarm shutdown shall occur for any enabled fault status, refer to manufacturer documentation for Alarm Shutdown Table

2. Stopping the dewatering operation shall initiate the following sequence (Optional stop timers for all equipment):

a. Normal or Extended stop timers shall be started

b. Dewatering Press Feed Pump(s) shall be turned off.

c. Polymer blending unit shall be stopped.

d. Drum equipment shall initiate system stop.
   1. All drum sprays shall operate on a separate cycle timer

e. Conveyor No. 1 shall run for 60 seconds and then stop. Zero rotation shall be confirmed.

f. Conveyor No. 2 shall run for 60 seconds and the stop. Zero rotation shall be confirmed.

g. Dewatering NPW Booster Pumps shall be stopped.

h. Some Optional Timers shall be bypassed by certain alarm groups, refer to manufacturer documentation for Alarm Shutdown Table.

i. E-Stops are hard-wired and shall shut off ALL equipment immediately and alarm SCADA.

SCADA Functions	Volute Press Overview: SCADA screen shall show the dewatering system in a graphical layout similar to the P&IDs. The screen shall show at a minimum, the PID sludge flow control setpoint, polymer dosing setpoint, equipment running, and any faults or alarms. Volute Press is a vendor provided package. The PCSS shall coordinate with the vendor for I/O tags and IP addresses. Volute Press Alarms: All alarms shall have red/green indication for each alarm activity. Each alarm shall display a timestamp and date of most recent activation.
Interlocks:	All interlocks below are hardwired: FIT-14A-101 Low Sludge Flow LSL-13-001 Sludge Holding Tank Low Level Alarm LSL-13-002 Sludge Holding Tank Low Level Alarm ES-14D-100 E-Stop Activated ES-14D-101 E-Stop Activated ES-14D-102 E-Stop Activated All interlocks below are programmed: FIT-14A-101 Low Sludge Flow PBU-14C-101 Polymer Blend Unit No. 1 Fail PBU-14C-201 Polymer Blend Unit No. 2 Fail PBU-14D-101 Polymer Blend Unit No. 1 Low Flow PBU-14D-201 Polymer Blend Unit No. 2 Low Flow PBU-14D-101 Polymer Blend Unit No. 1 Low Pressure PBU-14D-201 Polymer Blend Unit No. 2 Low Pressure VP-14D-101 Volute Press No. 1 System Fail MS-14D-101A Volute Press No. 1 Motion Sensor No. 1 Alarm MS-14D-101B Volute Press No. 1 Motion Sensor No. 2 Alarm MS-14D-101C Volute Press No. 1 Motion Sensor No. 3 Alarm MS-14D-101D Volute Press No. 1 Motion Sensor No. 4 Alarm MS-14D-101E Volute Press No. 1 Motion Sensor No. 5 Alarm MS-14D-101F Volute Press No. 1 Motion Sensor No. 6 Alarm DDP-14A-101 Dewatering Press Feed Pump No. 1 Fail DDP-14A-201 Dewatering Press Feed Pump No. 2 Fail DDP-14A-101 Dewatering Press Feed Pump No. 1 Low Pressure DDP-14A-201 Dewatering Press Feed Pump No. 2 Low Pressure VMP-14B-101 Dewatering NPW Booster Pump No. 1 Fail VMP-14B-201 Dewatering NPW Booster Pump No. 2 Fail VMP-14B-101 Dewatering NPW Booster Pump No. 1 Low Pressure VMP-14B-201 Dewatering NPW Booster Pump No. 2 Low Pressure FCT-14D-101 Flocculation Tank Mixer No. 1 Fail FCT-14D-102 Flocculation Tank Mixer No. 2 Fail FCT-14D-103 Flocculation Tank Mixer No. 3 Fail LSH-14D-102 High Flocculation Tank No. 1 Level LT-14D-101 High Flocculation Tank No. 2 Level LT-14D-102 High Flocculation Tank No. 3 Level SCC-14D-101 Screw Conveyor No. 1 Fail SCC-14D-102 Screw Conveyor No. 2 Fail SCC-14D-101 Screw Conveyor No. 1 Zero Speed Sensor SCC-14D-102 Screw Conveyor No. 2 Zero Speed Sensor

	LSL-13-001 Sludge Holding Tank Low Level Alarm LSL-13-002 Sludge Holding Tank Low Level Alarm ES-14D-100 E-Stop Activated ES-14D-101 E-Stop Activated ES-14D-102 E-Stop Activated
Alarms and Indications:	<u>Alarms Indicated on SCADA:</u> CP-14D-001 Dewatering Control Power Fail PLC-14D-101 Dewatering PLC Fail VP-14D-101 Volute Press No. 1 System Fail DDP-14A-101 Dewatering Press Feed Pump No. 1 Fail DDP-14A-201 Dewatering Press Feed Pump No. 2 Fail FIT-14A-101 Low Sludge Flow PS-14B-101 Dewatering NPW Booster Pump No. 1 Low Discharge Pressure PS-14B-201 Dewatering NPW Booster Pump No. 1 Low Discharge Pressure FCT-14D-101 Flocculation Tank Mixer No. 1 Fail FCT-14D-102 Flocculation Tank Mixer No. 2 Fail FCT-14D-103 Flocculation Tank Mixer No. 3 Fail LSH-14D-102 High Flocculation Tank No. 1 Level LT-14D-101 High Flocculation Tank No. 2 Level LT-14D-102 High Flocculation Tank No. 3 Level SCC-14D-101 Screw Conveyor No. 1 Fail SCC-14D-102 Screw Conveyor No. 2 Fail PBU-14C-101 Polymer Blend Unit No. 1 Fail PBU-14C-201 Polymer Blend Unit No. 2 Fail PBU-14D-101 Polymer Blend Unit No. 1 Low Flow PBU-14D-201 Polymer Blend Unit No. 2 Low Flow PBU-14D-101 Polymer Blend Unit No. 1 Low Pressure PBU-14D-201 Polymer Blend Unit No. 2 Low Pressure MS-14D-101A Volute Press No. 1 Motion Sensor No. 1 Alarm MS-14D-101B Volute Press No. 1 Motion Sensor No. 2 Alarm MS-14D-101C Volute Press No. 1 Motion Sensor No. 3 Alarm MS-14D-101D Volute Press No. 1 Motion Sensor No. 4 Alarm MS-14D-101E Volute Press No. 1 Motion Sensor No. 5 Alarm MS-14D-101F Volute Press No. 1 Motion Sensor No. 6 Alarm ES-14D-100 E-Stop Activated ES-14D-101 E-Stop Activated ES-14D-102 E-Stop Activated See IO list for a complete list of alarms and status indications.

END OF SECTION

SECTION 13852
DIGITAL, ADDRESSBLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fire Alarm Control Panel.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Remote annunciator.
7. Addressable interface device.
8. Digital alarm communicator transmitter.

B. Related Requirements:
1. Division 16 for cables and conductors for fire-alarm systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

B. Shop Drawings: For fire-alarm system.
1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include 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.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. 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. Locate detectors according to manufacturer's written recommendations.
12. 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 Architect.
   2. following qualifications:
      a. Trained and certified by manufacturer in fire-alarm system design.
      b. NICET-certified, fire-alarm technician; Level III minimum.
      c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: 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.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

C. Field quality-control reports.

D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 01340 "Shop Drawings," include the following and deliver copies to authorities having jurisdiction]:
      a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
      b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
      c. Complete wiring diagrams showing connections between all devices and equipment.
      d. Riser diagram.
      e. Record copy of site-specific software.
      f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
         1) Equipment tested.
         2) Frequency of testing of installed components.
         3) Frequency of inspection of installed components.
         4) Requirements and recommendations related to results of maintenance.
         5) Manufacturer's user training manuals.

g. Manufacturer's required maintenance related to system warranty requirements.
h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

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.

1.5 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 II technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

E. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

F. NFPA Certification: Obtain certification according to NFPA 72 by and local Fire Marshal.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system should one be present. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified or FM Global-placarded 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.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Carbon monoxide detectors.
6. Automatic sprinkler system water flow.
7. Fire-extinguishing system operation.
8. Fire standpipe system.
9. Tamper flow switch.

B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
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. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Activate preaction system.
9. Recall elevators to primary or alternate recall floors.
10. Activate elevator power shunt trip.
11. Activate emergency lighting control.
12. Activate emergency shutoffs for gas and fuel supplies.
13. Record events in the system memory.

C. Supervisory signal initiation shall be 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. Elevator shunt-trip supervision.
4. 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, or remote annunciator.
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.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways 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."

2.4 FIRE ALARM CONTROL PANEL

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. Silent Knight
2. Notifier
3. Simplex Grinnell
4. Fike
5. Siemens Industries

B. General Requirements for Fire-Alarm Control Panel (FACP):
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. 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, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 0.

E. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

I. 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.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

2.5 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.
   1. Single-action mechanism, breaking-glass or plastic-rod pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control panel.
   2. Station Reset: Key- or wrench-operated switch.

2.6 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 two-wire type.
   3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
   4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
   5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
   7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
      a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
      b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
      c. Multiple levels of detection sensitivity for each sensor.

d. 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. Ionization Smoke Detector:
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.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
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.).
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.

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.
1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature or a rate of rise.
1. Mounting: Adapter plate for outlet box mounting or Twist-lock base interchangeable with smoke-detector bases.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature.
1. Mounting: Adapter plate for outlet box mounting or Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 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: Vibrating type.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464.

D. 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-(25-mm-) high letters on the lens.
1. Mounting: Wall mounted unless otherwise indicated.
2. Flashing shall be in a temporal pattern, synchronized with other units.
3. Strobe Leads: Factory connected to screw terminals.
4. Mounting Faceplate: Factory finished, [red] [white].

2.9 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.

2.10 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. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.
   1. Allow the control panel to switch the relay contacts on command.
   2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:
   1. Operate notification devices.
   2. Operate solenoids for use in sprinkler service.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter (DACT) shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture [one] [two] telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall 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.

PART 3 - EXECUTION

3.1 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."

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

C. Equipment Mounting: Install fire-alarm control unit on finished floor.
   1. Comply with requirements for seismic-restraint devices specified in Division 16.

D. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.
   1. Comply with requirements for seismic-restraint devices specified in Division 16.

E. Manual Fire-Alarm Boxes:
   1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) 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 (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

F. Smoke- or Heat-Detector Spacing: Comply with NFPA 72.

G. 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 (9100 mm) long shall be supported at both ends.

H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

I. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

J. 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.

K. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) 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.

L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

M. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.
   1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.3 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 (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Smoke dampers in air ducts of designated HVAC duct systems.
2. Magnetically held-open doors.
3. Electronically locked doors and access gates.
4. Alarm-initiating connection to elevator recall system and components.
5. Alarm-initiating connection to activate emergency lighting control.
6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
7. Supervisory connections at valve supervisory switches.
8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
9. Supervisory connections at elevator shunt-trip breaker.
10. Supervisory connections at fire-extinguisher locations.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 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.

3.6 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by the Architect and/or authorities having jurisdiction as required by local authorities.

B. 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 NFPA 72 in its "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter.

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.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

G. 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.

3.7 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.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION

SECTION 15011
MECHANICAL GENERAL PROVISIONS

PART 1 – GENERAL

A. Except as modified in this section, General Conditions, Supplementary Conditions, applicable provisions of Division 1, General Requirements, and other provisions and requirements of the contract documents apply to work of Division 15, Mechanical.

B. Applicable provisions of this section apply to all sections of Division 15, Mechanical.

PART 2 – CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only, and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

PART 3 – SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

PART 4 – NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced by equipment, piping or other parts of work, rectify such conditions without cost to Owner. If item of equipment is judged to produce objectionable noise or vibration, demonstrate without cost to the Owner that equipment performs within designated limits.

PART 5 – ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturer lists can be found in individual specification sections and on the contract Bid Form. Where two (2) or more units of the same type or class of equipment are required, provide units of a single manufacturer. Manufacturer's names and catalog numbers specified under sections of Division 15 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, may be listed as a substitution and will be acceptable on approval. Submit complete design and performance data to the Engineer. Regardless of equipment start-up date, all equipment warranties shall remain in effect for a period of 12 months from date of substantial completion.

PART 6 – SUBMITTALS

A. Within 30 days after award of the contract, and before orders are placed or shop drawings are submitted, submit a list of equipment and principal materials specified. Give names of manufacturers, catalog and model numbers, and such other supplementary information as necessary for identification.

PART 7 – SHOP DRAWINGS

Shop drawing procedures are specified in Division 1, General Requirements. Items requiring shop drawings include:

A. Equipment and Materials. All items of equipment and principal materials proposed for installations, including all equipment listed in the paragraph of acceptable manufacturers.

PART 8 – OPERATING AND MAINTENANCE INSTRUCTIONS

A. Secure four (4) copies of operating and maintenance instructions, service manuals, and parts lists applicable to each item of equipment furnished in printed form. Submit one (1) PDF copy to the engineer for review and make changes as necessary. Once the changes are made, provide a PDF copy of the approved O&M manual to the engineer on a compact disk as described further under Section 01300 - Submittals. Delivery of required documents is a condition of final acceptance. Operation and maintenance instructions should include all nameplate data and design parameters. Clearly distinguish between information that pertains to the particular equipment and information that does not by crossing or blacking out all portions of standardized documents so that only the pertinent information remains.

B. Upon completion of work and at a time designated by the Engineer, provide services of competent representative of the Contractor for a period of at least eight (8) hours to instruct the Owner's representative in the operation and maintenance of the entire system.

PART 9 – OPERATING TESTS

A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to insure proper sequence and operation throughout the range of operation. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections.

PART 10 – LUBRICATION

A. Provide a complete spare charge of the correct lubricant for each item of equipment requiring lubrication.

END OF SECTION

SECTION 15100
VALVE BASIC REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE

A. This work includes furnishing all labor, equipment, and materials and performing of all operations required for proper fabrication and installation of valves, operators, supports, and appurtenances required to complete the work as shown on the Drawings and as specified herein.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Society of Mechanical Engineers (ASME)
2. American National Standards Institute (ANSI)
3. ASTM International (ASTM)
4. American Water Works Association (AWWA)
5. National Electrical Manufacturers Association (NEMA)
6. NSF International (NSF)
7. International Organization for Standardization (ISO)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01300 – Submittals and Section 01340 – Shop Drawings, Product Data and Samples. Submit for review, detailed drawings, data, and descriptive literature on all equipment and accessories including the following, arranged to facilitate submittal review:
1. Valves:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.
   c. Valve pressure and temperature ratings.
   d. Valve materials of construction, shop coatings, and linings.
   e. Valve dimensions and weight.
   f. Valve flow coefficient.
   g. Factory assembly and test reports shall be available upon request.
2. Operators:
   a. Complete data sheets and Manufacturer's installation instructions.
   b. Refer to Section 15560 – Actuators for electric, pneumatic, and electraulic actuator submittal requirements.

B. Provide the following Certifications:
1. The Manufacturer has examined the Contract Documents and agrees to the performance and material specifications, warranty conditions, and other requirements of the Contract.

2. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel.
3. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
4. The Manufacturer can provide a complete stock of spare parts within 48 hours of request.

C. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all curves, cut sheets, drawings, equipment lists, maintenance schedules, descriptions, etc. that are required to instruct operation and maintenance personnel.

D. Record Drawings: Submit record drawings under provisions of Section 01720 – Project Record Documents.

1.5 QUALITY ASSURANCE

A. The Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

C. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

D. Coordinate all dimensions to ensure adequate clearances for maintenance, removal, or replacement.

1.6 WARRANTY

A. For a period of 12 months from Substantial Completion, the Manufacturer shall warrant that the equipment shall be free of defects in material and workmanship. The Manufacturer shall repair or replace any defective equipment or components. The Owner shall not be responsible for any related costs, such as removal, shipping, or reinstallation.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Exposed flanges shall be covered and sealed with shrink wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

C. Accept units on-site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs or caps installed to protect the equipment during shipment until the equipment is installed and permanent connections are made.

F. Contractor shall maintain log of rotation or other equipment exercise and corrosion prevention activities recommended by the Manufacturer for extended storage (longer than 30 calendar days) prior to installation. Contractor shall furnish these logs upon request by the Engineer.

PART 2 – PRODUCTS

2.1 GENERAL

A. Identification and Signage:
1. Provide each valve with Manufacturer's name and rated pressure cast in raised letters on valve body.
2. Provide valves with minimum 1"x2" 316 stainless-steel nameplates attached to the valve body with 316 stainless-steel hardware. Nameplates shall have engraved letters displaying the valve P&ID tag. Buried valves shall have P&ID tag stenciled on valve box concrete apron.

B. Materials:
1. Valve materials shall be suitable for the associated valve's application, as specified. Refer to individual valve specification sections.
2. Coatings and materials shall protect valves from corrosion caused by contact or exposure to different fluids typically encountered in the valve application or caused by contact with adjacent metals.
3. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
4. Clean and descale fabricated stainless-steel items in accordance with ASTM A380 and A967. Any imperfections or abrasions occurring onsite or during the delivery process shall be remedied via Section 05501 – Miscellaneous Metals or via remedy required by valve manufacturer, and the process shall be approved by the valve manufacturer.

2.2 OPERATORS

A. General:
1. Provide operators as shown on construction drawings and as specified in the individual valve schedules. Refer to the individual valve sections.
2. Valves to be installed within the facility site shall be counterclockwise opening as viewed from the top. Refer to Division 2 Sections for requirements for valves installed outside of the facility site.
3. Direction of opening and the word "OPEN" to be cast in handwheel or valve bonnet. For valves installed out of reach or in buried service, stenciled signage shall be posted visibly on adjacent piping or supports or on valve box concrete collar.
4. Provide position indicators on all aboveground operators.

B. Buried Service Manual Operators:
1. Provide valve boxes per details shown in the construction drawings.
   a. Valves and valve boxes shall be installed per ANSI/AWWA C504, Appendix A.
2. Provide 2-inch square standard operating nut complying with Section 3.16 of AWWA C500.
3. Provide minimum two (2) tee-handle wrenches for operating nuts. Tee-handle wrench shall be minimum 6 feet long with 1.5-foot handle each side.
4. Extensions stems shall be installed on all valves greater than 4 feet below finished grade and must extend to within 6 inches below finished grade.
5. Provide concrete collar encasement of valve box as shown in the construction drawings for all buried valves unless specified otherwise.

C. Exposed Manual Operators:
   1. Handwheels:
      a. Size handwheels for valves in accordance with AWWA C500.
   2. Chainwheels:
      a. Provide chainwheels for all valves with a height of 5 feet or higher from operating floor level to center of valve.
      b. Chains shall be stainless steel.
      c. Chainwheels shall include chain guides to prevent jamming.
   3. Operating Nut or Lever:
      a. Provide operating nut for plug and ball valves of 4-inch and smaller. Furnish a minimum of two operating nut wrenches per valve size.
      b. Provide operating lever for butterfly valves of 6-inch and smaller. Levers shall have a minimum of 5 intermediary locking positions between open and closed.
   4. Geared Operators:
      a. Geared operators are required for plug valves and ball valves 6 inches in diameter and larger.
      b. Geared operators are required for gate valves 18 inches in diameter and larger.
      c. Geared operators are required for butterfly valves 8 inches in diameter and larger.
      d. Gear operators shall be fully enclosed, permanently lubricated and with sealed bearings.

D. Submerged or Below Operating Floor Operators:
   1. Operator shall be mounted on top of an extension bonnet, with operator mounted 3 feet above adjacent operating floor unless noted otherwise.
   2. The valve and bonnet connections shall be flanged and watertight.
   3. Provide a top brace support for the bonnet. Brace shall be mounted 6 inches below adjacent top of wall.
   4. Materials:
      a. Extension bonnet: Cast iron ASTM A126 or steel.
      b. Brace and anchor bolts: Type 304 stainless steel.
   5. Provide and install all extension shafts, mounts, brackets, and guide bearings as required for a complete and functional operating system.

E. Motorized Operators
   1. Motorized operators shall consist of an electric actuator and include electric motor, reduction gearing, stem nut, pedestal, torque and limit switches, enclosure strip heaters, reversing magnetic starter, pushbutton control, indicator lights, shop wiring, gear case, and handwheel for operation in case of power failure. Refer to Specification Section 15560 – Actuators.
   2. Unit shall be complete in an enclosure rated for area classification (NEMA 4X minimum) requiring only the field connection of 3 PH, 460 V electric power.
   3. The actuator shall be provided to the valve manufacturer for integration and packaging. Valve and actuator shall be provided as a single package.
   4. Electric actuators that are supplied to retrofit existing valves shall be provided with supports, fasteners, and all ancillary items necessary to attach actuator to existing valve. Supports and fasteners shall be of the same material as the existing valve.
   5. All electric actuators shall be provided by the same Manufacturer.
   6. Unless otherwise specified, actuators for valves installed in buried or submerged service or installed in vaults or manholes shall be sealed to withstand a minimum of 20 feet of submergence.
   7. Mounting:
      a. Coordinate and provide mounting brackets to couple actuator output shaft to the valve stem. Valve mounting brackets and components shall be manufactured from stainless steel and comply with ISO-5211 standards.

b. Provide independent actuator mounting brackets and support the actuator so the weight of the actuator is not transmitted to the valve and the valve loads are not transmitted to the actuator.

8. Extension stems shall be installed where installation requires it. Actuators shall be accessible from operating location. Stems shall be:
   a. Solid steel with key and nut and have a diameter equal or greater than the diameter of the valve actuator shaft.
   b. Pinned connections.
   c. Centered within the valve box, opening, or hatch with a guide bushing.

2.3 HARDWARE

A. All valve joints and restraints shall have stainless steel bolts and hardware. For stainless steel bolts, except where nitride nuts are required, use graphite-free anti-seize compound to prevent galling. The strength of the joint shall not be affected by use of anti-seize compound.

B. All supports shall be hot dip galvanized unless specified otherwise. All support hardware shall be stainless steel.

PART 3 – EXECUTION

3.1 INSPECTION

A. During installation, while the valve is free and not in place, inspect each valve for the defects. Reject defective, damaged, or unsound valves and remove them from the site.

3.2 INSTALLATION

A. Install all valves and accessories in accordance with manufacturers printed instructions, in such manner as to ensure a watertight fit, complete and ready for operation. Thoroughly clean the interior of valves of foreign matter before installation. Keep the interior clean until the work has been accepted.

3.3 FIELD TESTING

A. Valves shall be disinfected if installed in potable water applications. Disinfection methods shall be in accordance with Specification Section 15600 – Plant Piping.

B. Valves shall be pressure tested in accordance with Specification Section 15600 – Plant Piping.

END OF SECTION

SECTION 15101
BUTTERFLY VALVES

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provisions of all labor, materials and equipment to furnish and install butterfly valves and accessories, including training and testing, for a complete and operable system as shown on the construction drawings and specified herein. Refer to related work specified in other sections to coordinate the complete installation.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Water Works Association (AWWA)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. ASTM International (ASTM)
5. NSF International (NSF)
6. International Organization for Standardization (ISO)
7. Underwriters Laboratory (UL)

1.4 SUBMITTALS

A. Refer to Section 15100 - Valve Basic Requirements.

1.5 QUALITY ASSURANCE

A. Refer to Section 15100 - Valve Basic Requirements.

1.6 WARRANTY

A. Refer to Section 15100 - Valve Basic Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 15100 - Valve Basic Requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. Items in Specification Section 15100 – Valve Basic Requirements apply.

B. Provide butterfly valves which are specifically designed for the application as indicated in the construction drawings.

C. Furnish butterfly valves of standard dimensions, built to formed templates, such that parts will be interchangeable between like units.

2.2 PERFORMANCE REQUIREMENTS

A. Butterfly Valve Table Abbreviations
   1. Valve Type
      a. AWWA: AWWA Butterfly Valve
      b. AIR: Air Service Butterfly Valve
      c. HP: High Performance Air Service Butterfly Valve
   2. Connection Type
      a. FJ: Flange Joint
      b. MJ: Mechanical Joint
      c. MF: Mechanical Joint x Flange Joint
      d. WF: Wafer
      e. LG: Lug
   3. Service
      a. Refer to Fluid Abbreviations listed in the General Abbreviations Sheet
   4. Operator Type
      a. OL: Operating Lever
      b. HW: Handwheel
      c. CW: Chainwheel
      d. EA: Electric Actuator
      e. PA: Pneumatic Actuator
   5. Classified Area
      a. C1D1: Class I, Division I
      b. C1D2: Class I, Division II
      c. U: Unclassified

B. Butterfly Valve Table

Valve No.	P&ID	Area	Valve Size (in)	Valve Type	Connection Type	Service	Operator Type	Geared Operator (Y/N)	Modulating Actuator (Y/N)	Classified Area
BFV-04-002	4-I-1	Peak Shaving Basin	6	AIR	WF	AIR	OL	Y	N	N/A
BFV-05-301	5-I-1	Aeration Basins	10	AIR	WF	AIR	OL	N	N	N/A
BFV-05-302	5-I-1	Aeration Basins	6	AIR	WF	AIR	OL	N	N	N/A
BFV-05-303	5-I-1	Aeration Basins	6	AIR	WF	AIR	OL	N	N	N/A
BFV-05-304	5-I-1	Aeration Basins	6	AIR	WF	AIR	OL	N	N	N/A
BFV-06-301	6-I-1	Clarifiers	4	AIR	LG	AIR	OL	N	N	N/A
BFV-09-601	9-I-1	Blowers	10	HP	LG	AIR	HW	N	N	N/A
BFV-09-602	9-I-1	Blowers	10	HP	LG	AIR	HW	N	N	N/A
BFV-09-003	9-I-1	Blowers	16	HP	LG	AIR	HW	Y	N	N/A
BFV-09-004	9-I-1	Blowers	16	HP	LG	AIR	HW	Y	N	N/A
BFV-14C-001	14C-I-1	Dewatering Facility	6	DR	FJ	DR	HW	N	N	N/A
BFV-15-001	N/A	Reclaimed Water Storage Station	4	HP	FJ	NPW	HW	Y	N	N/A

2.3 AWWA BUTTERFLY VALVES

A. Acceptable Manufacturers
1. Provide AWWA butterfly valves of one of the following, no others will be allowed:
   a. DeZurik
   b. GA Industries
   c. Kennedy Valve
   d. Keystone
   e. Pratt
   f. Val-Matic
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of butterfly valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Valves shall be designed, manufactured, and tested in accordance with ANSI/AWWA C504 and C516.
2. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
3. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body
   a. Valve bodies shall be ASTM A126 Class B gray iron or ASTM A536 Grade 65-45-12 ductile iron.
   b. Valves shall be either wafer-style or full-bodied as specified in the Gate Valve Table. Full-bodied valves shall have either flange or mechanical joint connections as specified. Flanges shall be fully faced and drilled in accordance with ANSI Standard B16.1, Class 125, and mechanical joints shall be in accordance with ANSI A221.11/AWWA C111.
2. Shaft
   a. Shaft shall be ASTM A276 Type 304 stainless steel.
   b. Shaft seals shall be V-type or “U” cup-type and shall be replaceable without removal of the valve from the installation or the shaft from the valve body. The operator shall not be utilized to retain the packing and leakage shall be prevented from entering the actuator.
   c. Valves size 3-inch to 24-inch shall have through-type shafts. Valves 30-inch and larger shall have stub-type shafts.
   d. The shaft shall be locked to the disc by stainless steel taper pins and nuts and sealed by O-rings.
3. Disc
   a. Disc shall be ASTM A536 Grade 65-45-12 ductile iron with a Type 316 stainless steel seat edge.
   b. Disc shall be solid without external ribs or stiffeners.
   c. Disc shall provide 360-degree uninterrupted seating.
4. Seat
   a. Resilient seats shall be Buna-N or EPDM.
   b. Valves shall have field adjustable and replaceable seats fastened in place by Type 316 stainless steel retainer, studs, and self-locking nuts.
   c. Seats retained using epoxy or adhesives are not allowed.
5. Bearings
   a. Valves shall have PTFE or nylon upper and lower self-lubricating shaft bearings.
   b. Adjustable composite thrust bearings shall be provided on valves 30 inches and larger.
6. Hardware and Fasteners

a. All hardware and fasteners shall be Type 316 stainless steel.

D. Coatings
1. Valves shall be provided with an external protective shop prime epoxy coating for delivery and storage purposes. Valves shall be prepared and coated in accordance with Section 09921 – Protective Coating once installed.
2. Lining shall be an NSF/ANSI/CAN Standard 61 certified two-part polyamide epoxy at a minimum 8 mils DFT.

2.4 AIR SERVICE BUTTERFLY VALVES (< 250 °F)

A. Acceptable Manufacturers
1. Provide air service butterfly valves of one of the following, no others will be allowed:
a. DeZurik
b. GA Industries
c. Kennedy Valve
d. Pratt
e. Val-Matic
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of butterfly valve, all units shall be a common manufacturer.

B. Standard Compliance
1. Designed, manufactured, and tested in accordance with ANSI/AWWA C504 and C516.

C. Construction
1. Body
a. Valve bodies shall be ASTM A126 Class B gray iron or ASTM A536 Grade 65-45-12 ductile iron for flanged valves and ASTM A48 Class 40 for wafer style valves.
b. Valves shall be lugged or wafer style or have fully faced and drilled flanges as specified. Flanges shall be in accordance with ANSI Standard B16.1, Class 125.
2. Shaft
a. Shaft shall be ASTM A276 Type 304 stainless steel.
b. Shaft seals shall be V-type or “U” cup-type and shall be replaceable without removal of the valve from the installation or the shaft from the valve body. The actuator shall not be utilized to retain the packing or and leakage shall be prevented from entering the actuator.
c. Valves size 3-inch to 24-inch shall have through-type shafts. Valves 30-inch and larger shall have stub-type shafts.
d. The shaft shall be locked to the disc by stainless steel taper pins and nuts and sealed by O-rings.
3. Disc
a. Shall be ASTM A536 Grade 65-45-12 ductile iron with a Type 316 stainless steel seat edge.
b. Shall be solid discs without external ribs or stiffeners.
c. Disc shall provide 360-degree uninterrupted seating.
4. Seat
a. Resilient seats shall be EPDM.
b. Valves shall have field adjustable and replaceable seats fastened in place by Type 316 stainless steel retainer, studs, and self-locking nuts.
c. Seats retained using epoxy or adhesives are not allowed.
5. Bearings
a. Shall have composite upper and lower self-lubricating shaft bearings.
b. Adjustable composite thrust bearings shall be provided on valves 30 inches and larger.

6. Hardware and Fasteners
    a. All hardware and fasteners shall be Type 316 stainless steel.

D. Coatings
1. Valves shall be provided with an external protective shop prime epoxy coating for delivery and storage purposes. Valves shall be prepared and coated in accordance with Section 09921 – Protective Coating once installed.

2.5 HIGH PERFORMANCE AIR SERVICE BUTTERFLY VALVES (> 250 °F)

A. Acceptable Manufacturers
1. Provide high performance butterfly valves of one of the following, no others will be allowed:
    a. DeZurik
    b. Pratt
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of butterfly valve, all units shall be a common manufacturer.

B. Standard Compliance
1. Valves shall be designed, manufactured, and tested in accordance with ANSI/AWWA C504 and C516.

C. Construction
1. Body
    a. Valve bodies shall be constructed of 316 stainless-steel ASTM A351.
    b. Valve body shall be cast lugged or wafer configuration with a minimum of four guide holes.
    c. Valves shall be rated for a minimum of 150 psi operating pressure.
2. Shaft
    a. Shaft shall be Type 17-4 stainless steel.
    b. Shafts shall be one piece locked to the disc by stainless steel taper pins and nuts and sealed by O-rings.
    c. Shaft seals shall be V-type and shall be replaceable without removal of the valve from the installation or the shaft from the valve body. The actuator shall not be utilized to retain the packing or and leakage shall be prevented from entering the actuator.
3. Disc
    a. Shall be A351 Type 316 stainless steel and shall be offset.
    b. Shall be solid discs without external ribs or stiffeners.
    c. Disc shall provide 360-degree uninterrupted seating.
4. Seat
    a. Seat shall be PTFE, RTFE, or FKM polymer seat.
    b. Seats shall be retained in the body and must be replaceable without removing the disc or stem.
5. Bearings
    a. Shall have composite upper and lower self-lubricating shaft bearings.
    b. Adjustable composite thrust bearings shall be provided on valves 30 inches and larger.
6. Hardware and Fasteners
    a. All hardware and fasteners shall be Type 316 stainless steel.

2.6 OPERATORS

A. Provide factory-mounted operators, adjusted, and tested in accordance with AWWA C504.

B. Refer to Paragraph 2.2 and Section 15100 – Valve Basic Requirements.

PART 3 – EXECUTION

Refer to Section 15100 - Valve Basic Requirements.

END OF SECTION

SECTION 15102
GATE VALVES

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provisions of all labor, materials and equipment to furnish, and install gate valves and accessories, including training and testing for a complete and operable system as shown on the construction drawings and specified herein. Refer to related work specified in other sections to coordinate the complete installation.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Water Works Association (AWWA)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. ASTM International (ASTM)
5. NSF International (NSF)
6. International Organization for Standardization (ISO)
7. Underwriters Laboratory (UL)
8. Manufacturers Standardization Society (MSS)

1.4 SUBMITTALS

A. Refer to Section 15100 - Valve Basic Requirements.

1.5 QUALITY ASSURANCE

A. Refer to Section 15100 - Valve Basic Requirements.

1.6 WARRANTY

A. Refer to Section 15100 - Valve Basic Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 15100 - Valve Basic Requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. Items in Specification Section 15100 – Valve Basic Requirements apply.

B. Provide gate valves which are specifically designed for the application as indicated in the construction drawings.

C. Furnish gate valves of standard dimensions, built to formed templates, such that parts will be interchangeable between like units.

2.2 PERFORMANCE REQUIREMENTS

A. Gate Valve Abbreviations

1. Valve Type
   a. RG: Resilient Seat Gate Valve
   b. KG: Knife Gate Valve
   c. SGB: Small Diameter Gate Valve – Bronze
   d. SGS: Small Diameter Gate Valve – Stainless Steel
2. Connection Type
   a. FJ: Flange Joint
   b. MJ: Mechanical Joint
   c. MF: Mechanical Joint x Flange Joint
   d. PO: Push-On
   e. TD: Threaded
3. Service
   a. Refer to Fluid Abbreviations listed in the General Abbreviations Sheet
4. Operator Type
   a. ON: Operating Nut
   b. HW: Handwheel
   c. CW: Chainwheel
   d. EA: Electric Actuator
   e. PA: Pneumatic Actuator
5. Stem Configuration
   a. OSY: Outside Stem & Yoke
   b. NRS: Non-Rising Stem
6. Classified Area
   a. C1D1: Class I, Division I
   b. C1D2: Class I, Division II
   c. U: Unclassified

B. Gate Valve Table

Valve No.	P&ID	Area	Valve Size (in)	Valve Type	Connection Type	Service	Operator Type	Geared Operator (Y/N)	Modulating Actuator (Y/N)	Stem Configuration	Classified Area
KGV-03-001	3-I-1	Headworks	12	RG	FJ	RS	HW	Y	Y	NRS	C1D2
GV-14B-001	14B-I-1	NPW System	4	RG	FJ	NPW	HW	N	N	NRS	N/A

2.3 RESILIENT SEAT GATE VALVES

A. Acceptable Manufacturers:

1. Provide resilient seat gate valves of one of the following, no others will be allowed:
   a. American Flow Control
   b. Clow Valve
   c. J&S Valve
   d. Pratt
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of gate valve, all units shall be a common manufacturer.

B. Standard Compliance:
1. Valves shall be designed, manufactured, and tested in accordance with ANSI/AWWA C509 and C515.
2. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
3. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction:
1. Body and Bonnet:
   a. Valve bodies, bonnets, and stuffing boxes shall be ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 cast iron.
   b. Valve shall be rated for 250 psi operating pressure.
   c. Valves 14-inch and larger shall include integral carbon steel lifting eyes.
   d. Bonnet shall seal to the body via an EPDM O-ring.
   e. All internal hardware shall be stainless steel unless specified otherwise.
2. Stem:
   a. Operating stems shall be threaded bronze or stainless steel.
   b. Stems shall be sealed with multiple EPDM O-rings.
3. Disc and Track:
   a. Discs shall be ASTM A536 Grade 65-45-12 ductile iron encapsulated by EPDM. Disc nut shall be Bronze.
   b. Valves 30-inch and larger shall have stainless steel side tracks with stainless steel or bronze rollers and bronze scrapers.
4. Connections:
   a. Connections shall be flanged in accordance with ANSI Standard B16.1, Class 125 flanges, mechanical joint in accordance with ANSI A221.11/AWWA C111, or push-on as specified in the Gate Valve Table.
   b. All hardware and fasteners shall be Type 316 stainless steel.

D. Coatings:
1. Valves shall be provided with an external protective shop prime epoxy coating for delivery and storage purposes. Valves shall be prepared and coated in accordance with Section 09921 – Protective Coating once installed.
2. Lining shall be an NSF/ANSI/CAN Standard 61 certified two-part polyamide epoxy at a minimum 8 mils DFT.

2.4 KNIFE GATE VALVES

A. Acceptable Manufacturers:
1. Provide knife gate valves of one of the following, no others will be allowed:
   a. Wey
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of gate valve, all units shall be a common manufacturer.

B. Standard Compliance:
1. Valves shall be designed, manufactured, and tested in accordance with MSS-SP-81 and AWWA C520-10.
2. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction:
1. Body and Yoke:
   a. Valve bodies, bonnets, and glands shall be Type 316 Stainless Steel.
   c. Valve shall be rated for 150 psi operating pressure.
   d. Seat shall be integrally cast stainless steel.
   e. Yoke leg and block shall be cast stainless steel with a flat top design to allow for conversion of actuators.
   f. Gland shall be cast 304 stainless steel fastened to the body with Stainless Steel hardware.
   g. Packing material shall be PTFE lubricated synthetic fiber with a minimum of four rows.
2. Stem:
   a. Operating stems shall be threaded 304 stainless steel.
   b. Stem nut shall be brass or bronze.
3. Gate:
   a. Gate shall be 316 stainless steel with a round beveled seating edge.

4. Connections:
   a. Connections shall be flanged in accordance with ANSI Standard B16.5, Class 125 flanges.
   b. All hardware and fasteners shall be Type 316 stainless steel.

2.5 SMALL DIAMETER GATE VALVES – BRONZE

A. Acceptable Manufacturers:
1. Provide bronze gate valves of one of the following, no others will be allowed:
   a. Apollo
   b. Nibco
   c. Milwaukee Valve
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of gate valve, all units shall be a common manufacturer.

B. Standard Compliance:
1. Valves shall be designed, manufactured, and tested in accordance with MSS SP-80.
2. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.

3. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction:
1. Body, Disc, and Bonnet:
a. Valve bodies, discs, and bonnets shall be ASTM B62 bronze.
b. Stuffing box, gland, and gland nut shall be brass or bronze.
c. Valve shall be rated for 200 psi operating pressure.
2. Stem:
a. Operating stems shall be brass or bronze.
3. Connections:
a. Connections shall be National Pipe Thread (NPT) in accordance with ANSI B1.20.1.

2.6 SMALL DIAMETER GATE VALVES – STAINLESS STEEL

A. Construction:
1. Body, Disc, and Bonnet:
a. Valve bodies, discs, bonnets, and gland nut shall be ASTM A351 CF8M stainless steel.
b. Gland shall be AISI 304 stainless steel.
c. Valve shall be rated for 200 psi operating pressure.
d. Body seal and stem packing shall be PTFE.
2. Stem:
a. Operating stems shall be threaded AISI 316 stainless steel.
3. Connections:
a. Connections shall be National Pipe Thread (NPT) in accordance with ANSI B1.20.1.

2.7 OPERATORS

A. Refer to Paragraph 2.2 and Section 15100 - Valve Basic Requirements.

PART 3 – EXECUTION

Refer to Section 15100 - Valve Basic Requirements.

END OF SECTION

SECTION 15103
PLUG VALVES

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provisions of all labor, materials and equipment to furnish, and install plug valves and accessories, including training and testing for a complete and operable system as shown on the construction drawings and specified herein.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Water Works Association (AWWA)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. ASTM International (ASTM)
5. National Sanitation Department (NSF)
6. International Organization for Standardization (ISO)
7. Underwriters Laboratory (UL)

1.4 SUBMITTALS

A. Refer to Section 15100 - Valve Basic Requirements.

1.5 QUALITY ASSURANCE

A. Refer to Section 15100 - Valve Basic Requirements.

1.6 WARRANTY

A. Refer to Section 15100 - Valve Basic Requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. Items in Specification Section 15100 – Valve Basic Requirements apply.

2.2 PERFORMANCE REQUIREMENTS

A. Plug Valve Table Abbreviations

1. Valve Type
   a. EFP: Eccentric Full-Port Plug Valve
2. Connection Type
   a. FJ: Flange Joint
   b. MJ: Mechanical Joint
3. Service
   a. Refer to Fluid Abbreviations listed in the General Abbreviations Sheet
4. Operator Type
   a. ON: Operating Nut
   b. HW: Handwheel
   c. CW: Chainwheel
   d. EA: Electric Actuator
   e. PA: Pneumatic Actuator
   f. L: Lever
   g. GB: Gearbox
5. Classified Area
   a. C1D1: Class I, Division I
   b. C1D2: Class I, Division II
   c. U: Unclassified
   d. Buried

B. Plug Valve Table

Valve No.	P&ID	Area	Valve Size (in)	Valve Type	Connection Type	Service	Operator Type	Geared Operator (Y/N)	Classified Area
PV-03-005	3-I-1	Headworks	12	EFP	FJ	RS	EA	Y	C1D2
PV-03-006	3-I-1	Headworks	12	EFP	FJ	RS	EA	Y	C1D2
PV-04-003	4-I-1	Peak Shaving Basin	4	EFP	FJ	RS	L	N	N/A
PV-04-301	4-I-1	Peak Shaving Basin	6	EFP	FJ	RS	HW	N	N/A
PV-04-302	4-I-1	Peak Shaving Basin	6	EFP	FJ	RS	HW	N	N/A
PV-05-301	5-I-1	Aeration Basin	6	EFP	MJ	DR	ON	N	Buried
PV-05-302	5-I-1	Aeration Basin	6	EFP	MJ	DR	ON	N	Buried
PV-05-303	5-I-1	Aeration Basin	6	EFP	MJ	DR	ON	N	Buried
PV-06-301	6-I-1	Clarifier	6	EFP	MJ	DR	ON	N	Buried
PV-06-302	6-I-1	Clarifier	6	EFP	MJ	DR	ON	N	Buried
PV-06-303	6-I-1	Clarifier	6	EFP	MJ	DR	ON	N	Buried
PV-06-304	6-I-1	Clarifier	6	EFP	MJ	DR	ON	N	Buried
PV-14A-101	14A-I-1	Dewatering Press Feed Pumps	6	EFP	FJ	WAS	ON	N	N/A
PV-14A-201	14A-I-1	Dewatering Press Feed Pumps	6	EFP	FJ	WAS	ON	N	N/A
PV-14A-102	14A-I-1	Dewatering Press Feed Pumps	6	EFP	FJ	WAS	ON	N	N/A
PV-14A-202	14A-I-1	Dewatering Press Feed Pumps	6	EFP	FJ	WAS	ON	N	N/A
PV-14A-103	14A-I-1	Dewatering Press Feed Pumps	6	EFP	FJ	WAS	ON	N	N/A
PV-14A-203	14A-I-1	Dewatering Press Feed Pumps	6	EFP	FJ	WAS	ON	N	N/A
PV-14D-001	14D-I-1	Dewatering Facility	6	EFP	FJ	DR	HW	N	N/A

2.3 ECCENTRIC FULL PORT PLUG VALVES

A. Acceptable Manufacturers
1. DeZURIK Industries
2. GA Industries
3. Henry Pratt Company
4. Clow Valves
5. Crispin Valves
6. Val-Matic
7. Flomatic

B. Construction
1. Body
a. Valve bodies and bonnets shall be ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 cast iron.
b. Body seat shall be a welded overlay of 95% pure nickel applied directly to the interior of the valve body.
c. Valves 12-inch and smaller shall be rated for 175 psi operating pressure and valves 14-inch and larger shall be rated for 150 psi operating pressure.
d. Valves shall have port area of not less than 100% of pipe area.
e. The words “SEAT END” shall be cast on the exterior of the body seat end.
2. Plugs and Body Seat
a. Plug shall be rectangular, ductile iron ASTM A536 Grade 65-45-12 encapsulated in Buna-N rubber.
3. Shaft Seal
a. Shaft seals shall be either V-type packing or U-cup type Buna-N rubber.
4. Bearings
a. Shaft bearings shall be permanently lubricated Type 316 stainless steel.
b. Thrust bearings shall be PTFE
5. Connections
a. Connections shall be flanged in accordance with ANSI Standard B16.1, Class 125 flanges or mechanical joint in accordance with ANSI A221.11/AWWA C111 as specified in the Plug Valve Table.
b. All hardware and fasteners shall be Type 316 stainless steel.

D. Coatings
1. Lining shall be an NSF/ANSI/CAN Standard 61 certified two-part polyamide epoxy at a minimum 8 mils DFT.

2.4 OPERATORS

A. Refer to Paragraph 2.2 and Section 15100 – Valve Basic Requirements.

B. Buried plug valves shall have a sealed gearbox, extension stem, and a 2-inch square AWWA operating nut.

C. Above ground plug valves in treatment facilities shall be gearbox with a handwheel.

D. Handwheels shall be at least 12-inches in diameter.

E. Above ground plug valves with operating nuts shall be provided with an extension lever.

PART 3 – EXECUTION

Refer to Section 15100 – Valve Basic Requirements.

END OF SECTION

SECTION 15104
BALL VALVES

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provisions of all labor, materials and equipment to furnish, and install gate valves and accessories, including training and testing for a complete and operable system as shown.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Water Works Association (AWWA)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. ASTM International (ASTM)
5. NSF International (NSF)
6. International Organization for Standardization (ISO)
7. Underwriters Laboratory (UL)

1.4 SUBMITTALS

A. Refer to Section 15100 - Valve Basic Requirements.

1.5 QUALITY ASSURANCE

A. Refer to Section 15100 - Valve Basic Requirements.

1.6 WARRANTY

A. Refer to Section 15100 - Valve Basic Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 15100 - Valve Basic Requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. Items in Specification Section 15100 – Valve Basic Requirements apply.

B. Furnish ball valves of standard dimensions, built to formed templates, such that parts will be interchangeable between like units.

2.2 PERFORMANCE REQUIREMENTS

A. Ball Valve Abbreviations

1. Valve Type
   a. SB: Stainless Steel Ball Valve
   b. BB: Brass Ball Valve
   c. DB: Ductile Iron Ball Valve
2. Connection Type
   a. FJ: Flange Joint
   b. TD: Threaded
3. Service
   a. Refer to Fluid Abbreviations listed in the General Abbreviations Sheet
4. Operator Type
   a. OL: Operating Lever
   b. EA: Electric Actuator
   c. PA: Pneumatic Actuator
   d. HW: Handwheel
5. Classified Area
   a. C1D1: Class I, Division I
   b. C1D2: Class I, Division II
   c. U: Unclassified

B. Ball Valve Table

Valve No.	P&ID	Area	Valve Size (in)	Valve Type	Connection Type	Service	Operator Type	Geared Operator (Y/N)	Modulating Actuator (Y/N)	Classified Area
-	-	All Non-Potable Water Service BVs	All	SB	TD	NPW	OL	N	N	N/A
-	-	All Air Service BVs	All	SB	TD	AIR	OL	N	N	N/A
-	-	All WAS BVs	All	SB	TD	WAS	OL	N	N	N/A
-	-	All BW BVs	All	SB	TD	BW	OL	N	N	N/A

2.3 STAINLESS STEEL BALL VALVES

A. Acceptable Manufacturers:

1. Apollo
2. McMaster-Carr
3. Powell Valves
4. Approved Equal

B. Construction:

1. Body and End Piece:
   a. Valves shall have a two-piece body.
   b. Valve bodies and end pieces shall be ASTM A351 CF8M stainless steel.
   c. Body seal shall be PTFE.
   d. Valve shall be rated for minimum 250 psi operating pressure.
2. Stem and Lever:
   a. Valve stems shall be of the blow-out proof design.
   b. Valve stems and glands shall be ASTM A276 316 stainless steel.
   c. Stem packing and thrust bearing shall be PTFE.
   d. Valve levers shall be ASTM A276 304 stainless steel with a vinyl grip.
   e. Lever nuts shall be stainless steel.
3. Ball:
   a. Valve ball shall be full port, constructed of ASTM A351 CF8M stainless steel.
   b. Valve seats shall be reinforced PTFE.
4. Connections:
   a. Threaded connections shall be National Pipe Thread (NPT) in accordance with ANSI B1.20.1.
   b. Flanged connections shall be ASME Class 150 rated. Fasteners shall be Type 316 stainless steel.

2.4 BRASS BALL VALVES

A. Acceptable Manufacturers:

1. Apollo
2. Nibco
3. Milwaukee Valve
4. Approved Equal

B. Construction:

1. Body and End Piece:
   a. Valves shall have a two-piece body.
   b. Valve bodies and end pieces shall be ASTM B283 brass.
   c. Body seal shall be PTFE.
   d. Valve shall be rated for minimum 250 psi operating pressure.
2. Stem and Lever:
   a. Valve stems and glands shall be brass or stainless steel.
   b. Stem packing and thrust bearing shall be PTFE.
   c. Valve levers shall be zinc-plated steel with a vinyl grip.
3. Ball:
   a. Valve ball shall be full port design, constructed of brass or stainless steel.
   b. Valve seats shall be reinforced PTFE.
4. Connections:
   a. Connections shall be National Pipe Thread (NPT) in accordance with ANSI B1.20.1.

2.5 DUCTILE IRON BALL VALVES

A. Acceptable Manufacturers:

1. GA industries
2. Pratt
3. Val-Matic
4. Approved Equal

B. Construction:

1. Body:
   a. Valves shall have a one-piece, two-piece, or three-piece body.
   b. Valve bodies and end pieces shall be ASTM A536, grade 65-45-12 ductile iron.
   c. Body seal shall be stainless steel.
   d. Valve shall be rated for minimum 250 psi operating pressure.
2. Stem, Bearing, and Seal:
   a. Valve stems shall be Type 630 stainless steel.
   b. Valve shall be fitted with sleeve-type bearing.
   c. Shaft seal shall be Buna-N.
3. Ball:
   a. Valve ball shall be full port, constructed of ASTM A536, grade 65-45-12 ductile iron.
   b. Resilient seat shall be EPDM.
4. Connections:
   a. Connections shall be flanged in accordance with ANSI Standard B16.1, Class 125 or Class 250 flanges. Flanged shall be flat faced.
   b. All hardware and fasteners shall be Type 316 stainless steel.

D. Coatings:

1. Valves shall be provided with an external protective shop prime epoxy coating for delivery and storage purposes.
2. Valve internal passages shall have a factor-applied two-part polyamide epoxy at a minimum 8 mils DFT.

2.6 OPERATORS

A. Refer to Paragraph 2.2 and Section 15100 - Valve Basic Requirements.

PART 3 – EXECUTION

Refer to Section 15100 - Valve Basic Requirements.

END OF SECTION

SECTION 15105
CHECK VALVES

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provisions of all labor, materials and equipment to furnish, and install check valves and accessories, including training and testing for a complete and operable system as shown on the construction drawings and specified herein. Refer to related work specified in other sections to coordinate the complete installation.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Water Works Association (AWWA)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. ASTM International (ASTM)
5. NSF International (NSF)
6. International Organization for Standardization (ISO)
7. Underwriters Laboratory (UL)

1.4 SUBMITTALS

A. Refer to Section 15100 - Valve Basic Requirements.

1.5 QUALITY ASSURANCE

A. Refer to Section 15100 - Valve Basic Requirements.

1.6 WARRANTY

A. Refer to Section 15100 - Valve Basic Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 15100 - Valve Basic Requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. Items in Specification Section 15100 – Valve Basic Requirements apply.
B. Provide check valves which are specifically designed for the application as indicated in the construction drawings.

C. Furnish check valves of standard dimensions, built to formed templates, such that parts will be interchangeable between like units.

2.2 PERFORMANCE REQUIREMENTS

A. Check Valve Table Abbreviations
   1. Valve Type
      a. DCV: Double Disc Check Valve
      b. DBV: Duckbill Check Valve
      c. SCK: Silent Check Valve
      d. SCV: Swing Check Valve
      e. BCV: Ball Check Valve
   2. Connection Type
      a. FJ: Flange Joint
      b. WF: Wafer
      c. SO: Slip-On
      d. SI: Slip-In
      e. LG: Lugged
   3. Installation Type
      a. C: Concentric
      b. S: Sloped Bottom
      c. I: Inline
   4. Service
      a. Refer to Fluid Abbreviations listed in the General Abbreviations Sheet

B. Check Valve Table

Valve No.	P&ID	Area	Valve Size (in)	Valve Type	Connection Type	Installation Type	Service
SCV-04-301	4-I-1	Peak Shaving Basin	6	SCV	FJ	I	RS
DCV-09-601	9-I-1	Blowers	10	DCV	FJ	I	AIR
SCV-14A-101	14A-I-1	Dewatering Press Feed Pumps	6	SCV	FJ	I	WAS
SCV-14A-201	14A-I-1	Dewatering Press Feed Pumps	6	SCV	FJ	I	WAS
SCV-14B-101	14B-I-1	Dewatering Facility	2	SCV	FJ	I	NPW
SCV-14B-201	14B-I-1	Dewatering Facility	2	SCV	FJ	I	NPW
BCV-14B-001	14B-I-1	Dewatering Facility	2	BCV	FJ	I	NPW

2.3 DOUBLE DISC CHECK VALVES

A. Acceptable Manufacturers
1. Provide dual disc check valves of one of the following, no others will be allowed:
   a. DeZurik
   b. Pratt
   c. Val-Matic
   d. Stayflow
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of check valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Designed, manufactured, and tested in accordance with ANSI/AWWA C518.
2. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
3. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body
   a. Valve bodies shall be ASTM A536 Grade 65-45-12 ductile iron.
   b. Valves shall be wafer style for installation between ANSI Standard B16.1, Class 125 flanges.
   c. Valves shall be per ASME B16.5 Class 150 pressure rating.
   d. Valves 10-inch and larger shall include an integral carbon steel lifting eye.
2. Shaft(s), Pins, and Springs
   a. Shaft(s) and hinges shall be Type 304 stainless steel.
   b. Stop pins shall be Type 304 stainless steel.
   c. Springs shall be Type 316 stainless steel. Valves 18-inch diameter and larger shall have two springs.
   d. Hinge and stop pin retainers shall be ASTM A1035 carbon steel with EPDM seal.
3. Discs
   a. Air Service: discs shall be either aluminum bronze, cast bronze, or 304 stainless steel.
   b. Potable/Non-Potable Service: discs shall be 304 or 316 stainless steel.
4. Seat
   a. Seats shall be EPDM and vulcanized or molded to the valve body.
5. Hardware and Fasteners
   a. All hardware and fasteners shall be Type 316 stainless steel.

D. Coatings
1. Valves shall be provided with an external protective shop prime epoxy coating for delivery and storage purposes. Valves shall be prepared and coated in accordance with Section 09921 – Protective Coating once installed.
2. Lining shall be an NSF/ANSI/CAN Standard 61 certified two-part polyamide epoxy at a minimum 8 mils DFT.

2.4 DUCKBILL CHECK VALVES

A. Acceptable Manufacturers
1. Provide duckbill check valves of one of the following, no others will be allowed:
   a. Cla-Val
   b. Onyx Valve
   c. Red Valve
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of check valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
3. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body
   a. Cover and tube material shall be Neoprene.
   b. Valves with flanged connections shall have 304 stainless steel backing flanges for connection to ASME B16.1 Class 125 flanges.
   c. Slip-on or slip-in installation valves shall have 304 stainless steel clamps and hardware.

2.5 SILENT CHECK VALVES

A. Acceptable Manufacturers:
1. Provide silent check valves of one of the following, no others will be allowed:
   a. DeZurik/APCO
   b. Pratt
   c. Val-Matic
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of check valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Designed, manufactured, and tested in accordance with ANSI/AWWA C508.
2. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
3. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body
   a. Valve bodies shall be wafer or globe style per the construction drawings.
   b. Constructed of ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 Class B cast iron.
2. Disc, Shaft, and Spring
   a. Disc shall be centered within the valve body on an integral shaft and spring all of Type 316 stainless steel construction.
   b. Disc shall be concave to the upstream direction of flow.

3. Seat
   a. Seats shall be EPDM and molded to the valve body.

D. Coatings
1. Valves shall be provided with an external protective shop prime epoxy coating for delivery and storage purposes. Valves shall be prepared and coated in accordance with Section 09921 – Protective Coating once installed.
2. Lining shall be an NSF/ANSI/CAN Standard 61 certified two-part polyamide epoxy at a minimum 8 mils DFT.

2.6 SWING CHECK VALVES

A. Acceptable Manufacturers
1. Provide swing check valves of one of the following, no others will be allowed:
   a. DeZurik
   b. GA Industries
   c. Pratt
   d. Val-Matic
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of check valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Designed, manufactured, and tested in accordance with ANSI/AWWA C508.
2. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
3. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body and Cover
   a. Body and cover shall be ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 Class B gray iron.
   b. Valves shall have fully faced and drilled flanges in accordance with ANSI B16.1, Class 125.
   c. Body seat shall be stainless steel.
2. Disc
   a. Disc and arm shall be ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 Class B gray iron.
   b. Disc seat shall be Buna-N rubber.
3. Pivot Shaft and Seal
   a. Shaft shall be stainless steel and sealed with virgin PTFE packing in a ductile iron or bronze packing gland.
4. Lever and Weight
   a. Lever and weight shall be ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 Class B gray iron.
   b. Air cushion mechanisms shall be provided as specified. Air cushion cylinder shall be either aluminum or bronze in a ductile iron bracket with stainless steel hardware.
5. Hardware and Fasteners
   a. All hardware and fasteners shall be Type 316 stainless steel.

D. Coatings
1. Valves shall be provided with an external protective shop prime epoxy coating for delivery and storage purposes. Valves shall be prepared and coated in accordance with Section 09921 – Protective Coating once installed.
2. Lining shall be an NSF/ANSI/CAN Standard 61 certified two-part polyamide epoxy at a minimum 8 mils DFT.

2.7 BALL CHECK VALVES

A. Acceptable Manufacturers
1. Provide ball check valves of one of the following, no others will be allowed:
a. GA Industries
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of check valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Designed, manufactured, and tested in accordance with ANSI/AWWA C508.
2. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
3. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body and Cover
a. Body and cover shall be ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 Class B gray iron.
b. Valves shall have fully faced and drilled flanges in accordance with ANSI B16.1, Class 125.
c. Body seat shall have a Buna-N O-ring.
2. Ball
a. Balls shall have an aluminum core with Buna-N rubber coating.
3. Hardware and Fasteners
a. All hardware and fasteners shall be Type 316 stainless steel.

D. Coatings
1. Valves shall be provided with an external protective shop prime epoxy coating for delivery and storage purposes. Valves shall be prepared and coated in accordance with Section 09921 – Protective Coating once installed.
2. Lining shall be an NSF/ANSI/CAN Standard 61 certified two-part polyamide epoxy at a minimum 8 mils DFT.

PART 3 – EXECUTION

Refer to Section 15100 - Valve Basic Requirements.

END OF SECTION

SECTION 15106
THERMOPLASTIC VALVES

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provisions of all labor, materials, and equipment to furnish, and install thermoplastic valves and accessories, including training and testing for a complete and operable system as shown on the construction drawings and specified herein. Refer to related work specified in other sections to coordinate the complete installation.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Water Works Association (AWWA)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. ASTM International (ASTM)
5. NSF International (NSF)
6. International Organization for Standardization (ISO)
7. Underwriters Laboratory (UL)

1.4 SUBMITTALS

A. Refer to Section 15100 - Valve Basic Requirements.

1.5 QUALITY ASSURANCE

A. Refer to Section 15100 - Valve Basic Requirements.

1.6 WARRANTY

A. Refer to Section 15100 - Valve Basic Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 15100 - Valve Basic Requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. Items in Specification Section 15100 – Valve Basic Requirements apply.
B. Provide valves which are specifically designed for the application as indicated in the construction drawings.

C. Furnish valves of standard dimensions, built to formed templates, such that parts will be interchangeable between like units.

2.2 PERFORMANCE REQUIREMENTS

A. Thermoplastic Valve Table Abbreviations

1. Valve Type
   a. BV: Thermoplastic Ball Valve
   b. BCV: Thermoplastic Ball Check Valve
   c. BFV: Thermoplastic Butterfly Valve
   d. GV: Thermoplastic Gate Valve
   e. WYS: Thermoplastic Wye Strainer
   f. BPV: Thermoplastic Backpressure Valve
   g. PRV: Thermoplastic Pressure Relief Valve
   h. DGV: Thermoplastic Degassing Valve
   i. ARV: Thermoplastic Air Release Valve
   j. DCK: Thermoplastic Diaphragm Check Valve
2. Connection Type
   a. FJ: Flange Joint
   b. WF: Wafer
   c. SW: Solvent Welded
   d. TD: Threaded
3. Service
   a. Refer to Fluid Abbreviations listed in the General Abbreviations Sheet
4. Operator Type
   a. ON: Operating Nut
   b. OL: Operating Lever
   c. HW: Handwheel
   d. EA: Electric Actuator
   e. PA: Pneumatic Actuator
5. Classified Area
   a. C1D1: Class I, Division I
   b. C1D2: Class I, Division II
   c. U: Unclassified

A. Thermoplastic Valve Table

Valve No.	P&ID	Area	Valve Size (in)	Valve Type	Connection Type	Service	Operator Type	Geared Operator (Y/N)	Modulating Actuator (Y/N)	Classified Area
-	-	All Sodium Bisulfite Solution Valves	All	Varies	SW	SBS	OL	N	N	N/A
-	-	All Sodium Hypochlorite Solution Valves	All	Varies	SW	SH	OL	N	N	N/A
-	-	All Aluminum Sulfate Solution Valves	All	Varies	SW	ALUM	OL	N	N	N/A
-	-	All Polymer Solution Valves	All	Varies	SW	PS	OL	N	N	N/A
-	-	All Raw Polymer Valves	All	Varies	SW	POLY	OL	N	N	N/A

2.3 THERMOPLASTIC BALL VALVES

A. Acceptable Manufacturers
   1. Provide ball valves of one of the following, no others will be allowed:
      a. Asahi
      b. Chemtrol
      c. George Fischer
      d. Hayward Flow Control
      e. Plast-O-Matic
      f. Thermoplastic Valves Inc.
   2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
   3. If multiple units are required per type of thermoplastic valve, all units shall be of a common manufacturer.

B. Standard Compliance
   1. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
   2. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
   1. Body
      a. Valve shall be Type 21/21a and the body, stem, carrier, ball, and union nuts shall be PVC conforming to ASTM D1784. Valves installed in hot water applications shall be CPVC.
      b. Valves shall be true union style.
      c. Valves shall have PTFE seats with elastomeric backing cushions.
      d. Stems and union connections shall seal to the valve body with EPDM O-rings.
      e. Valves shall have a minimum operating pressure rating of 150 psi.
      f. Connections shall be socket or threaded type.
   2. Operator
      a. Shall be standard T-lever type and red or orange ABS material.
      b. Operator extensions and supports shall be provided by the valve manufacturer in locations as shown on the drawings.

2.4 THERMOPLASTIC BALL CHECK VALVES

A. Acceptable Manufacturers
   1. Provide ball check valves of one of the following, no others will be allowed:
      a. Asahi
      b. Chemtrol
      c. George Fischer
      d. Hayward Flow Control
      e. Plast-O-Matic
      f. Thermoplastic Valves Inc.
   2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
   3. If multiple units are required per type of thermoplastic valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
2. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body
a. Body, ball, stop ring, and union nut shall be PVC conforming to ASTM D1784. Valves installed in hot water applications shall be CPVC.
b. Valves shall be true union style.
c. Stop ring shall have an EPDM seat.
d. Union connections shall seal to the valve body with EPDM O-rings.
e. Valves shall have a minimum operating pressure rating of 150 psi.
f. Connections shall be socket or threaded type.

2.5 THERMOPLASTIC BUTTERFLY VALVES

A. Acceptable Manufacturers
1. Provide butterfly valves of one of the following, no others will be allowed:
a. Asahi
b. Chemtrol
c. George Fischer
d. Hayward Flow Control
e. Thermoplastic Valves Inc.
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of thermoplastic valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
2. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body
a. Valve body and disc shall be PVC conforming to ASTM D1784 with an EPDM seat and seal. Valves installed in hot water applications shall be CPVC.
b. Valves shall be wafer style and seal to connecting flanges with EPDM O-rings.
c. Stems shall be Type 316 Stainless Steel.
d. Stems shall seal to the valve body with EPDM O-rings.
e. Valves shall have a minimum operating pressure rating of 150 psi.
2. Operator
a. Shall be standard lever type and red or orange PVC or ABS material.
b. Valves 6-inch and larger shall have a watertight gear operator and handwheel.
c. Operator extensions and supports shall be provided by the valve manufacturer in locations as shown on the drawings.

2.6 THERMOPLASTIC GATE VALVES

A. Acceptable Manufacturers
1. Provide gate valves of one of the following, no others will be allowed:
a. Asahi
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of thermoplastic valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
2. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body
a. Valve body, bonnet, stem, and gate shall be PVC conforming to ASTM D1784. Valves shall have a non-rising stem.
b. Valve bonnet shall seal to the body with an EPDM O-ring.
c. Valves shall have flanged connections with EPDM gaskets.
d. Valves shall have a minimum operating pressure rating of 150 psi.
2. Operator
a. Operator extensions and supports shall be provided by the valve manufacturer in locations as shown on the drawings.
3. Hardware and Fasteners
a. All hardware and fasteners shall be Type 316 stainless steel.

2.7 THERMOPLASTIC WYE STRAINER

A. Acceptable Manufacturers
1. Provide wye strainers of one of the following, no others will be allowed:
a. Asahi
b. George Fischer
c. Hayward Flow Control
d. Thermoplastic Valves Inc.
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of thermoplastic valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
2. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body
a. Strainer body and cap shall be PVC conforming to ASTM D1784.
b. Strainer shall be stainless steel mesh with 1/32-inch openings.
c. Cap shall be threaded and seal with an EPDM O-ring.
d. Connections shall be socket or threaded type.

2.8 THERMOPLASTIC BACKPRESSURE & PRESSURE RELIEF VALVES

A. Acceptable Manufacturers
1. Provide backpressure and pressure relief valves of one of the following, no others will be allowed:
   a. Asahi
   b. George Fischer
   c. Hayward Flow Control
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of thermoplastic valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body
   a. Body shall be PVC conforming to ASTM D1784. Adjusting bolt, lock, nut, and fasteners shall be stainless steel. Spring shall be plated steel.
   b. Plug seal shall be EPDM and attached to the PTFE shaft. Shaft shall be sealed to the body via EPDM U-cup seals.
   c. Connections shall be threaded type.

D. Accessories
1. Valve discharges shall be routed to a nearby drain or the edge of the slab out of the way of access to the process area via Schedule 80 PVC pipe.
2. Backpressure valves shall be installed in line with the path of flow and pressure relief valves shall be installed on a threaded connection out of the path of flow.

2.9 THERMOPLASTIC DEGASSING VALVES

A. Acceptable Manufacturers
1. Provide pressure relief valves of one of the following, no others will be allowed:
   a. Plast-O-Matic
2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
3. If multiple units are required per type of thermoplastic valve, all units shall be of a common manufacturer.

B. Standard Compliance
1. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
1. Body
   a. Body shall be PVC conforming to ASTM D1784. Internal components shall be PVC or chemical resistant plastic material with EPDM seals.
   b. Connections shall be threaded type.

D. Accessories
1. Degassing valves shall be installed at the highest possible point of the piping and include Schedule 80 PVC vent piping directing gases outside and away from working areas.

2.10 THERMOPLASTIC AIR RELEASE VALVES

A. Acceptable Manufacturers
   1. Provide air release valves of one of the following, no others will be allowed:
      a. Hayward Flow Control
      b. Plast-O-Matic
   2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
   3. If multiple units are required per type of thermoplastic valve, all units shall be of a common manufacturer.

B. Standard Compliance
   1. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
   2. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
   1. Body
      a. Body and plug shall be PVC conforming to ASTM D1784.
      b. Plug seal shall be EPDM and must completely seal at minimum 10 psi system pressure.
      c. Connections shall be socket or threaded type.

2.11 THERMOPLASTIC DIAPHRAGM CHECK VALVES

A. Acceptable Manufacturers
   1. Provide ball check valves of one of the following, no others will be allowed:
      a. Plast-O-Matic
   2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
   3. If multiple units are required per type of thermoplastic valve, all units shall be of a common manufacturer.

B. Standard Compliance
   1. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.
   2. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

C. Construction
   1. Body
      a. Housing and union nut shall be PVC conforming to ASTM D1784. Valves installed in hot water applications shall be CPVC.
      b. Diaphragms shall be EPDM or FKM.
      c. Valves shall have a minimum operating pressure rating of 150 psi.
      d. Connections shall be socket or threaded type.

PART 3 – EXECUTION

Refer to Section 15100 - Valve Basic Requirements.

END OF SECTION

SECTION 15107
PRESSURE RELIEF VALVES

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provisions of all labor, materials and equipment to furnish, and install pressure relief valves and accessories, including training and testing for a complete and operable system.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Water Works Association (AWWA)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. ASTM International (ASTM)
5. NSF International (NSF)
6. International Organization for Standardization (ISO)
7. Underwriters Laboratory (UL)

1.4 SUBMITTALS

A. Refer to Section 15100 - Valve Basic Requirements.

B. Pressure setting range.

1.5 QUALITY ASSURANCE

A. Refer to Section 15100 - Valve Basic Requirements.

1.6 WARRANTY

A. Refer to Section 15100 - Valve Basic Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 15100 - Valve Basic Requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide pressure relief valves which are specifically designed for the application as shown.

B. Furnish valves of standard dimensions, built to formed templates, such that parts will be interchangeable between like units.

C. Furnish valves with adjustable set pressures. Valves without adjustable set pressures shall not be allowed.

D. Items in Specification Section 15100 – Valve Basic Requirements apply.

2.2 PERFORMANCE REQUIREMENTS

A. Pressure Relief Valve Table Abbreviations
   1. Valve Type
      a. PRV: Spring Loaded Pressure Relief Valve For Water Service
      b. PRVA: Spring Loaded Pressure Relief Valve For Air Service
      c. PRVW: Weighted Pressure Relief Valve For Air Service
   2. Connection Type
      a. FJ: Flange Joint
      b. TD: Threaded
   3. Service
      a. Refer to Fluid Abbreviations listed in the General Abbreviations Sheet
   4. Classified Area
      a. C1D1: Class I, Division I
      b. C1D2: Class I, Division II
      c. U: Unclassified

B. Pressure Relief Valve Table

Valve No.	P&ID	Area	Valve Inlet Size (in)	Valve Discharge Size (in)	Valve Type	Connection Type	Service	Operating Pressure Range (psig)	Set Pressure (psig)	Backpressure (psig)	Max. Temperature (°F)	Classified Area
PRV-10-001	10-I-1	NPW Pump Station	2	2	PRV	TD	NPW	0-125	80	0	104	N/A
PRV-14C-001	14C-I-1	Dewatering Facility	2	2	PRV	TD	NPW	0-125	80	0	104	N/A

2.3 SMALL DIAMETER PRESSURE RELIEF VALVES FOR LIQUID SERVICE (1" OR LESS)

A. Acceptable Manufacturers
   1. Provide iron mud valves of one of the following, no others will be allowed:
      a. Apollo
      b. Cla-Val
      c. GA Industries
      d. Mueller
      e. Watts
      f. Zurn
      g. Approved Equal
   2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.

B. Standard Compliance:
   1. Valves used in applications with potable water or water that will be treated to become potable shall be certified to meet NSF/ANSI/CAN Standard 61 or Manufacturer can provide certification of conformance with requirements of NSF/ANSI/CAN Standard 61 by a third-party organization accredited by ANSI.

C. Construction
   1. Body:
      a. Valve body and cover shall be two parts and stainless steel or cast bronze.
      b. Valve shall be rated for 150 psi minimum operating pressure.
      c. All other trim components shall be stainless steel.
      d. Valve shall have a calibrated adjusting screw to vary the spring load on the disc seat.
   2. Seat and Spring:
      a. Body seat shall be stainless steel. Disc seat shall be EPDM or Buna-N rubber.
      b. Spring shall be stainless steel.
   3. Connections:
      a. Valves shall have threaded NPT connections and be installed using PTFE thread sealing tape.
      b. All hardware shall be stainless steel.

PART 3 – EXECUTION

A. Refer to Section 15100 - Valve Basic Requirements.

B. Valves shall be tested in accordance with ASTM PTC 25.

END OF SECTION

SECTION 15120
PIPING SPECIALTIES

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provisions of all labor, materials and equipment to furnish, and install all piping specialties and accessories, including training and testing for a complete and operable system as shown on the construction drawings and specified herein. Refer to related work specified in other sections to coordinate the complete installation.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. American Water Works Association (AWWA)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. ASTM International (ASTM)
5. National Sanitation Department (NSF)
6. International Organization for Standardization (ISO)

1.4 SUBMITTALS

A. Submit piping layout and product data on each type of coupling, expansion joint, and other piping specialties and accessories, including gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract documents. Submit certificates, manufacturer's instructions, source quality control, and qualification stations, as requested by Engineer.

1.5 QUALITY ASSURANCE

A. Component Supply and Compatibility
1. Obtain each type of piping specialty and accessory product including in this Section, regardless of component manufacturer, from a single piping specialty and accessories manufacturer.
2. Supplier shall prepare, or review, and approve all submittals for components furnished under this section.
3. Components shall be suitable for specified service conditions and be integrated into overall assembly by the Supplier.

B. For surface water or potable water application, valves shall be certified to NSF/ANSI 61 Drinking Water System Components – Health Effects.

C. Valves shall be certified to be Lead free in accordance with NSF/ANSI 61 and 372.

1.6 WARRANTY

Refer to Division 00, 01 & 15.

PART 2 – PRODUCTS

2.1 COUPLINGS

A. Sleeve-type, Flexible Couplings
   1. Acceptable Manufacturers
      a. Provide one of the following, no others will be allowed:
         i. JCM Industries
         ii. PowerSeal
         iii. Smith Blair
         iv. Victaulic
      b. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
      c. If multiple units are required per type, all units shall be of a common manufacturer.
   2. Construction
      a. Pressure and Service: Same as connected piping.
      b. Material: Ductile Iron.
      c. Gaskets: Suitable for specified service, as recommended by manufacturer. Gaskets for air service must be rated for continued service at 250°F.
      d. Bolts and Nuts: Type 304 Stainless steel bolts, washers, nuts, and other associated hardware.
   3. Harnessing
      a. Harness couplings to restrain pressure piping. For pipelines that will be under pressure, test pressures are specified in the piping section.
      b. Tie adjacent flanges with Stainless steel bolts. Provide flange-mounted stretcher bolt plates to be designed by manufacturer, unless otherwise approved.
      c. On plain-end piping, for harnessing couplings, provide anchor restraint systems.
      d. Conform to dimensions, size, spacing, and materials for lugs, bolts, washers, and nuts as recommended by manufacturer and approved by Engineer for pipe size, wall thickness, and test pressure required. Provide minimum 5/8-inch diameter bolts.

B. Flanged Coupling Adapters
   1. Acceptable Manufacturers
      a. Provide one of the following, no others will be allowed:
         i. JCM Industries
         ii. PowerSeal
         iii. Smith Blair
         iv. Victaulic
      b. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
      c. If multiple units are required per type, all units shall be of a common manufacturer.
   2. Construction
      a. One end of adapter shall be flanged and opposite end shall have sleeve-type flexible coupling.
      b. Pressure and Service: Same as connected piping.
      c. Material: Ductile Iron.
      d. Gaskets: Suitable for specified service, as recommended by manufacturer.

e. Bolts and Nuts: Type 304 Stainless steel bolts, washers, nuts, and associated hardware.

3. Harnessing
   a. Harness couplings to restrain pressure piping. For pipelines that will be under pressure, test pressures are specified in the piping specifications.
   b. Provide number of studs required to restrain test pressure and service conditions.
   c. Harness shall be as designed and recommended by flanged adapter manufacturer.
   d. Dimensions, sizes, spacing, and materials shall be suitable for service and conditions encountered and shall be approved by Engineer.

C. Dismantling Joints
1. Acceptable Manufacturers
   a. Provide one of the following, no others will be allowed:
      i. Dresser
      ii. JCM Industries
      iii. Romac
      iv. Smith Blair
      v. Victaulic
   b. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
   c. If multiple units are required per type, all units shall be of a common manufacturer.
2. Construction
   a. Pressure and Service: Same as connected piping.
   b. Material: Ductile Iron.
   c. Gaskets: Suitable for specified service, as recommended by manufacturer.
   d. Bolts and Nuts: Type 304 Stainless steel bolts, washers, and nuts.

2.2 EXPANSION JOINTS

A. Rubber Arch Type Expansion Joints
1. Provide rubber arch-type expansion joints at all expansion joint locations, except where other types of expansion joints are shown or specified.
2. Axial travel of expansion joints shall not be less than 1.5 inches.
3. Refer to the construction drawings for locations and number of arches.
4. Acceptable Manufacturers
   a. Provide one of the following:
      i. Flexicraft
      ii. Holz Rubber Company
      iii. Mercer Rubber
      iv. Proco
      v. U.S. Rubber Supply
   b. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
   c. If multiple units are required per type, all units shall be of a common manufacturer.
5. Liquid Service
   a. Material shall be compatible with the liquid, but at a minimum material shall be neoprene or Buna-N suitable for temperatures up to 180 degrees F.
   b. Type: Filled arch type.
   c. Provide backup or retaining rings as recommended by expansion joint manufacturer.

d. Yoking
   i. Shall be yoked in manner to provide transmission of tension loading to which expansion joint may be subjected during system operation.
   ii. Compressive or lateral movement of expansion joint shall not be impaired by yoking system.
   ii. Details of expansion joint yoking shall be submitted to Engineer for approval.

6. Air Service
   a. Provide pipe expansion joints in air piping where shown as a minimum. Provide additional expansion joints if recommended by pipe manufacturer.
   b. General
      i. Type: U-type arch.
      ii. Provide flanged ends. Provide stainless steel split steel retaining rings to prevent damage to flanges when bolts are tightened.
      iii. Rated for continuous operation at temperatures up to 300 degrees F and pressures to 20 psig.
      iv. For locations at air blower inlet and outlet connections expansion joints: shall minimize the transmission of vibration from blower to piping at inlet and outlet connections.
   c. Harnessing
      i. Harness each joint against thrust for test pressure in piping.
      ii. Provide control units consisting of two or more tie rods connected between flanges, set for maximum allowable elongation of expansion joints.
      iii. Provide stainless steel triangular plates to connect tie rods to flanges. Tie rods shall be Type 304 stainless steel and include rubber washers between the triangular plates and rods.
      iv. Provide control units in accordance with recommendations of expansion joint manufacturer.

B. Stainless Steel Expansion Joints
1. Acceptable Manufacturers
   a. Provide one of the following:
      i. Senior Flexonics Canada, Ltd
      ii. Hyspan Precision Products
      iii. or Equal
   b. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
   c. If multiple units are required per type, all units shall be of a common manufacturer.
2. Construction
   a. Pressure and Service: Same as connected piping. Shall absorb thermal expansion of piping. Burst strength shall be equal to four times working pressure of pipeline, and test hydrostatic pressure shall be equal to 1.5 times rated working pressure of expansion joint.
   b. Material: Type 304 stainless steel
   c. Provide free flexing type with internal sleeves with fixed rolled angle flange.
   d. Joints in yard air piping shall have internal guide with thickness equal to piping wall thickness.
3. Harnessing
   a. Harness each joint against thrust for test pressure in piping.
   b. Hall be by 2 or more limit rods connected between flanges set for maximum allowable elongation of expansion joint.
   c. Limit rods and connection accessories shall be of Series 300 stainless steel.
   d. Provide limit rods in accordance with the recommendation of the manufacturer.

2.3 MISCELLANEOUS PIPING

A. HDPE Tubing
1. Diameter: Tubing diameter indicated on the construction drawings, represents tubing interior diameter (I.D.).
2. All tubing shall be, as much as possible, continuous without couplings from the source of pressure to the control device.
3. Fittings to be HDPE or polypropylene sleeved compression fittings.
4. Provide Schedule 40 PVC carrier conduits unless otherwise specified.

2.4 MISCELLANEOUS SPECIALITIES AND ACCESSORIES

A. Quick Connect Couplings – Water Service
1. Construction
a. Type: Dual cam and groove, male end with dust cap, Type 316 stainless steel chain and lock.
b. Body: Polypropylene.
c. Cam Arms: Type 304 stainless steel.
d. Gaskets: Buna-N.

B. Quick Connect Couplings – Chemical Service
1. Construction
a. Type: Dual cam and groove, male end with dust cap, Type 316 stainless steel chain and lock.
b. Body: Polypropylene.
c. Cam Arms: Type 316 stainless steel.
d. Gaskets: Ethylene Propylene Dienne Thermopolymer (EDPM).
e. End Connections: Solvent socket welded.

C. Mechanical Type Wall Seals
1. Mechanical type seals shall consist of an adjustable modular bolted, EPDM sealing element as shown on the Drawings. The seals shall be Link-Seal as manufactured by GPT Enpro or equal. Associated hardware shall be 304 SS.

D. Diaphragm Seals
1. Construction
a. Type 316 stainless steel housing with diaphragm material rated for application.
b. Seals installed in air application shall be rated for continuous service up to 300°F.
2. Diaphragm seals shall be manufactured by Ashcroft or approved equal.

E. Annular Diaphragm Seals
1. Construction
a. End plates and body shall be carbon steel.
b. Shall be wafer style installation between pipe flanges.
c. Instrument connection shall be a Stainless steel NPT threaded connection with a needle valve.
d. Flexible liner shall be Buna-N.
2. Annular diaphragm seals shall be manufactured by Ashcroft or approved equal.

2.5 PAINTING

A. Coatings shall conform to Section 09921 – Protective Coatings.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect materials for defects in material and workmanship. Verify compatibility of products with pipe, fittings, valves, and appurtenances.

3.2 INSTALLATION

A. Install piping specialties in accordance with the Contract Documents and manufacturer's instructions.

B. Adjust expansion joints as required to ensure that expansion joints will be fully extended when ambient temperature is at minimum operating temperature, and fully compressed at maximum operating temperature for the system in which expansion joints are installed.

C. Adjacent piping shall be fabricated and installed level and aligned. Piping specialties shall not be used to accommodate misaligned and unlevel piping.

END OF SECTION

SECTION 15180
PARSHALL FLUME LINERS

PART 1 – GENERAL

1.1 SCOPE

A. This section includes provisions of all labor, materials and equipment to furnish and install parshall flume liners and accessories, including training and testing for a complete and operable system as shown on the drawings and specified herein.

B. The manufacturer shall provide a parshall flume liner for installation in the proposed effluent flowmeter channel.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Reference Standards:
1. ASTM D 638 – Standard Test Method for Tensile Properties of Plastics.
2. ASTM D 790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
3. ASTM D 2583 – Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples. Include the following, arranged to facilitate submittal review.
1. Scope of supply including part numbers, quantity, location, and manufacturer listed in table format.
2. Cut sheets, construction materials, dimensions, and weights.
3. Performance characteristics including flow chart.

B. The Manufacturer shall provide the following certifications:
1. Certified shop test results.
2. Installation approved certification.

D. Record Drawings: Submit record drawings under provisions of Section 01720 - Project Record Documents.

E. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Manufacturer's on-site services shall be provided via one or more qualified full-time factory employee(s), or service technician(s) with extensive experience in on-site installation and testing of equipment similar to that specified herein.

C. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

D. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

1.6 GUARANTEE

A. For a period of 12 months from substantial completion of the plant, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material or workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Crate and protect all equipment against damage during shipment. Cribbing shall be done at the factory prior to shipping. Exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

B. Store equipment off the ground in enclosed shelter. Store and maintain equipment in accordance with Manufacturer's recommendations and per provisions of the Contract.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide Parshall flume liners specifically designed for the application. Refer to the service design conditions outlined in the 2.2 Performance Requirements.

B. The flume provided must fit within the existing channel's width and length. Any modifications to the flume shall be performed in the factory and approved by the Engineer.

2.2 DESIGN REQUIREMENTS

A. Parshall flume liners shall conform to the following requirements:

Design Conditions	Units	PF-08-001
Minimum Throat Width	In	12
Minimum Flow	MGD	0.15
Average Flow	MGD	1.5
Maximum Flow	MGD	3.0
Maximum Headloss at Maximum Flow	ft	1.12

2.3 ACCEPTABLE MANUFACTURERS

A. Provide parshall flume liners of one of the following:
1. Plasti-Fab
2. Tracom
3. VPC Fiberglass
4. Warminster Fiberglass

B. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.

2.4 PARSHALL FLUME LINERS

A. Materials of Construction:
1. Fiberglass reinforced plastic:
   a. Tensile strength (ASTM D 638): 12,000 PSI.
   b. Flexural strength (ASTM D 790): 22,000 PSI.
   c. Flexural modulus (ASTM D 790): 1,000,000 PSI.
   d. Barcol hardness (ASTM D 2583): 30
   e. Gloss inside surfaces, free of irregularities.
   f. Minimum wall thickness: 3/16 inches
   g. Minimum glass by weight: 30%.
   h. Isophthalic polyester resin.
   i. Removable pultruded fiberglass bracing at top of flume with T-304 stainless steel hardware.
   j. 2 inch (minimum) top and end stiffening flanges.
   k. Molded-in stiffening ribs, maximum 12 inch center to center spacing.
   l. Anchor clips drilled for 3/4 inch, pultruded fiberglass construction.
2 Gel Coating:
   a. All surfaces shall be gel coated.
   b. Interior surfaces shall be coated white. Exterior surfaces shall be coated gray.
   c. Gel coating shall be 15 mil Isophthalic U.V. resistant.

Field cut surfaces shall be re-coated with resin obtained from the fabricator.

B. The liners shall be accurate in all dimensions and shall include, in one (1) integral piece, the approach, throat, and downstream sections. Each section shall have a floor and vertical sidewalls. The inside surfaces shall be smooth and free from irregularities. Flanges and anchors shall be provided as necessary on the outside surfaces to ensure

that the liner will be permanently anchored to the concrete. No threaded connection shall be provided in the approach section.

C. The liners shall be stiffened and braced so that the deflection caused by concrete placement shall not exceed $^{1}/_{16}$-inch ($^{1}/_{16}$") at any point. Internal braces shall be readily removable after concrete is placed without damage to the inside surfaces of the liner. All permanent reinforcing members shall be completely encased in plastic.

D. Provide an integral staff gauge in the molding of the FRP of the flume on the side opposite of the walkway such that it is visible from the walking surface. The H_a position gauge shall be graduated in foot and inch, and MGD. The H_b position gage shall be graduated in foot and inch. Provide intermediate graduations of no greater than $^{1}/_{4}$-inch ($^{1}/_{4}$") increments.

E. Provide and install two (2) 12-inch (12”) diameter FRP stilling wells with two-inch (2”) interconnection tubing between the flume and the stilling well at the measurement points.

F. Provide vertically adjustable stainless steel or FRP ultrasonic mounting brackets at each stilling well.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that equipment has no defects on the structure or surface that will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the work to the Engineer.

3.1 INSTALLATION

A. Install Parshall flume liner in accordance with the manufacturer’s written instructions in locations shown on the Drawings.

B. The liner shall be carefully leveled and rigidly braced and anchored in position before the adjacent concrete and/or grout is placed.

C. The installation of the flume shall not occur until the final effluent system has been installed and tested.

3.3 FIELD TESTING

A. All equipment will be given running tests by Contractor and Manufacturer’s Representative at the Site following installation of the equipment and controls.

B. The Contractor shall provide all necessary test equipment.

C. Contractor shall ensure there is sufficient volume to conduct test and that all downstream components are capable of receiving liquid. If there is no flow to the effluent channel upon start up, the Contractor shall provide water for

testing purposes. If downstream components are not in place, Contractor shall make provisions for recycling water and disposal.

D. Field tests shall consist of operating the equipment under normal and abnormal conditions.

E. Should the tests indicate any malfunction, Contractor shall make any necessary repairs and adjustments, and then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the Engineer, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

3.4 SERVICES BY MANUFACTURER

A. A factory trained representative of the manufacturer shall provide services for installation and supervision, start-up, test services, and operation and maintenance personnel training services.

B. Manufacturer's representative shall perform on-site services, including training of Owner's personnel, according to the following schedule, excluding travel time.

Work	Person Days	Trips
Installation assistance and inspection	0.5	1
Functional and Performance Testing	0.5	1
Pre-startup on-site training of Owner personnel	0.5	Can combine with equipment tests
Startup	0.5	Can combine with equipment tests
Post-startup on-site training of Owner personnel	0.5	Can combine with equipment tests

C. Manufacturer shall provide a written start-up report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

D. Manufacturer shall operate the system during the field test in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. The representative shall revisit the site as often as necessary until all problems are corrected and the installation is entirely satisfactory. The Manufacturer shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals, and incidentals for additional visits shall be at no additional cost to the Owner.

F. Contractor will be back charged by the client for an unsuccessful field testing demonstration. Schedule the field testing a minimum of 48 hours following a successful start-up procedure.

END OF SECTION

SECTION 15190
MECHANICAL IDENTIFICATION

PART 1 – GENERAL

1.1 SCOPE

A. The work includes providing and installing protective coating top coat color requirements, labeling requirements for process piping and valves, and identification of mechanical products installed under Division 15 and existing equipment, piping and valves to remain after construction.

1.2 REFERENCES

A. All labels and color codes shall comply with the latest requirements of the Texas Commission on Environmental Quality (TCEQ). If any discrepancy exist, the current TCEQ regulations shall control for public water and/or wastewater projects.

1.3 DESCRIPTION

A. Provide pipe identification markers or stencils as specified identifying all proposed plant piping and valves throughout the plant site. All signs shall be stated in English and shall include arrows indicating the direction of flow. Every aboveground pipe shall be coated entirely in the appropriate color.

B. All pipes shall have flow direction arrows and process labels.

C. Galvanized and stainless steel pipe shall have colored bands painted every ten feet (10’).

D. PVC Piping
   1. Non-Potable Water Pipe
      a. Schedule 80 PVC non-potable water pipe shall be manufactured gray or white pipe with painted labels and purple-colored paint or banding.
      b. Schedule 40 and DR-18 PVC non-potable water pipe shall be manufactured purple pipe.
   2. Potable Water Pipe
      a. Schedule 80 PVC potable water pipe shall be manufactured gray or white pipe with painted labels and light blue-colored paint or banding.
      b. Schedule 40 and DR-18 PVC potable water pipe shall be manufactured light blue pipe.
   3. Other PVC pipe not manufactured in the colors designated below shall be manufactured white, gray, or green and shall be wrapped entirely in the designated color.

E. If color choice is not listed below, the color shall be determined by the Engineer.

F. All proposed above ground chemical feed piping, potable and non-potable water piping, and other exposed piping subject to potential freezing shall have pipe insulation in accordance with Specification 15226 – Pipe Insulation. Insulation shall be fitted around pipe, and wrapped with the designated color tape, with UV resistant adhesive labels, manufactured by 3M every 20 feet (20') that denote the process pipe type (e.g. "Non-Potable Water") in the designated color text.

G. Metallic tracer tape labeling the pipe service and color coded to match the designation below shall be installed above all non-metallic buried piping.

1.4 SUBMITTALS

A. Shop Drawings. Submit shop drawings, product manufacturer's installation instructions, and samples as specified in Division 1, General Requirements.

B. Submit a color schedule of pipes with selection for each type to be identified and their location.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Wastewater Treatment Facility Color. All piping to follow the color schedule below:

Process Pipe	**Color**
Sludge	Brown
Natural Gas	Red
Potable Water	Light Blue
Chlorine	Yellow
Sulfur Dioxide	Lime Green with Yellow Bands
Sewage	Grey
Compressed Air	Light Green
Heated Water	Blue with 6-inch Red Bands Spaced 30 Inches Apart
Power Conduit	In Compliance with NEC
Reclaimed Water	Purple
Instrument Air	Light Green with Dark Green Bands
Liquid Alum	Yellow with Orange Bands
Alum (Solution)	Yellow with Green Bands
Ferric Chloride	Brown with Red Bands
Ferric Sulfate	Brown with Yellow Bands
Polymers	White with Green Bands
Ozone	Stainless Steel with White Bands
Raw Water	Tan
Effluent After Clarification	Dark Green

B. Plastic Nameplates. Provide laminated three-layer plastic with engraved letters on light colored contrasting background color. Nameplates shall be securely mounted with locking nylon ties through brass grommets located at each sign corner.

C. Stencil Pipe Markers. Stencil identification shall consist of one coat of black (or white if dark base) polyurethane paint applied with stencil in locations visible while standing. Letters height to be at least four inches (4"). All stencils shall be black or white, as appropriate.

PART 3 – EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces, if needed, prior to installing identification materials.

3.2 INSTALLATION

A. Identify piping, concealed or exposed, with stencil pipe markers.

B. All proposed pipes running across walkways shall be marked with black and safety yellow stripes 2" wide. Letter "Watch Step" in either black or white letters (whichever is more visible) from both directions of pipe crossing.

C. Stencil pipe identification at all overhead crossings seven feet (7') or less from the finished floor with the phrase "Caution Overhead Hazard".

D. Identify service and flow direction of pipe. Stencils shall be at above ground and readily visible at header and before entering a process basin or tank.

E. Install in clear view and align with axis of piping.

F. Location of identification shall not to exceed 40 feet on straight runs including risers and drops if adjacent label is visible. Provide additional identification adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

G. Provide stenciled identification numbers for each pump and blower which correspond to the identification numbers in the control panels.

H. Stencil each above ground valve body with its function (RAS, WAS, Air, etc.) and source (Clr1, Aer2). If valve is submerged or of insufficient size for lettering to be legible, paint stenciling on adjacent concrete or steel wall with arrow pointing towards valve to valve stem/operator. Valves near pipe stenciling stating function and source need not be labeled.

END OF SECTION

SECTION 15202
SINGLE WALL HIGH DENSITY POLYETHYLENE TANKS

PART 1 – GENERAL

1.1 SCOPE

A. This section specifies the labor and materials for furnishing and installation of single wall high density polyethylene (HDPE) storage tanks and accessories.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
1. Association of Rotational Molders (ARM)
2. American Society of Mechanical Engineers (ASME)
3. American Society of Testing Materials (ASTM)
4. American Nation Standards Institute (ANSI)
5. International Building Code (IBC)
6. National Fire Protection Association (NFPA)
7. National Sanitation Foundation (NSF)
8. Occupational Safety and Health Administration (OSHA)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01300 & 01340 – Shop Drawings, Product Data and Samples.

1. Descriptive literature and technical specifications of tank, nozzles, and accessories.
2. Dimensional drawings locating all openings, fittings, accessories, restraints, and supports.
3. Resin data sheet, gasket material data sheet.
4. Certification of chemical compatibility.
5. Bill of materials.
6. Color Chart.
7. Wall thickness calculations.
8. Calculations for tank thickness, restraint and anchorage, stamped and signed by a Professional Engineer in the state of the installation.
9. Supporting literature and details for heat trace and insulation.

B. Factory Test Reports
   1. Impact Tests.
   2. Verification of dimensions and placement of fittings and accessories.
   3. Gel test.
   4. Hydrostatic Tests/Leak Test.
   5. Wall thickness.

C. Manufacturer's Certifications
   1. Warranty Information.
   2. Certification that the tank has been installed per manufacturer's requirements.
   3. Certification from the manufacturer that the materials of construction are recommended and suitable for the service conditions specified and indicated.

D. Operations and maintenance manuals

1.5 QUALITY ASSURANCE

A. Tank manufacturers must demonstrate experience in rotationally molded tanks based on ASTM D1998 utilizing Type I and Type II resins, for at least ten (10) years, and show experience with the specified chemicals.

B. Factory Tests
   1. Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.
   2. Use Method C of ASTM D 1998 - Section11.4 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.
   3. Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 1 degree radial.
   4. Subject tanks to design operating pressure conditions, or as a minimum, completely fill the tanks with clean water. No leakage is allowed.
   5. Provide a written report on test results to Engineer prior to shipment.

1.6 WARRANTY

A. For a period of 12 months from substantial completion of the plant, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Crate and protect all equipment against damage during shipment. Exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

B. Store equipment off the ground in enclosed shelter. Store and maintain equipment in accordance with Manufacturer's recommendations and per provisions of the Contract.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide high density cross linked polyethylene tanks (HDPE) molded from Type II linear polyethylene resin. Resin shall be virgin resin containing a UV stabilizer.

B. HDPE tanks shall be installed on concrete pedestals, as specified in the plans. The Sodium Hypochlorite HDPE tanks shall be installed on top of existing concrete pedestals.

2.2 DESIGN CRITERIA

A. The tanks shall meet the following conditions listed in the table below and as shown in the contract drawings:

	Units	Design Conditions	
Tank ID No.	-	**SWT-11B-101 & SWT-11B-201**	**SWT-11A-101 & SWT-11A-201**
Chemical	-	38% Sodium Bisulfite	12.5% Sodium Hypochlorite
Location	-	Chemical Area	Chemical Area
Service Ambient Temperature	°F	14-115	14-115
Interior/Exterior	-	Interior	Interior
Specific Gravity	-	1.34	1.2
Orientation	-	Vertical	Vertical
Type	-	Single Wall Tank	Single Wall Tank
Top	-	Dome	Dome
Bottom	-	Flat	Flat
Gross Storage Volume, each	gal	205	625
Maximum Diameter	in	32	48
Maximum Sidewall	in	65	102
Vent Size/Type	-	2”/U-Vent with Insect/Animal Screens	3”/U-Vent with Insect/Animal Screens
Outlet Diameter	in	1/2	1/2
Drain Diameter	in	2	3
Overflow Diameter	in	3	3
Fill Connection Diameter	in	2	2
Insulation, Yes/No	-	Yes	Yes
Heat Tracing, Yes/No	-	Yes	No
Visual Measurement Type	-	Sight Glass or Reverse Float Level Gauge	Sight Glass or Reverse Float Level Gauge

2.3 ACCEPTABLE MANUFACTURERS

A. HDPE tanks shall be manufactured by one of the following. No others will be allowed:
1. Poly Processing
2. Assmann
3. Chem-Tainer

B. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.

2.4 TANKS

A. Tanks shall be rotationally-molded, vertical, high density cross-linked polyethylene, one-piece seamless construction, cylindrical in cross-section. Tanks shall be stress, crack and impact resistant. Tanks shall be adequately vented. The percent gel level for crosslinked tanks on the inside 0.125 in of the wall shall be a minimum of 60%.

B. Tank thickness shall meet or exceed the thickness prescribed by ASTM D 1998, and shall be designed using a hoop stress of no greater than 600 psi.

C. The bottom head shall be integrally molded with the cylindrical wall. Knuckle radius shall be a minimum of 1 inch for tank diameters less than or equal to 6 feet and a minimum of 1-1/2" for tank diameters more than 6 feet.

D. Provide tanks with lifting lugs for handling.

E. Provide pipe support brackets on side of tank, to support fill piping and overflow piping.

F. Clean tanks internally prior to shipment. Ship tanks protected to prevent damage to tanks and their protective coatings. Provide open nozzles with masonite or plywood covers.

G. Provide top of tank capable of supporting the following loads:
1. Ultrasonic Level/Differential Level Meter
Transducer
a. Type
i. Non-contact, ultrasonic level transducer.
b. Function/Performance
i. Measuring Range: Transducer range shall be suitable for the installation indicated on the Drawings, up to 50 ft. (15m).
ii. Temperature Range: –20 to 60 degrees C.
iii. Relative Humidity: Zero to 100 percent.
iv. Temperature Compensation: Transducers shall be provided with integral temperature sensors for temperature compensation at above temperature ranges.
c. Function/Performance
i. Transducers shall be potted/encapsulated in a Kynar or other chemical and corrosion-resistant housing. Where indicated on the Drawings, transducers shall be approved for installation in Class I, Division 1, Groups C and D (Zone 0) environments.
ii. The surface of transducers shall be Teflon-coated where mounted on chemical tanks and exposed to vapors in the tanks that are not compatible with the transducer material.
iii. Transducers shall be capable of being completely submerged without damage.

iv. Transducers shall be suitable for surface, pipe, or flange mounting as indicated on the Drawings or Instrumentation List. Appropriate mounting hardwired shall be provided. Flanges shall be six inch (150 mm) and resistant to attack by the medium being metered or, where required, shall be protected by corrosion- resistant coatings and facings.

d. Options/Accessories Required
   i. Transducers located in areas where freezing condensation may occur shall be provided with special heaters or other type of transducer protection designed to prevent sensor icing.
   ii. Signal cable as recommended by the manufacturer, for installation between the transducer(s) and the transmitter. Length, up to 1000 feet (300 m), shall be as required by installation indicated on the Drawings.

e. Manufacturer(s)
   i. Siemens XPS-10 or ST-H
   ii. Endress+Hauser Prosonic

2. Transmitter/Converter

a. Type
   i. Microprocessor based compatible with the transducer(s) provided.

b. Functional/Performance
   i. Resolution (including transducer): Plus or minus 0.1 percent of range or 0.08 inches (2 mm), whichever is greater.
   ii. Accuracy (including transducer): Plus or minus 0.25 percent of range or 0.24 inches (6 mm).
   iii. Range: As required by the installation indicated on the Drawings.
   iv. Temperature Range: -20 to 50 degrees C.
   v. Output: Minimum one isolated 4-20 mA output and minimum four alarm contacts (number of contacts above 4 required of each device to be determined by signals required as shown on the drawings adjustable to trip at any point in the instrument range. Output contacts shall be rated 5 A at 230 VAC.
   vi. Temperature Compensation: Compensation over the temperature range of the sensor.
   vii. Display: Digital indicator displaying level/differential level or volume in engineering units or percent as indicated on the Drawings or in the Instrumentation List.
   viii. Diagnostics: On-screen instructions and display of self-diagnostics.
   ix. Loss of Signal: Transmitter shall ignore momentary loss-of-echo signals and shall indicate loss of echo on the transmitter unit.
   x. Configuration Protection: Programmable parameters shall be protected using E2PROM. Battery backup protection is not acceptable.

c. Physical
   i. Transmitter shall be suitable for surface or pipe stand mounting.
   ii. Enclosure shall be NEMA 4X (IP65).
   iii. A/C power will be as specified in Section 13300.

d. Acessories Required
   i. Hand-held programmer where required for configuration and calibration of the instrument.

e. Manufacturer(s)
   i. Siemens Model HydroRanger 200
   ii. Endress+Hauser Prosonic

H. Existing level transmitters for the existing Sodium Bisulfite, Sodium Hypochlorite, and Alum Feed Tanks are to be relocated and reused as specified on the construction plans. Existing level elements at the existing tanks may be reutilized if compatible, with cost differential credited back to the owner. See construction plans for details on the wiring and conduits related to these items.

I. The tank shall be molded from a virgin High Density Cross-Linked Polyethylene resin, with no fillers.

J. Tank shall be fabricated of UV Inhibitor/ resistant material and suitable for indoor/outdoor installation.

K. All edges cut into the tank or provided with the tank shall be smooth edges.

L. Sodium Hypochlorite tanks shall include a medium density polyethylene oxidation system with four times the anti-oxidation properties of standard polyethylene. The oxidation system shall be bonded to the interior tank surface during the manufacturing process.

M. All fittings shall be flange style unless specifically shown otherwise. PVC self-aligning bulkhead type may only be used if approval is requested in writing and granted by the Engineer.

N. Provide tank nozzles meeting ASME B16-5, as indicated.

O. Project nozzles at least 4-inches (100 mm) from the tank surface. Nozzles shall be reinforced with gussets.

P. There shall be a single 150 lb. ANSI PVC flange and a 1/4-inch gasket attached to the inside tank wall. The flange shall be bolted to the tank from the inside with a minimum of four (4) 1/2-inch diameter all thread bolts welded to a common backing ring encapsulated in black polyethylene. The encapsulation shall be a minimum of 1/4-inch of the threads closest to the bolt head. Each bolt shall have a 1/4-inch EPDM gasket with head on the inside of the tank.

Q. All edges cut out for manway or other openings shall be trimmed to have smooth edges.

R. Vents shall be sized for the maximum anticipated fill rate and withdrawal rate and shall comply with OSHA 1910.106(F)(iii)(2)(IV)(9).

S. Tanks shall have gallon markers on exterior.

2.5 ACCESSORIES

A. All bulk chemical storage tanks shall have manways 10” diameter or greater.

B. Anchorage:
1. Adhesive anchor bolts shall be provided for tanks larger than 2,000 gallons, or if located outdoors (including if under a canopy) and subjected to wind loads. Cast-in-place j-bolts are not acceptable.
2. SST cable tie-downs shall be provided.

C. Provide flexible expansion joints for connections to ensure no stresses from the piping is transferred to the tank.

D. Tanks requiring insulation shall use be polyurethane foam with a density of 2.5 lb/ft3 with a minimum an “R” value of 6.3/in. The foam shall be applied with a nominal thickness of 2” to the external tank surfaces except the tank bottom. Upon completion of application and curing of the insulation, 2 full coverage coats of latex mastic coating shall be applied to the surface of the insulation in such manner as to seal the insulation from the outside environment.

E. Heat tracing system for sodium bisulfite tank temperature maintenance shall be a tank heating system designed to maintain a desired product temperature, not to exceed 100 degrees F. Each system shall include tank heating pads and a temperature controller. Power supply to be the only field installation required. Pads to operate on 120 VAC single phase with a maximum power density of 0.5 watts/sq.inch. Silicone type pad heaters must fully comply with Article 427-23 (b) of the National Electric Code. Temperature controller to be supplied with two electronic thermostats switching the heating system via one solid state relay. Primary thermostat to control desired product temperature and secondary thermostat to provide over temperature protection at 150 degrees F.

F. All bulk storage tanks shall be provided with a visual measurement system as indicated in the performance table in Section 2.2. All measurement systems shall be located in a location visible from fill line connection.

2.6 TANK SIGNAGE

A. National Fire Rating (NFR):
1. Provide signage for the National Fire Rating System (NFR) designation conforming to NFPA 704, for the chemicals contained in the tanks.
2. Provide two (2) signs per tank. Location to be determined in the field by the Engineer for proper visibility.
3. Signs to be vinyl, screen printed with UV resistant inks, and a minimum of 18 inches per side. No mechanical fasteners are allowed.

B. Tank Nameplate:
1. Provide a Stainless steel nameplate permanently fastened to the tank, with tank ID, chemical stored, specific gravity, gross volume of tank, date of manufacturer, tank serial no., and resin type.

C. Provide signage for identifying the chemicals contained in the tanks in accordance with DOT Chart 15.
1. Location to be determined in the field by the Engineer for proper visibility.
2. Letters to be 6-inches high, colors of letters and background to be submitted for acceptance. Signs to be vinyl and screen printed and UV resistant inks. No mechanical fasteners are allowed.

D. Provide additional, redundant signage to be mounted to exterior of chemical area for all chemicals.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the Work to Engineer.

3.2 INSTALLATION

A. Install all items as shown, specified, and as recommended by the manufacturers.

B. Request instructions from Engineer, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.

C. Present conflicts between piping systems and/or equipment and/or structures to Engineer, in writing, who will determine corrective measures to be taken.

D. Do not modify structures to facilitate installation of piping, unless specifically approved by Engineer.

E. Properly plug or cap the open ends of all piping at the end of each day's work or other stopping point throughout construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

F. Inspect all equipment prior to installation and promptly report defects which may affect the work to Engineer.

G. Do not use fittings for handling.

H. Install tanks on concrete pads as shown. Provide a ¼" thick neoprene gasket for the tank to rest on.

I. Assure there is no stress on tank nozzles.

J. After installation, clean tanks of loose debris, wash out with clean water, and dry prior to tests.

3.3 FIELD TESTING

A. Supply all pipe, hose, pumps, water, power and other equipment required to convey the test liquids and carry out the tests.

B. Clean water test:
1. All tanks shall be hydro-tested for 24 hours prior to placing into service. Apply required hydrostatic test pressure in addition to pressures imposed by filling tank with required liquid. In order to simulate these conditions, attach standpipe to top of tank, and fill tank and standpipe assembly with water. Measure height of standpipe above highest point of tank. Provide standpipe of height equal to height of tank times difference between specified gravity of required liquid and specific gravity of water, plus additional height equal to hydrostatic test pressure specified.
2. Do not test acid tanks with water; use air at pressure of 5 psig for one hour prior to test with acid.
3. No leakage is allowed.
4. Repair leaks or damage using factory-trained tradesman at no cost to the Owner.

C. Chemical Test:
1. Fill all systems with chemical, and monitor for leakage for 24 hours.
2. No leakage is allowed. Repair leaks or damage using factory-trained tradesman at no cost to the Owner.
3. Fully test all equipment, valves, etc. in operation.
4. Provide a written report on results of testing to Engineer.

3.4 MANUFACTURER SERVICES

A. A factory trained representative of the manufacturer shall provide services for installation, supervision, start-up, field testing services, and operation and maintenance personnel training services as part of the services provided for the commissioning of the chemical dosing systems. See specification 111160 – Peristaltic Pumps.

END OF SECTION

SECTION 15226
PIPE INSULATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section provides requirements for insulation of chemical feed piping, potable and non-potable water piping, and all other exposed piping subject to potential freezing. All insulation shall be wrapped and color coded in accordance with specification 15190 – Mechanical Identification.

1.2 QUALITY ASSURANCE

A. All materials used shall be new and of high grade and of properties best suited to the Work required.

B. Manufacturer's Qualifications:
   1. Equipment provided under this Section shall be a standard product in regular production by manufacturers whose products have proven reliable in similar service for at least five (5) years.
   2. Insofar as possible, all equipment of the same specific type shall be the product of one (1) manufacturer.

1.3 ACCEPTABLE MANUFACTURERS

A. Provide materials from, Schuller, CertainTeed, Owens/Corning, or approved equal.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01300.

B. Shop Drawings:
   1. Submit for review detailed drawings, data and descriptive literature on all equipment and all accessories, including:
      a. Performance characteristics.
      b. Dimensions.
      c. Materials of construction.
      d. Weight.
      e. Protective coating.
      f. Testing data (where applicable).
      g. Electrical characteristics (where applicable).
      h. Wiring diagram (where applicable).

1. 5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01720.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01600.

B. Store and protect products under provisions of Section 01600.

C. Store equipment off the ground in enclosed shelter.

1.7 GUARANTY

A. Provide guaranty under provisions of the General Conditions.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Insulation: Rigid fiberglass with factory installed vapor barrier jacket, Johns Manville "MicroLok Fiberglass Insulation," Owens/Corning SSL-II, or approved equal. Johns Manville "Thermo-12 Gold" insulation may be used without vapor barrier.

B. Premolded fittings: Proto premolded PVC one-piece insulation fittings. Insulation to be Zeston Hi-Lo Temp insert, solid filament, and chemical stable glass.

C. Jacketing: Johns Manville "Zeston 2000 Series Colored PVC" with Zeston "Perma-Weld", aluminum jacketing with moisture barrier, or approved equal. Jacketing to have splash resistance to Sodium Hypochlorite and Sodium Hydroxide. Jacketing to be overlapped 2 to 3 inches and held in place with metal bands. In metal jacketing, matching elbows, tees, and valve covers are to be used with weather resistant seals.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install insulation according to manufacturer's instructions only after all piping has been installed and tested and after any heat tracing has been installed. Terminate insulation flush against tanks and chemical handling area floors. All terminations and joints are to be neat and water proof. Valves and fittings are to insulated and sealed. All pipes are to be labeled and color coded according to schedule in Protective Coating – 09921 and Mechanical Identification 15190. Only workmen skilled in this trade are to be used.

END OF SECTION

SECTION 15249
BOLTED STEEL GROUND STORAGE TANK

PART 1 – GENERAL

1.1 SCOPE

A. The work to be performed under this specification consists of furnishing all new materials, tools, equipment, and necessary labor for the design, manufacture, delivery, erection, testing of a factory powered coated bolted steel ground storage tank, including foundation. This section specifies a tank with a center support and roof rafters.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Perform the work in conformance with the following standards:
   1. American Water Works Association
      a. AWWA D-103 Factory Coated Bolted Carbon Steel Tanks for Water Storage
      b. AWWA C652 Standard for Disinfection of Water Storage Facilities
   2. Texas Commission on Environmental Quality
      a. Title 30 Texas Administrative Code, Rules and Regulations for Public Water Systems
   3. National Sanitation Foundation International
      a. NSF International 61 Drinking Water System Components – Health Effects
   4. ASTM International
      a. ASTM A36
      b. ASTM A123
      c. ASTM A153
      d. ASTM A570

1.4 SUBMITTALS

A. Provide shop drawings and product data, including schematic piping and detailed installation instructions and drawings. Submit as specified in the section on Shop Drawings, Products Data and Samples, Division 1 – General Requirements.
   1. Submit one PDF copy of the design drawings and calculations for the bolted tank to the Engineer for design concept review and distribution. The drawings and calculations shall be sealed by a Professional Engineer experienced in the design of bolted tanks and registered in the state of Texas. The construction submittal package shall consist of the following:
      a. All major dimensions; the size of main structural members, the thickness of all plates, and miscellaneous details such as views for bolted sections as specified in the Shop Drawing section.
      b. Design calculations for the shell plate and support columns.
      c. Design calculations for the roof rafters. Rafters shall be designed in accordance with AWWA D-103. Do not use skin friction between roof and rafters to calculate lateral stability of the rafters as AWWA allows. The rafters must be laterally stable.

d. Furnish roof details indicating the bottom of roof rafters will be more than 6-inches above the top of the overflow weir box. Provide design calculations for sizing the overflow weir box.
e. Design calculations for the flush cleanouts and manways. AWWA D-103 standards must be followed.
f. Provide detail drawings for all the GST and piping connections, ladders, OSHA cage and lockable cover, safety rails, shell manway, flush cleanout with davit arm, foundation block outs, roof hatches, roof vent, guard rails with kickplates, piping hangers, riser pipe supports, oil skimmer plate hangers, overflow weir box, and any other tank accessories as specified in section on Shop Drawings, Division 1 – General Requirements.
g. The roof shall be sloped such that ponding is not possible.
h. All shop drawings and calculations shall be signed, sealed and dated by a Professional Engineer licensed in the State of Texas.
i. Provide cut sheets and calculations for the sacrificial anode cathodic protection system design and installation.

B. Material Certification
1. Submit three copies of the mill certificate for approval of steel plate and structural members before the delivery of materials to the project site.
2. Provide certificates of the reliable testing laboratory that the steel plates, structural members, and bolts and nuts meet specifications.
3. Provide proof that the certificate covers the material used in the field.

C. Project Closeout
1. With a written notice of completion of work, Contractor shall submit copies of the equipment operation and maintenance manuals; spare parts and maintenance materials; project record documents; and any applicable guarantees, warranties and bonds for work performed under this section as per the section on Shop Drawings.

1.5 QUALITY ASSURANCE

A. Qualifications and Experience
1. All tank work shall be performed by a company which specializes in the design and construction of bolted steel ground storage tanks which is capable of meeting all the requirements of these specifications. No company is considered qualified unless it has designed and built in its own name at least 30 bolted steel tanks conforming to AWWA D-100 in the last fifteen years of equal size or greater which have been in successful service for a minimum of five years in the surrounding Houston metro area.

B. Singular Responsibility
1. It is the express intent of this specification to create a singular responsibility for the design and construction of the bolted steel ground storage tank. The design and construction of all aspects of the floor, wall, support column, roof, internal piping, rafters, coating, and roof accessories must be performed by the tank contractor.

D. Provide capable and experienced personnel and suitable equipment to perform this work.

E. Provide adequate safety equipment, including welding hood and gloves. Enforce the use of hard hats by all personnel except welders, and the use of proper safety equipment by the construction crew while on the job site.

F. Splicing of the GST roof rafters or center support column **WILL NOT BE PERMITTED**. Rafters and column must be one piece and cut to length.

G. Notify the Engineer 72 hours prior to proceeding with the following work:
   1. Starting the tank padding
   2. Starting the tank floor
   3. Starting the tank shell
   4. Starting the tank roof

H. All components are to be protected from damage during shipment. No staves shall be secured against other staves for shipping purposes. Sheets shall be stacked together in such a manner that water is shed away from them and no movement between the sheets is allowed.

I. Tank components shall be placed on racks or pallets during transportation to jobsite. Once delivered to the job site, the racks or pallets shall be stored on an incline above the ground to allow water to be shed away from them and to allow free flow of air across the tank component surfaces. Placing the panels on the ground or concrete is not acceptable.

1.6 OPERATION AND MAINTENANCE DATA

A. The manuals shall be prepared specifically for this installation and shall include all required cut sheets, drawings, equipment lists, descriptions, etc. In addition to the requirements of Section 01720, the manuals shall include the following at a minimum:
   1. Complete parts list, cross-referenced to exploded view of assembly drawings
   2. Dimensional drawings for all provided components with their respective weights
   3. Final elevation of overflow weir and finished floor

1.7 PERMITS

A. Obtain any necessary building permits before commencing field operations.

PART 2 – PRODUCTS

2.1 GENERAL

A. Design Criteria
   1. One (1) 27,910-gallon (16’-1” tall, 14’-3” side water depth, and 17’-2 ¼” internal diameter) bolted steel ground storage tank.

B. Acceptable manufactures are:
   1. Superior
   2. Approved Equal

C. Wind Zone Criteria
   1. Tank shall be designed for the applicable wind zone.

2.2 MATERIALS

A. Furnish materials required for the construction of the ground storage tank in accordance with the following provisions.

1. Concrete
   a. Provide Class "C" concrete for the tank ring wall foundation with a minimum compressive strength of 4,000 pounds per square inch ("psi") after 28 days. Refer to specifications in Division 3 - Concrete.
2. Reinforcing Bar
   a. As specified in section on Concrete Reinforcement, Division 3 - Concrete.
3. Sand
   a. Sand may be concrete sand or clean bank sand free of clay lumps and other foreign material.
   b. Provide sand with a Plasticity Index not over 3.0 and not more than 10% by weight of which will pass through a No. 200 mesh sieve.
4. Salt-Free and Chloride-Free Sand
   a. Use clean bank-run sand with little or no clay, chloride content less than 100 ppm, and sulfate content less than 200 ppm.
   b. Place and compact sand inside the ring wall as shown in the drawings.
   c. Test sand for compaction before placing tank pad.
5. Steel
   a. Steel sheets shall conform to hot-rolled quality as specified in the latest edition of ASTM A570 with a designation of Grade 33 or Grade 40 steel.
   b. Sheets shall have a minimum yield strength of 33,000 psi and a 12 gauge minimum thickness.
   c. Plate steel and rolled structural shapes shall conform to the latest edition of ASTM A36.
   d. Plate steel will have a minimum yield strength of 36,000 psi.
6. Bolts and Nuts
   a. Bolts used in joints shall be a minimum 1/2 diameter with square or hexagonal shaped bolt heads and nuts unless otherwise approved by the Engineer.
   b. NSF approved encapsulated bolt heads and polycapped steel nuts shall be used for factory coated tanks unless otherwise approved by the Engineer.
7. Washers
   a. Washers are to have rubber backing and the rubber is to serve as the interface between the galvanized steel portion of the washer and the galvanized surfaces of any tank panels or components.
   b. Rubber-backed washers shall be provided and installed along with nuts and bolts anywhere on the tank where panels or components come in contact with any other galvanized steel surfaces.
   c. The washers shall be completely galvanized.
   d. Rusting of washers is not permitted.
8. Tank Padding
   a. Provide and install minimum ½-inch thick, asbestos free sheets of asphalt impregnated fiberglass tank padding in compliance with the latest edition of ASTM D1751. Provide "SEALTIGHT Fiber Expansion Joint" filler manufactured by W.R. Meadows, Inc., or an approved equal.
9. Joint Mastic
   a. Tank padding joints shall be sealed using asbestos free Gulf Seal 304 Mastic, or an approved equal.
10. Foundation Mastic
   a. Place a prime bead of "Sikaflex 1A", or an approved equal, between the edge of the bottom flange of the GST and the concrete ring wall surface. This bead is meant to seal closed the opening and should not support the tank.

11. Gaskets and Sealants
    a. Must conform to the latest edition of AWWA D103 section 4.10.

2.3 ACCESSORIES

A. Furnish the following accessories for each tank in accordance with AWWA D-103 and the TCEQ, Rules and Regulations for Public Water Systems.

1. Roof Vent
    a. Provide and install a 20-inch diameter, flanged outlet pipe pointing upward at the location shown on the contract drawings. Provide and install a mushroom roof vent assembly as described and shown on the drawings. The openings on the roof vent shall be covered with a No. 16 mesh, 316 stainless steel screen with 0.018-inch wire and 50% openings. Use thin wall, schedule 10 steel pipe for roof vent material.
    b. The vent should be sized to handle a maximum draw down rate and maximum fill rate.
2. Overflow Pipe
    a. Provide and install a 6-inch overflow pipe with an overflow weir box as shown on the drawings.
    b. The bottom of the 4-inch by 10-inch by 18-inch deep overflow weir box shall be installed flush with the flowline of the overflow pipe to allow the box to drain dry.
    c. The weir should be sized to handle the maximum fill rate with the max water rise.
3. Cleanouts and Manways
    a. Provide and install two (2) 42-inch by 46-inch rectangular, flush cleanout in the bottom tank ring in accordance with AWWA D-103 and API Standard 650.
    b. Provide a davit arm above the flush cleanout to facilitate removal of the cover plate.
    c. Provide hinges on the shell manway cover plate.
4. Roof Hatches
    a. Provide and install one (1) roof hatch with a 30-inch by 30-inch opening centered over the interior ladder and one (1) roof hatch with a 24-inch by 24-inch opening centered over the overflow weir box.
    b. Provide the hatches with a minimum curb height of 4-inches and a cover that overlaps the curb a minimum of 2-inches.
    c. Hatches must be lockable and have watertight seals as shown on the drawings.
    d. Use ¼-inch plate for hatch hinges. Do not use mortise hinges.
    e. All hardware shall be stainless steel.

5. Tank Ladders
   a. Furnish a tank ladder both inside and outside.
      i. Interior Ladder
         A) A galvanized steel ladder shall extend from the hatch to the floor.
         B) The ladder shall have a fall prevention device attached consisting of a sliding, locking mechanism and safety belt and complying with applicable OSHA standards.
         C) The ladder shall have an stainless steel safety extension capable of extending a minimum of three feet above the roof hatch.
         D) Provide two OSHA approved safety harnesses to be used with OSHA approved fall prevention device.
         E) Mount a 30-inch long tube to the end of the guard rail to store the safety rail extension.
      ii. Exterior Ladder
         A) A galvanized steel ladder shall extend from the tank roof to 1-foot above the final grade.
         B) Equip the ladder with an approved locking cage and security door as shown on the drawings.
         C) Tank ladder shall conform to OSHA requirements.
         D) The ladder shall have a fall prevention device attached consisting of a sliding, locking mechanism and safety belt and complying with applicable OSHA standards.
         E) The ladder shall have an stainless steel safety extension capable of extending a minimum of three feet above the roof hatch.
         F) Provide two OSHA approved safety harnesses to be used with OSHA approved fall protection device. Safety harness provided for the interior ladder shall be compatible with the exterior ladder
   b. Both tank ladders shall conform to the latest edition of the OSHA rules and regulations.
   c. All the GST ladders and accessories are to be constructed as detailed on the drawings.
6. Pipe Connections
   a. Provide and install pipe connections on the GST at the locations shown on the drawings.
7. Water Level Gauge
   a. As specified in the section on Division 13.
8. Sample Tap
   a. Provide and install a ¾-inch sample tap assembly as shown on the drawings.
9. Fire Department Connection
   a. Provide and install an 8-inch fire department connection assembly as shown on the drawings.
10. Drain
   a. Include a 6-inch drain pipe that shall discharge via underground pipeline to an existing on-site manhole.
11. Steel Pipe
   a. Provide steel pipe as shown on the drawings and in section 15600.
12. Fittings
   a. Provide and install fittings at the locations shown on the drawings.
13. Interior Hanger Supports
   a. Provide and install, Engineer approved, coated steel hanger supports for the overflow box attached to the GST roof and rafters.
   b. Contractor will install support hangers as needed to rigidly secure accessories inside tank to

prevent bowing or excessive movement from water turbulence during plant maintenance operations.

c. Welding hangers to roof rafters is not permitted.

14. Exterior Riser Supports
    a. Provide and install steel riser pipe supports attached to the exterior tank shell as shown on the contract drawings.
    b. One (1) pipe support is required on each riser pipe unless otherwise approved by the Engineer.
    c. Welding supports to tank shell is not permitted.
15. Guard Rails
    a. Provide 7.5-foot long sections of guard rail on each side of the exterior tank ladder.
    b. Provide two 7.5-foot long sections of guard rail centered on both sides of the overflow roof hatch.
    c. Location and orientation of the guard rails on the GST roof is shown and specified on the drawings.
    d. Railing sections shall be constructed of galvanized steel piping and rolled to the curvature of the GST shell.
    e. Securely brace railings to the GST roof and shell in compliance with the most current OSHA rules and regulations.
    f. Open ends of railings shall be closed with watertight, properly fitted steel end caps.
16. All accessories shall be hot-dipped galvanized, unless specified otherwise, prior to erection or assembly in accordance with ASTM A123 and ASTM A153. Touch-ups and repairs shall be required in areas damaged during shipping, storage, and construction at no additional cost to the Owner. See Section 3.5 – Repairs and Touch-Ups in this specification.
17. Sacrificial Anode Cathodic Protection System
    a. Provide and install eight (8) zinc alloy anode bar assemblies including floor supports, galvanized steel bolts & nuts with rubber-backed washers. Install at 0°, 90°, 180°, & 270° and locate/space each bar assembly near the perimeter and center of the tank. Submit cut sheets on anode supplier and install to provide electrical continuity with the tank walls, ceiling and floor.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect in accordance with the latest revision of AWWA D-103.

B. Dimensional tolerances per AWWA D-103 will be checked.

3.2 FOUNDATION

A. Subgrade
1. Clear the entire foundation area.
2. Refer to section on Structural Excavation and Backfill, Division 2 – Site Work for more details on excavating and backfilling of the ring wall foundation.
3. Refer to geotechnical report for more information.

B. Concrete
1. Provide Class "C" concrete for the tank ring wall foundation with a minimum compressive strength of 4,000 psi after 28 days.
2. Refer to section on Cast-in-Place Concrete, Division 3 – Concrete and the contract drawings for more details. **Do Not Use Earthen Forms**.

C. Tank Base
1. Reference to contract drawings and geotechnical report.

D. Salt-Free Sand Cushion
1. After the concrete ring wall has been placed and cured, place a sand cushion of not less than 4 -inches minimum thickness over the entire area inside of the ring wall.
2. Material used in this cushion must be salt-free and chloride-free sand suited to the purpose and obtained from an approved source.
3. Compact to not less than 95% proctor density at optimum moisture per latest edition of ASTM D-698.
4. Protect the cushion from rainfall until tank padding is in place.

E. Tank Padding
1. After the sand cushion has been shaped and compacted, place the sheets of tank padding directly on top of the tank foundation with the joints staggered on every half a sheet mark.
2. Extend the padding past the concrete ring wall with the joints fitted tightly against each other.
3. All joints shall be sealed afterwards with an approved joint mastic material to form a continuous protective layer between the tank floor and foundation.
4. After the tank floor is constructed, trim off any excess padding material flush with the outside edge of the tank floor.

3.3 WELDING

A. All welding performed on a galvanized steel tank must be approved in writing by the Engineer at least 48 hours to performing the work.

B. Perform all welding in accordance with the latest specifications of the American Welding Society.

C. Any indentation or discontinuity caused by improper welding procedures will be not be accepted.

D. All welding is to be complete before protective coatings are applied.

E. All coating touch-ups are to be done in accordance with the manufacturer's specifications in the presence of the Engineer or the FPR.

F. All steel touch-ups shall be performed with an tank manufacturer approved paint.

3.4 TESTING

A. Floor
1. When the bottom of the ground storage tank has been completely bolted and the lowest shell ring has been attached, test the tank bottom with a strong soap solution or linseed oil on each seam and apply air pressure or vacuum.

B. Shell
1. After the tank has been completely erected and painted, fill it completely with water to the maximum working level and observe all joints for leaks. If the tank leaks, the Contractor shall remediate the issue at no additional cost to the Owner. Contractor may utilize on-site non-potable water and shall coordinate its use with the Operator.

C. Upon completion and in the presence of the Engineer, test all pipelines for tightness in an acceptable manner. If water tightness test fails, Contractor to fix/repair issue, with approval by Engineer, and fill tank up at no additional cost to Owner.

D. Furnish suitable testing plugs, and caps, all necessary pipe connections, gauges, or other equipment and all labor required.

3.5 REPAIRS AND TOUCH-UPS

A. Repair any leaks.

B. Touch-Ups
1. Any damage to the factory powered coating is to be touched-up.
2. The process proposed to touch-up the damage shall be submitted to the Engineer for approval before the touch-up is performed.
3. Touch-up shall be performed in the presence of the Engineer or the FPR.

3.6 COATINGS

A. Factory power coatings shall be applied according to tank manufacturer's specific procedure and shall comply with AWWA D103.

B. Coatings shall be holiday tested, at no additional cost to Owner, prior to water tightness test. The entire tank shall be tested, including corners, in the presence of the Owner's representative. All holidays shall be fixed and retested at no additional cost to the Owner.

END OF SECTION

SECTION 15258
FIBER REINFORCED PLASTIC TANKS

PART 1 – GENERAL

1.1 SCOPE

A. This section provides for furnishing and installing all labor, equipment, materials, tools, supplies, fittings, and appurtenances required for the fabrication, support, installation, anchorage, hook-up, lining, protective coating, and testing of fiberglass-reinforced plastic tank(s), and all appurtenant work, for a complete and workable installation as specified herein, in accordance with the requirements of the Contract Documents and information in this section.

B. The fiberglass reinforced plastic tanks will be supplied as part of the alum feed system.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Comply with the current provisions of the following codes and standards:
1. ANSI/NFPA 70 National Electrical Code.
2. ANSI B16.5 Pipe flanges and flanged fittings.
3. ASTM C 581 Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures, Intended for Liquid Service.
4. ASTM C 582 Contact-Molded duct
5. ASTM D 638 Test Method for Tensile Properties of Plastics.
6. ASTM D 695 Test Method for Compressive Properties of Rigid Plastics.
7. ASTM D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
8. ASTM D 883 Definitions of Terms Relating to Plastics.
9. ASTM D 1599 Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.
10. ASTM D 2563 Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts.
11. ASTM D 2583 Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
12. ASTM D 2584 Test Method for Ignition Loss of Cured Reinforced Resins.
13. ASTM D 3299 Specification for Filament-Wound Glass Fiber Reinforced Thermoset Resin Chemical-Resistant Tanks.
14. ASTM D 4097 Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks.
15. ASME RTP-1 Reinforced Thermoset Plastic Corrosion Resistant Equipment
16. UBC Uniform Building Code, International Conference of Building Officials.
17. OSHA Occupational Safety and Health Act.

B. When two or more of the above regulations are applicable, the more stringent requirement shall be met.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples.

B. The Contractor shall furnish shop drawings of all items and accessories in accordance with the General Requirements. Shop drawings shall include detailed design calculations stamped by a registered engineer, bill of materials listing all components, resins, catalysts, promoters, ultraviolet light absorbers, agents, reinforcing materials, etc., with manufacturer's name, trade, and identification marks. The laminate sequence used for all tanks must either be attached to or included on drawings used by the fabricator's shop personnel.

C. All plastic and fiberglass items shall be manufactured of material suitable for the chemicals they serve and shall be certified for such use on the shop drawings. Tanks shall be designed by a Professional Engineer registered in State of Texas with a minimum of 5 years' experience in fiberglass construction. The designs shall be checked for all loads to be incurred during service, including, but not limited to, initial lifting and setting into place, wind, thermal stress and snow loads. These designs and calculations shall be stamped, signed and then submitted to the Engineer for approval.

D. Fiber Reinforced Plastic Tank Data:
1. Purchase order number, project number, and equipment number.
2. Name of manufacturer.
3. Bill of materials listing all components, resins, catalysts, promoters, ultraviolet light absorbers agents, reinforcing materials, etc. with manufacturers name, trade, and identification marks.
4. Dimensions including anchor bolt layouts.
5. Nozzle schedule including size, thickness or schedule, pressure rating, elevation, and orientation.
6. Details of all clips and lugs for ladders, stairs, platforms, hold down lugs, pipe brackets, and anchor bolts, used as integral parts of the tank shall be accompanied with calculations verifying stability of the tanks. Calculations showing compliance with OSHA and building code requirements shall be stamped and signed by a state of Texas registered civil or structural engineer.
7. Details of structural support members. The spacing on all tank supported pipe supports shall be a maximum 5-feet on centers.
8. Equipment capacity (gallons).
9. Maximum design specific gravity.
10. Maximum design temperature.
11. Shop testing procedures
12. Equipment weights, empty and filled with the liquid to be stored in the tank.
13. Laminate sequence of construction and all materials of construction listed.
14. A letter from the resin manufacturer that the laminate and reinforcing material used will provide chemical resistance at least equal to the published chemical resistance for the resin for the intended application.
15. Curing compounds and cure process.
16. Liquid level indicator including guard details where applicable.
17. References for filament wound and contact molded.
18. Specifications and recommended torques for all supplied bolting, gaskets, and accessory items.
19. Structural calculations for tank and anchoring system shall be reviewed and approved by a Professional Engineer registered in State of Texas.
20. Design criteria for the following physical laminate properties.
    a. Contact Molded Tanks:
        i. Tensile strength of the laminate.
        ii. Flexural strength of the laminate.

iii. Tangent Modulus of the laminate.
iv. Minimum physical properties for the tests enumerated in ASTM C582.

b. Filament Wound Tanks:
i. Tensile strength of the laminate.
ii. Flexural strength of the laminate.
iii. Tangent Modulus of the laminate.
iv. Minimum physical properties for the tests enumerated in ASTM C582.
v. Strain Modulus per ASTM C582

c. Contact Molded Appurtenances of Filament Wound Tanks:
i. As specified above for Contact Molded Tanks.

21. Identification of products to be used for coating the tanks.

E. The Manufacturer shall provide the following certifications.
1. The manufacturers of proposed electrical, mechanical, and structural systems affecting the performance of the equipment have examined the Contract Documents and agree to the performance and material specifications, warranty conditions, and other requirements set forth herein.
2. The maximum power required of any motor will not exceed the motor rating.
3. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
4. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel. (A written certification of a proper and correct installation and start-up, including all set points and calibrations, shall be provided.)
5. Owner's personnel have received sufficient training and are qualified to operate the equipment

F. Record Drawings: Submit record drawings under Submit record drawings under provisions of Section 01720 - Project Record Documents.

G. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

H. This Section does not necessarily include all required information, reports, testing, services, and certifications. The Manufacturer shall provide all information necessary to fulfill the intent of this Section and of the Contract.

1.5 QUALITY ASSURANCE

A. A single Manufacturer shall provide and warrant all herein specified equipment, components, and subcomponents. The items specified under this Section shall be furnished by manufacturers who have experience in the manufacture of similar products for a period of at least 5 years. The tank manufacturer's experience shall include at least ten (10) tanks of equal or greater size, and of generally similar construction to those specified herein. In addition, each of these 10 tanks, shall have been in service for a period of at least three (3) years. Subcomponents obtained from the OEMs during fabrication of the Manufacturer's equipment shall be considered as a product of the Manufacturer and warranted by the Manufacturer.

B. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

C. The equipment shall be designed, constructed, and installed in accordance with the Manufacturer's best practices and methods. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

D. Manufacturer and Contractor shall coordinate all dimensions to ensure adequate clearances for equipment maintenance, or removal, or replacement.

E. All welding shall be done at the Manufacturer's factory. Field welding shall not be permitted without the Engineer's express written approval.

F. The requirements of this Section shall be considered the minimum limits of acceptability.

1.6 WARRANTY

A. For a period of 12 months from substantial completion of the work, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Exposed flanges shall be covered and sealed with shrink wrap to prevent the entrance of moisture. Take proper measures to prevent rust and corrosion.

C. Accept units on site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter, where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs, or caps installed to protect equipment during shipment until the equipment is installed and permanent connections made.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide one single-walled tank for alum storage.

2.2 DESIGN REQUIREMENTS

A. Design

1. General: Fiberglass tanks shall be constructed using the filament winding or contact molded method. Tanks shall have a minimum wall thickness of 5/16-inch, access hatches and accessories where shown, and 1-1/2 inch radius sidewall knuckles. Tank sidewall thickness shall have a continuous taper not made of stepped thickness courses or shall have a uniform thickness which shall be equal to the maximum design thickness for any portion of the tank side wall. Any tank where the ratio of shell height to diameter is greater than one (1) shall be filament wound. Tanks less than 6'-0" diameter can be manufactured with either contact molded or filament wound construction. Tanks greater than 6'-0" in diameter shall be filament wound. Shallow helical winding or hoop winding without axial reinforcing glass is not allowed. Hoop wound and chop construction with no other reinforcing is not allowed. Acceptable methods of filament wound construction are as follows:
   a. Helical wound with a wind angle of 55 degrees.
   b. Helical winding with wind angle less than 55 degrees but includes chopped fiberglass roving and woven roving between wind cycles.
   c. Hoop filament winding with uni-directional glass or woven roving placed between wind cycles.
2. Flanged Nozzles: Each flanged nozzle shall have four (4) plate gussets. Conical gussets are not allowed. Gaskets shall be provided for each flange. Unless otherwise specified, all gaskets shall be full face Viton or Hypalon. All flanged nozzles shall comply with ANSI B16.5. The chemical resistant barrier shall be smooth and continuous from the inner tank wall to the flanged face of each nozzle. Nozzles shall have a six (6) inch projection as measured from the face of the flange to the outer tank wall. Shell nozzles shall be mounted radially, perpendicular to the side shell. Top and bottom nozzles shall be mounted parallel to the vertical axis of the tank with bolt holes straddling the principal axis. Nozzles shall be finished flush with the inside face of the tank.
3. Filament-wound: For filament-wound tanks the design stress shall be determined using an allowable strain value of 0.0010 in/in max. Longitudinal stress in filament-wound tanks may be resisted by hoop and chop construction, hoop and longitudinal fiber construction, a suitably low filament wrap angle, i.e. the projected angle between the longitudinal axis of the tank and the laying direction of the filament, or a combination of these methods; with the exception that for tanks with a height to diameter ratio greater than 1:1, hoop and chop construction shall not be allowed.
4. Contact Molded: For contact molded tanks, the design stress shall be 10 percent of the minimum ultimate tensile stress of the selected laminated thickness given in ASTM D4097, thereby providing a factor of safety of 10:1 against load conditions.

C. Top Head, Connections and Liquid Level Gage:

1. Top Head: Top heads shall be dished. The top head shall be designed for an external live load of 25 pounds per square foot. The top head shall also be designed to support a single concentrated load of 250 pounds on any 4-inch by 4-inch area. The outer surface of the top head shall be provided with an anti-skid surface for additional safety during maintenance operations.
2. Access ports/access hatches: There shall be a flanged access hatch installed on the top of each tank. Where locations are not indicated in the drawings, submit a proposed location for approval by the Engineer.
3. Connections: Each tank shall be furnished with pipe connections for fill, outlet, drain, vent, overflow, and other connections as specified on Tank Schedule.

D. Fiberglass Tank Schedule: The following fiberglass tanks are included in this Section.

	Units	Design Conditions
Tank ID No.	-	**SWT-11C-301**
Chemical	-	Alum
Location	-	Chemical Area
Service Ambient Temperature	°F	14-115
Interior/Exterior	-	Interior
Chemical Specific Gravity	-	1.33
Orientation	-	Vertical
Type	-	Single Wall Tank
Top	-	Dome
Gross Storage Volume, each	gal	2500
Maximum Diameter	in	84
Maximum Sidewall	in	106
Vent Size/Type	-	8”/U-Vent w/ Insect & Animal Screens
Outlet Diameter	in	1/2
Drain Diameter	in	3
Overflow Diameter	in	3
Fill Connection Diameter	in	2
Insulation, Yes/No	-	Yes
Heat Tracing, Yes/No	-	No
Visual Measurement Type	-	Sight Glass or Reverse Float Level Gauge

Notes:
1. Tanks shall be of the orientation and general dimensions shown on the drawings. Tanks of other dimensions must be submitted for approval by the Engineer and all resultant changes at no cost to the Owner.
2. Fill lines have FRP supports and enter the tanks as shown on the drawings.
3. Overflow pipes shall have FRP supports and terminate as shown on the drawings.
4. Outlets shall enter the tank at a level four inches (4") above the floor of the tank.
5. Provide gooseneck type vents with 16 mesh insect/animal screens made of suitable material. Vent supports are detailed on the construction drawings.
6. Manways shall have bolts and gaskets and shall be located as shown on the drawings.

2.3 ACCEPTABLE MANUFACTURERS

A. Provide tanks from one of the following approved manufacturers:
1. Diamond Fiberglass
2. LMF

B. Manufacturer shall hold a valid ASME RTP-1 Certificate of Authorization issued by the American Society of Mechanical Engineers (ASME). Per ASME RTP-1, 7-800 states “No Fabricator shall claim qualification to fabricate to this Standard until having satisfactorily completed and tested the demonstration vessel…” No exceptions will be allowed to permit non-certified fabricators to build to the ASME standard.

C. Listing as an approved manufacturer will not relieve the manufacturer from conforming to these specifications.

2.4 MATERIALS OF CONSTRUCTION

A. Resin: Resin to be used in fabricating the tanks shall be a vinyl-ester resin such as Derakane 411-35 as manufactured by Dow Chemical Co., Hetron 922 as manufactured by Ashland Chemicals or equal. Polyester resins are not acceptable. The minimum elongation of the resin shall be 5.5%, consistent with corrosion resistance to the tanks intended service and the maximum tank operating temperature. Fillers up to 2 percent by weight of thixotropic agent may be used for viscosity control in the paraffinated top coat on vertical surfaces, provided it will not interfere with visual inspection. To ensure that fresh resin is used, at the completion of the job, lot numbers of the resin used must be shipped with the completed tank. For NaOCl tanks, the cure compound shall be Benzoyl Peroxide catalyst with a Dimethyl Aniline accelerator (BPO/DMA) for NaOCl tanks. For NaHSO3 tanks, the cure compound shall be Methyl Ethyl Ketone Peroxide (MEKP) with 9% active oxygen. The cure process used for the resin shall be in accordance with the resin manufacturer's current recommendations. Proper curing of the resin is the fabricator's responsibility. All products fabricated in this specification shall be cured to at least 90 percent of the minimum Barcol hardness specified by the resin manufacturer. The requirement applies to both interior and exterior surfaces. A separately cured, unreinforced Gel-Coat shall not be used. No chemical-resistant surface (resins), interior or exterior, shall be acetone sensitive. Where application of polyester film to prevent air inhibition of these surfaces is impractical, a wax containing resin coating formulated according to the resin manufacturer's most recent recommendations, must be used. The minimum thickness of the polyester film shall be 4 mils. No pigment shall be used in the resins used for fabrication as this will hamper the visual inspection of the tank for air bubbles, voids, dry glass, etc. Protection against ultra-violet (U.V.) is achieved in the outer jacket or coating.

B. Chemical Resistant Barrier: The Chemical surfacing mat (veil) for the sodium hypochlorite (NaOCl) tanks shall be a Nexus (polyester) veil, minimum 20 mils thick. . The chemical surfacing mat shall be C-veil, minimum 100 mils thick. Chopped strand mat shall be Type E (electrical borosilicate) glass, 1-1/2 oz per sq ft, with silane finish and a styrene-soluble reactive binder. Continuous roving used in chopper gun for spray-up shall be Type E glass. Woven roving shall be Type E glass, nominal 24 oz/sq yd, 4 by 5 weave, with silane-type finish. Continuous roving used for filament winding shall be Type E glass with a silane type finish.

C. Coating: Gel-coat with UV inhibitor

D. Insulation: Insulation with outer jacket shall be applied to the tanks indicated in the schedule. The insulation shall be two inch (2") thick polyurethane foam board with a minimum density of 2 lb/cu ft. The insulation shall be of uniform density and thickness. The vertical sides and top of the tanks shall be insulated. External expansion joints shall be provided in the insulation covering. They shall be designed to prevent seepage from resin or an overflowing tank. Where insulation has been cut away to install nozzles and fittings, the edges of exposed insulation shall be capped. Where the outer jacket and insulation has been cut away, and the tank is exposed, the tank surface shall be treated to provide ultra-violet (U.V.) protection.

E. Outer jacket: The insulation shall be protected by a minimum 0.125-inch thick fiberglass covering (Outer Jacket) of chopped glass strand and filament winding. The resin used in the final exterior ply shall be protected against the ultra-violet (U.V.) rays of sunlight by proper pigmentation of the resin. The exterior surface shall also be protected by an exterior Gel-coat with UV inhibitor. This coating shall not be applied until after the Engineer's inspection. The color of the exterior of the tanks shall be "smokey white".

2.5 CONSTRUCTION

A. General: The tank shell will consist of an inner surface and interior layer which together constitutes the chemical resistant barrier. The primary function of the outer, exterior layer shall be to provide structural support. For all tanks, the inner surface shall be completely free from any cracks or crazing and have a smooth finish.

B. The resin rich surface shall consist of two (2) layers of C-Veil with a minimum thickness of 0.010" inches. The resin to glass (veil) ratio shall be approximately 90% resin; 10% glass. The interior layer shall consist of chopped fiberglass roving. The minimum thickness of this interior layer shall be equal to two (2) layers of 1 ½ ounce E-glass chopped fiberglass mat. In no case shall the combined thickness of the inner surface and the interior layer be less than 0.12" inches. Application of resin and/or glass roving by use of a chopper gun or spray process is allowed for this service. The glass content for the interior layer shall be 20% - 30% by weight when tested in accordance with ASTM D-3299 and D-2583. The chemical resistant barrier shall be allowed to gel and set prior to the application of the structural layer. Resin for this application shall be cured with the MEKP cure system as recommended by resin manufacturer. Heat curing of tank is only required if the Barcol hardness is not achieved from room temperature cure.

C. Prior to first cycle of structural winding being applied, a minimum of one pass of chopped fiberglass shall be applied to prevent bridging of the winding glass.

D. Contact Molded Laminates: The contact molded process includes fabrication by the hand lay-up, contact pressure molding, and spray processes or combinations thereof, according to ASTM D 4097 and ASTM C582, except as otherwise noted. In addition, inner surface and interior layer shall be constructed as specified in the preceding paragraph. The exterior layer or body of the laminate shall provide the additional strength necessary to meet the tensile and flexural requirements. Where separate layers such as mat unidirectional tape or woven roving are used, all layers shall be lapped a minimum of 1 inch (2.25 inches for woven roving). Laps shall be staggered as much as possible. If woven roving or unidirectional tape is used, a layer of chopped strand glass shall be placed as alternate layer. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections. On laminates containing woven roving, cut edges exposed to the chemical environment shall be coated with resin, surfacing mat, and C-glass or Nexus veil, and all machined flange faces shall be faced with C-glass or Nexus veil.

E. Filament-Wound Laminates: Filament Wound Fiber Glass Reinforced Polyester Chemical Resistant Tanks shall be according to ASTM D 3299, unless otherwise noted. In addition, inner surface and interior layer shall be constructed as specified above. The exterior or structural layer of filament-wound tanks may include chopped glass strand interspersed between the windings or unidirectional tape to provide additional strength, and resistance to permeation and chemical attack. Glass content of this filament wound layer shall be 50 to 80 percent by weight. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections. For tanks with a height to diameter ratio greater than 1:1, hoop and chop construction shall not be allowed.

F. Outer Surface: When air-inhibited resins are cured with an air- exposed surface, a waxcontaining resin coating, formulated according to the resin manufacturer's most recent recommendations, must be used.

G. Tank Connections: Unless otherwise specified, all connections shall be flanged. Access hatches on storage tanks and equipment shall be 24-inch ID. All flanges shall be made by hand lay-up. Flanges shall be flat and true to a tolerance of plus or minus 1/32 inches. If machining is required, the machined surface shall be faced with "C"-glass or Nexus veil. Machine facing of the back of hand lay-up flanges is not permitted. All bolt holes shall be spot faced for SAE-size washers. Flange drilling on pipe connections shall be in accordance with ANSI B-16.5 for 150 psi pressure class. Minimum flange thickness shall be based on 50 psi pressure rating. All nozzles, except access hatches, shall be reinforced with four (4) plate gussets. Bolt holes in flanged nozzles are to straddle the vertical centerline. Tolerance in bolt hole locations and in diameter of bolt circle shall be plus or minus 1/16-inch. On all flanged joints, use 1/8-inch thick full-faced elastomeric gaskets having a Return Shore A Durometer hardness of 60 plus or minus 5. The reinforcement pad of nozzle and manhole openings in the vessel walls shall consist of alternate plies of mat and woven roving with the final top layer being of mat surfacing veil.

H. Anchor: Provide anchor bolts and the anchor brackets shall be fabricated from 316 SS and filament wound into the tank shell.

I. Lifting Lugs: There shall be a minimum of three (3) 316 SS lifting brackets filament wound into the tank shell.

J. Provide and install a top mounted 316 SS cable tie down system designed for holding the tanks in place for wind loads at 100 mph.

K. Construct the tanks with an exterior Gel-Coat with UV inhibitor.

2.6 INSPECTION

A. The Engineer or the Inspector shall be permitted access to the plant area at all times during fabrication and shall be notified five (5) days minimum prior to the estimated date of tests and/or inspections.

B. The inspection of the tank shall include, but not be limited to, the following:
1. Check for compliance with drawing dimensions and adherence to construction standards.
2 An acetone wipe test to check surface cure. No surface tackiness is permitted.
3. A Barcol hardness test; at least 90 percent of manufacturer's specified hardness must be attained.
4. Examination of laminated (nozzle) cutouts.
5. A hydrotest of at least 24 hours duration to check for leaks. The hydrotest shall consist of filling to the highest point or flange face. Temporary blind flanges, plugs, or caps shall be used as necessary to seal nozzles during the hydrotest. Any tanks shipped without fittings shall be tested before and after the installation of the fittings. A second test shall be performed in the field after all piping connections are made.

2.7 SHIPPING AND HANDLING

A. Each tank and components shall be adequately protected during transportation, in storage at the jobsite, and during subsequent installation and construction activities. Damaged units will be rejected and shall be replaced with undamaged units.

2.8 BOLTS, ANCHOR BOLTS, NUTS, WASHERS, SUPPORTS, AND HOLD DOWN LUGS

A. The Contractor shall provide all bolts, anchor bolts, nuts, washers, and supports for the tanks and appurtenances specified in this Section in accordance with the requirements of the manufacturers. All bolts, nuts, anchor bolts, washers, hold down lugs, and supports shall be of Type 316 stainless steel. All flanged nozzles shall ship with a service duty-rated blind flange and EPDM gasket bolted in place.

2.9 CHEMICAL IDENTIFICATION PLACARDS

A. Each tank shall be furnished with two (2) identification placards encapsulated in the exterior gel coat. The placards shall meet current Department of Transportation (DOT) standards and shall state the chemical name and DOT number. In addition, each tank shall have a plate with the manufacturers name, capacity in gallons, design maximum temperature, design pressure, chemical service, specific gravity, design wall thickness, minimum wall thickness, vessel resin name, percent composition and manufacture date.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the Work to Engineer.

3.2 INSTALLATION

A. Install all items as shown, specified, and as recommended by the manufacturers.

B. Request instructions from Engineer, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.

C. Present conflicts between piping systems and/or equipment and/or structures to Engineer, in writing, who will determine corrective measures to be taken.

D. Do not modify structures to facilitate installation of piping, unless specifically approved by Engineer.

E. Properly plug or cap the open ends of all piping at the end of each day's work or other stopping point throughout construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

F. Inspect all equipment prior to installation and promptly report defects which may affect the work to Engineer.

G. Do not use fittings for handling.

H. Install tanks on concrete pads as shown. Provide a ¼" thick neoprene gasket for the tank to rest on.

I. Assure there is no stress on tank nozzles.

J. After installation, clean tanks of loose debris, wash out with clean water, and dry prior to tests.

3.3 FIELD TESTING

A. Supply all pipe, hose, pumps, water, power and other equipment required to convey the test liquids and carry out the tests.

B. Clean water test:
1. All tanks shall be hydro-tested for 24 hours prior to placing into service. Apply required hydrostatic test pressure in addition to pressures imposed by filling tank with required liquid. In order to simulate these conditions, attach standpipe to top of tank, and fill tank and standpipe assembly with water. Measure height of standpipe above highest point of tank. Provide standpipe of height equal to height of tank times difference between specified gravity of required liquid and specific gravity of water, plus additional height equal to hydrostatic test pressure specified.
2. Do not test acid tanks with water; use air at pressure of 5 psig for one hour prior to test with acid.
3. No leakage is allowed.
4. Repair leaks or damage using factory-trained tradesman at no cost to the Owner.

C. Chemical Test:
1. Fill all systems with chemical, and monitor for leakage for 24 hours.
2. No leakage is allowed. Repair leaks or damage using factory-trained tradesman at no cost to the Owner.
3. Fully test all equipment, valves, etc. in operation.
4. Provide a written report on results of testing to Engineer.

3.4 MANUFACTURER SERVICES

A. A factory trained representative of the manufacturer shall provide services for installation, supervision, start-up, field testing services, and operation and maintenance personnel training services as part of the services provided for the commissioning of the chemical dosing systems. See specification 111160 – Peristaltic Pumps.

B. Manufacturer's Representative shall perform on-site services, including training of Owner's personnel, according to the following schedule, excluding travel time.

Work	Person Days	Trips
Manufacturer's inspection and certification of installation	1	1
Pre-demonstration functional and performance testing	1	1
Pre-demonstration onsite training of owner personnel	0.5	Can be combined w/ pre-demonstration start up
Pre-demonstration start up	0.5	1
Demonstration remedial inspection, field testing, and training	As Required	As Required by Engineer

C. Manufacturer's Representative shall provide a written start-up report certifying that the installation has been checked, is adequate for the intended purpose, and that the equipment is ready to be placed into service.

D. Manufacturer's Representative shall operate the system during the field test in the presence of the Engineer and verify that the equipment meets or exceeds the specified requirements. The representative shall revisit the site as often as necessary until all problems are corrected and the installation is entirely satisfactory. The Manufacturer's Representative shall provide a written report documenting the results of the field testing.

E. All costs, including travel, lodging, meals, and incidentals for additional visits shall be at no additional cost to the Owner

END OF SECTION

SECTION 15413
EMERGENCY SHOWER AND EYEWASH EQUIPMENT

PART1 – GENERAL

1.1 SCOPE

A. This section specifies the furnishing and installation of emergency shower and eyewash equipment that, when the eyes or body of any person may be exposed to injurious corrosive materials, this station will provide quick drenching or flushing of the eyes and body.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. American National Standards Institute (ANSI) Z358.1
   2. Occupational Safety and Health Administration (OSHA)
   3. American Water Works Association (AWWA) C510-97
   3. Other applicable Codes and Standards as referenced in other Master Specifications.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data and Samples.

B. Record Drawings: Submit record drawings under provisions of Section 01720 - Project Record Documents.

C. Eyewash and Shower Data
   1. Bill of materials
   2. Signage stating compliance with ANSI Z358.1 and OSHA regulations
   3. Heat tracing equipment, materials, and wiring diagram
   4. Dimensional drawings
   5. Minimum and maximum water flows of shower and eyewash
   6. Operation and Maintenance Manual

D. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

E. Maintenance data for inclusion in Operating and Maintenance Manual.

1.5 QUALITY ASSURANCE

A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.

B. The Drawings show an indication of the arrangement of equipment, ducts, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. Piping, equipment, ducts, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions, without additional cost to the Owner.

C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each case, adequately provide for expansion and perfect circulation and minimize the amount of space required for the same.

D. Assemble and test equipment at factory prior to shipment.

E. The Drawings do not show all offsets, fittings, accessories, and details, which may be required. Contractor shall carefully examine all of the General Construction, Electrical, Mechanical, Structural, and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

F. Units shall be 100% assembled, pressure tested, crated, and tested to meet or exceed ANSI Z358.1.

1.6 OPERATION AND MAINTENANCE

A. Submit operation and maintenance data under provisions of Section 01300 - Submittals. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Emergency shower and eye/face wash stations shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer's designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

D. Deliver emergency shower and eye/face wash station units as factory-assembled units to the extent allowable by shipping limitations, with protective crating and covering.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide corrosion-resistant combination shower and eyewash units in the sodium hypochlorite and sodium bisulfite rooms that comply with the most current OSHA rules and regulations.

B. The safety stations shall be located as shown on the construction drawings. Assemble the safety stations according to the manufacturer's specifications and secure to the mounting surface using suitable stainless-steel hardware. All pipe joints shall be sealed according to manufacturer recommendations.

2.2 DESIGN

A. General Requirements:

Description	Units	EWS-14B-001
Location	N/A	Dewatering Building
Mount	N/A	Floor Mount
Number Required	N/A	1
Shower Flow (Min.)	gpm	20
Eyewash Flow (Min.)	gpm	4
Operating Range	psi	30-90
Water Type	N/A	Potable
Equipment Type	N/A	Primary
Freeze Protection Valve	N/A	Yes
Heat Trace Cable Voltage	VAC	120

2.3 ACCEPTABLE MANUFACTURERS

A. Provide combination emergency shower and eyewash stations of one of the following:
1. Guardian Equipment
2. Haws
3. Speakman

B. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.

2.4 MATERIALS AND/OR EQUIPMENT

A. Combination Shower and Eyewash Unit
1. Shower Valve
   a. Provide a 1" chrome-plated brass stay-open ball valve. Including stainless steel actuating arm and pull rod.
2. Eyewash Valve
   a. Provide a ½" chrome-plated brass three-way self-draining stay open, full blow ball valve including ½" port to drain water from spray heads after use.
3. Pipe and Fittings
   a. Provide Schedule 40 galvanized steel pipe and fittings unless otherwise stated in the drawings.
   b. Provide stainless steel pull rod and handle.
   c. Provide a powder-coated cast stainless steel floor flange.

4. Supply
   a. Provide a 1-inch (1") water supply line with a minimum pressure of 30 psi, unless the manufacturer requires a larger diameter line.
5. Sign
   a. Provide an ANSI and OSHA-compliant identification sign.
6. Eye/Face Wash Head
   a. Provide a stainless steel head that is capable of providing specified flow control.
7. Flow Switch
   a. Provide a single pole, double throw flow switch for remote sensing capability.
   b. Furnished by the manufacturer to ensure compatibility and proper sensing of flows from shower, eyewash, or combination of the two flows.
   c. Flow switch shall be Haws model SP154DPDT or approved equal.
8. Operation
   a. The shower will be activated by pulling down on a stainless steel triangular pull handle and will stay on until the handle is manually pushed back up.
   b. The eye/face wash will be activated by pushing back on a paddle handle and will stay on until the handle is manually pulled back.
   c. All units will be capable of discharging a minimum of 15 minutes of flushing fluid and activate within one second or less.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install all items as shown, specified, and as recommended by the manufacturers. Units shall be straight, plumb, and true to line to ensure proper connection to the water supply line.

B. Request instructions from Engineer, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.

C. Present conflicts between piping systems and/or equipment and/or structures to Engineer, in writing, who will determine corrective measures to be taken.

D. Do not modify structures to facilitate installation of piping, unless specifically approved by Engineer.

E. Properly plug or cap the open ends of all piping at the end of each day's work or other stopping point throughout construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

F. Inspect all equipment prior to installation and promptly report defects which may affect the work to Engineer.

G. Locate the eye/face unit as dictated by the manufacturer.

H. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

3.2 FIELD TESTING

A. Fill all systems and fully test all equipment, valves, etc. in operation, in presence of FPR.

B. Installed systems and components will not be released to Owner, unless all systems have been tested and approved by the Engineer.

3.3 INSPECTION

A. Examine areas to receive piping, valves, and accessories for any defects that adversely affect execution and quality of the work, deviations beyond allowable tolerances, and start the work only when conditions are satisfactory.

B. The Engineer reserves the right to reject or authorize replacement of piping and accessories found to be defective.

3.4 ADJUSTING

A. Adjust all controls for proper settings. While system is operable balance all equipment, valves, etc. to achieve design conditions.

3.5 CLEANING

A. Thoroughly clean and disinfect all piping, fittings, valves, and accessories prior to installation.

B. Cap all pipes to protect against entrance of foreign matter.

C. Remove all dirt, rust, dust, etc. from piping in preparation for painting.

D. Remove and dispose of all rubbish, debris, and excess materials from the site resulting from installation.

END OF SECTION

SECTION 15550
GATE BASIC REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE

A. This work includes furnishing all labor, equipment, and materials and performing of all operations required for proper fabrication and installation of gates, supports, and appurtenances required to complete the work as shown on the Drawings and as specified herein.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
   1. American National Standards Institute (ANSI)
   2. American Society for Testing and Materials (ASTM)
   3. American Water Works Association (AWWA)
   4. National Electrical Manufacturers Association (NEMA)
   5. American Society of Mechanical Engineers (ASME)

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01300 – Submittals and Section 01340 – Shop Drawings, Product Data and Samples. Submit for review, detailed drawings, data, and descriptive literature on all equipment and accessories including the following, arranged to facilitate submittal review:
   1. Gates:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer’s information, specifications, dimensional drawings, materials of construction and weight of all major equipment.
      c. Installation diagrams and requirements, including anchors and anchor bolt location.
      d. A complete bill of materials including generic model numbers.
      e. Certification of all shop test and leak test results.
      f. Certification that all components were designed based on the maximum seating and unseating conditions specified. Design calculations shall be approved by a licensed engineer (PE) in the state of Texas and shall be available upon request.
      g. Provide the quantity, size, and location of all anchorage openings and provide the minimum required load capacity of the anchors for verification of anchorage design as included in the contract documents.
      h. Manufacturer’s equipment warranty.
   2. Operators:
      a. Complete data sheets and Manufacturer's installation instructions.
      b. Refer to Section 15560 – Actuators for electric, pneumatic, and electraulic actuator submittal requirements.

B. Provide the following Certifications:

1. The Manufacturer has examined the Contract Documents and agrees to the performance and material specifications, warranty conditions, and other requirements of the Contract.
2. The final installation is as specified herein, as intended by the Manufacturer, and suitable for continued operation by Owner's personnel.
3. Field test results are satisfactory and match the intent of this specification, as well as the expectations of the Owner, Engineer, and Manufacturer.
4. The Manufacturer can provide a complete stock of spare parts within 48 hours of request.

C. Operation and Maintenance Data: Submit operating and maintenance data under provisions of Section 01720 - Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include all cut sheets, drawings, equipment lists, maintenance schedules, descriptions, etc. that are required to instruct operation and maintenance personnel.

D. Record Drawings: Submit record drawings under provisions of Section 01720 - Project Record Documents.

1.5 QUALITY ASSURANCE

A. All equipment specified shall be furnished by a single manufacturer who is experienced, reputable, and qualified in the manufacturing of the proposed equipment.

B. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

C. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

D. Coordinate all dimensions to ensure adequate clearances for maintenance, removal, or replacement.

1.6 WARRANTY

A. For a period of twelve months from Substantial Completion, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment, or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Take proper measures to prevent rust and corrosion.

C. Accept units on-site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs or caps installed to protect the equipment during shipment until the equipment is installed and permanent connections are made.

F. Contractor shall maintain log of rotation or other equipment exercise and corrosion prevention activities recommended by the Manufacturer for extended storage (longer than 30 calendar days) prior to installation. Contractor shall furnish these logs upon request by the Engineer.

PART 2 – PRODUCTS

2.1 GENERAL

A. Identification and Signage:
1. Provide each gate with Manufacturer's name and rated pressure cast in raised letters on valve body.
2. Provide gates with 316 stainless-steel nameplates attached to the gate with 316 stainless-steel hardware. Nameplates shall have engraved letters displaying the following information:
   a. Gate P&ID tag.
   b. Gate size.
   c. Manufacturer and date of manufacture.

B. Materials:
1. Gate materials shall be suitable for the associated gate's application, as specified. Refer to individual gate specification sections.
2. Coatings and materials shall protect gates from galvanic corrosion caused by contact of different fluids or adjacent metals.
3. Clean and descale fabricated stainless-steel items in accordance with ASTM A380 and A967. Any imperfections or abrasions occurring onsite or during the delivery process shall be remedied via Section 05501 – Miscellaneous Metals or via remedy required by gate manufacturer, and the process shall be approved by the gate manufacturer.

2.2 OPERATORS

A. General
1. Provide operator of the type listed in the respective Performance Requirements tables for each gate.
2. All operators, whether manual or motorized, shall be equipped with a polycarbonate stem cover with a closed top and ventilation hole. The cover shall bear graduation in inches to indicate the position of the gate. Additional markings may be required for specific gates and stem covers. See Performance Requirements in Section 15551 – Fabricated Gates for additional details.

B. Manual Operators
1. The gate shall be able to be operated with no more than 40 lbs of effort when the gate is in the closed position and under maximum operating head condition.
2. The thrust bearing assembly or the gearbox shall be mounted on the yoke of the gate for all gates specified as self-contained or on a pedestal for gates specified as non-self-contained.
3. Pedestal height shall be such that the handwheel or input shaft of the gearbox is located approximately 40 inches above the grating or walkway.
4. Where shown on the drawings or when specified, a wall bracket shall be supplied to support the pedestal. The pedestal wall bracket shall be designed and supplied by the gate manufacturer to ensure that it can resist to all operating efforts of the gate based on the same design calculation criteria used for the yoke.
5. The design and detail of the brackets and floor stand shall be provided by the manufacturer. The manufacturer shall supply all brackets, anchor bolts, and accessories as part of the gate assembly.
6. An arrow with the word "OPEN" shall be casted onto the operator to indicate the direction or rotation to open the gate.
7. The handwheel shall be removable and shall have a minimum diameter of 15 inches.

C. Motorized Operators

1. Motorized operators shall consist of an electric actuator and include electric motor, reduction gearing, stem nut, pedestal, torque and limit switches, enclosure strip heaters, reversing magnetic starter, pushbutton control, indicator lights, shop wiring, gear case, and handwheel for operation in case of power failure. Refer to Specification Section 15560 – Actuators.
2. Unit shall be complete in an enclosure rated for area classification (NEMA 4X minimum) requiring only the field connection of 3 PH, 460 V electric power.
3. The actuator shall be provided to the gate manufacturer for integration and packaging. Gate and actuator shall be provided as a single package.
4. Electric actuators that are supplied to retrofit existing gates shall be provided with supports, fasteners, and all ancillary items necessary to attach actuator to existing gate. Supports and fasteners shall be of the same material as the existing gate.
5. All electric actuators shall be provided by the same Manufacturer.
6. Gate operation speed: 12 inches per minute.

2.3 HARDWARE

A. All supports shall be hot dip galvanized unless specified otherwise. All support hardware shall be stainless steel.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the Work to Engineer.

3.2 INSTALLATION

A. Install all items to be embedded in concrete by template when structure is poured. Oil and grease moving parts. Install all gates and accessories in accordance with manufacturer's printed instructions, in such manner as to ensure a watertight fit, complete and ready for operation.

3.3 MANUFACTURER SERVICES

A. Furnish the services of a manufacturer’s technical representative, who has complete knowledge of proper installation, startup, and operation of the gates, and to inspect the final installation and supervise a test of the equipment. If there are difficulties in operation of the equipment due to the manufacturer’s fabrication or Contractor’s installation, additional services shall be provided at no additional cost to the Owner.

B. Train Owner’s personnel in the proper operation and maintenance of all gates.

3.4 FIELD TESTING

A. Following the completion of each gate installation, the gates shall be operated through one (1) cycle, i.e., "open, close, open" or "close, open, close" to assure they have been properly lubricated and adjusted. Installation checks shall be performed by factory trained field service technician.

B. All gates shall be field tested at maximum differential head to ensure that all items of equipment are in compliance with this Section, including the leakage requirements.

C. In the event that any unit fails to meet the above requirements, the necessary changes shall be made, and the unit retested. If the unit remains unable to meet the test requirements to the satisfaction of the Owner's Representative, it shall be removed and replaced with a satisfactory unit at no additional cost to the Owner.

END OF SECTION

SECTION 15551
FABRICATED METAL GATES

PART 1 – GENERAL

1.1 SCOPE

A. This work includes furnishing all labor, equipment, and materials and performing of all operations required for proper fabrication and installation of fabricated metal gates, supports, and appurtenances required to complete the work as shown on the Drawings and as specified herein.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
   1. American National Standards Institute (ANSI)
   2. American Society for Testing and Materials (ASTM)
   3. American Water Works Association (AWWA)
   4. National Electrical Manufacturers Association (NEMA)
   5. American Society of Mechanical Engineers (ASME)

1.4 SUBMITTALS

A. Reference Specification Section 15550 – Gate Basic Requirements for submittal requirements.

1.5 WARRANTY

A. Reference Specification Section 15550 – Gate Basic Requirements for warranty requirements.

1.6 QUALITY ASSURANCE

A. Reference Specification Section 15550 – Gate Basic Requirements for quality assurance requirements.

1.7 DELIVERY, STORAGE AND HANDLING

A. Reference Specification Section 15550 – Gate Basic Requirements for delivery, storage, and handling requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. Items in Specification Section 15550 – Gate Basic Requirements apply.

B. Stainless steel and aluminum fabricated gates shall be manufactured in accordance with the latest revisions of AWWA C561 and AWWA C562,respectively.

C. Weir gates shall be downward opening with sealing on three (3) sides, designed for wastewater applications. They shall have level control capability by allowing flow only over the top of the gate slide. The weir gate location, size, frame type, mounting type, and operator type shall be as specified in the Performance Requirements.

D. Slide gates shall be upward opening with sealing on four (4) sides, designed for submergence in wastewater applications. They shall have flow control capability by allowing only flow through the open area in partial opening situations. The slide gate location, size, frame type, mounting type, and operator type shall be as specified in the Performance Requirements.

E. Gate leakage shall not exceed 0.1 gpm per foot of wetted seal perimeter in seating and unseating head conditions.

2.2 MATERIALS OF CONSTRUCTION

Gate Component	Stainless Steel Gates	Aluminum Gates
Slide	316 SS	6061 T-6 Aluminum
Frame and Yoke	316 S.S.	6061 T-6 Aluminum
Side Seals/Guides	UHMWPE	UHMWPE
Top Seal	UHMWPE	UHMWPE
Bottom Seal	UHMWPE	UHMWPE
Flush Bottom Seal	EPDM or Neoprene	EPDM or Neoprene
Stem	316 SS	316 SS
Stem Guides	316 SS	316 SS
Lift Nut	Bronze	Bronze
Pedestal	316 SS	304 SS
Wall Brackets	316 SS	316 SS
Anchor Bolts and Hardware	316 SS	316 SS

2.3 PERFORMANCE REQUIREMENTS

A. Fabricated Gate Table Abbreviations
   1. Frame Type
      a. SC: Self-contained
      b. NSC: Non-self contained with pedestal
   2. Mounting Type
      a. W: Wall-mounted
      b. FS: Flange-mounted, square
      c. FR: Flange-mounted, round
      d. CNE: Channel-mounted, non-embedded
      e. CE: Channel-mounted, embedded
   3. Operator Type
      a. HW: Handwheel
      b. HC: Handcrank
      c. EA: Electric Actuator
   4. Stem Configuration
      a. RS: Rising stem
      b. NRS: Non-rising stem
   5. Material
      a. SS: Stainless steel
      b. AL: Aluminum
   6. Classified Area
      a. C1D1: Class I, Division I
      b. C1D2: Class I, Division II
      c. U: Unclassified

B. Fabricated Metal Gate Table

Gate No.	P&ID	Area	Clear Opening (in)		Pressure Rating (ft-in)		Frame Type	Mounting Type	Operator Type	Geared Operator (Y/N)	Stem Config.	Material	Classified Area
			Width	Height	Seating	Unseating							
SG-05-301	5-I-1	Rapid Mix Basin No. 2	2’-0”	2’-0”	11’-3”	11’-4”	NSC	W	HW	N	RS	SS	N/A
WG-06-301	5-I-1	Clarifier No. 3	4’-0”	4’-0”	6’-0”	6’-0”	SC	W	HW	N	RS	SS	N/A

2.4 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers:
   1. Provide stainless steel or aluminum fabricated gates of one of the following:
      a. Fontaine
      b. Hydro-Gate
      c. Waterman
   2. Listing as an acceptable manufacturer will not relieve the Manufacturer from conforming to these specifications.
   3. If multiple units are required per fabricated gate, all units shall be a common manufacturer.

2.5 FRAME

A. The gate frame shall be made of formed plates or structural members creating the clear opening of the specified dimensions in a rigid one-piece unit.

B. The gate frame shall be designed to allow for embedded mounting, mounting directly to a wall with stainless steel anchors and grout, or mounting to a wall thimble with stainless steel studs. Mounting style shall be as specified in the Gate Schedule.

C. Gussets shall be provided as necessary to support the guide members in an unseating head condition.

D. The frame shall extend to accommodate the entire height of the slide when the slide is in the fully opened position.

E. Yoke deflection shall not exceed 1/360 of the gate width or a maximum of 1/4" whichever is less. The yoke shall be designed to allow removal of the slide. The yoke shall be sized to withstand normal operating loads as well as the maximum hoist output. On self-contained gates, a yoke shall be provided across the top of the frame.

F. A rigid invert member shall be provided across the bottom opening. The invert member shall be flush bottom on upward opening gates.

G. A rigid top seal member shall be provided across the top of the opening on gates designed to cover submerged openings.

H. Minimum material thickness of all members of the frame shall be ¼ in.

2.6 SLIDE

A. Gate slide shall consist of a flat plate with welded reinforcing ribs. Reinforcing stiffeners shall be welded to the slide and mounted horizontally. Vertical stiffeners shall be welded on the outside of the horizontal stiffeners for additional reinforcement if necessary.

B. Gate slide shall be designed to withstand the design head specified in the gate schedule with a maximum deflection of 1/360 of the gate opening width or 1/16 in., whichever is less.

C. Minimum material thickness of all members of the slide shall be ¼ in.

2.7 SEALS

A. All gates shall be provided with a self-adjusting UHMW-PE seal system to restrict leakage in accordance with the requirements listed in this specification. Gates that utilize rubber "J" seals or "P" seals are not acceptable.

B. All seals must be bolted or otherwise mechanically fastened to the frame or slide.

C. Seals shall be replaceable without removing the frame from the wall.

D. Side Seals: The guides combined with the elastomeric cord shall provide sealing on both sides of the opening. Side seals shall be securely fastened to the frame with stainless steel retainers.

E. Bottom Seal: For downward-opening gates, sealing at the bottom section of the gate shall be achieved with a seat maintained in contact by an elastomeric cord.

F. Flush Bottom Seals: All upward-opening gates shall incorporate a flush-bottom seal that is mechanically fastened to the bottom frame invert member. Seals attached to the slide are not acceptable.

G. Top Seal: For upward-opening gates, top member shall be sufficiently flexible to self-adjust, using a mechanically fastened compression cord, accounting for deflection in the slide plate under unseating loads. For gate widths 24" and greater, top wedges may be used to ensure engagement of the top seal and prevent overclosure of the slide.

2.8 STEM AND STEM GUIDE

A. Provide a threaded stem to connect the operating mechanism to the slide. On rising stem gates, the threaded portion shall engage the operating nut in the operator. On non-rising stem gates, the threaded portion shall engage the nut on the slide.

B. The stem shall be threaded to allow full travel of the slide unless the travel distance is otherwise stated or shown.

C. Stems with more than one section shall be joined by stainless steel couplings. The coupling shall be threaded and bolted to the stem. Stem extension pipe will not be allowed.

D. The threaded potion of the stem shall have machine rolled threads of the full acme type with 16 microinch finish or better. Stub threads will not be allowed.

E. Stems with manual operators shall be provided with adjustable stop collars to prevent over-closing of the slide.

F. Provide stem guide when necessary to ensure the maximum L/R ratio is less than 200. The maximum L/R ratio for the unsupported part of the stem shall not exceed 200.

G. In compression, the stem shall be designed for a critical buckling load caused by a 40 lb effort on the crank or handwheel with a safety factor of 2, using the Euler column formula.

H. The stem shall be designed to withstand the tension load caused by the application of a 40 lb effort on the crank or handwheel without exceeding 1/5 of the ultimate tensile strength of the stem material.

I. Stem guides shall be outfitted with UHMWPE bushings.

J. Stem guides shall be adjustable in two directions.

K. When the gate width is greater than twice the height and over 48” wide a tandem stem arrangement shall be used.

2.9 ANCHOR BOLTS

A. Provide the quantity, size, and location of all anchorage openings and provide the minimum required load capacity of the anchors for verification of anchorage design as included in the contract documents.

PART 3 – EXECUTION

A. Reference Specification Section 15550 – Gate Basic Requirements.

END OF SECTION

SECTION 15560
ACTUATORS

PART 1 – GENERAL

1.1 SCOPE

A. This work includes furnishing all labor, equipment, and materials and performing of all operations required for proper completion, installation and fabrication of all actuators required to complete the work as shown on drawings and specified herein.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 STANDARD MANUFACTURED PRODUCTS

A. Details and specifications, for which standard manufactured products are available, are representative guides for requirements of these items. Standard manufactured products conforming to these general requirements will be acceptable if details of construction and installation are approved by Engineer.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340 – Shop Drawings, Product Data, and Samples.

B. Actuator Data
1. Certified shop and installation drawings showing details of construction, weight, and dimensions.
2. Manufacturer's specification
3. Descriptive literature, bulletins and/or catalogs of the equipment
4. Catalog data sheets for major components, i.e. drive, motor, etc
5. Complete bill of materials for all equipment with materials of construction
6. Descriptive literature on surface preparation and shop coating
7. Factory performance test results and certifications
8. Control system information including electrical schematic and interconnection wiring diagrams.
9. L-10 bearing life calculations
10. Spare parts list
11. Submit start-up and manufacturer field services schedule

C. Motor Data
1. Horsepower
2. Electrical characteristics
3. Bearing life ratings
4. Insulation ratings
5. Weight
6. Thrust Bearing
7. Wiring Diagram
9. Dimensions

10. Nameplate data

D. Instruction Books
1. Service and maintenance manual
2. Service parts list
3. Outline drawing

E. Manufacturer's Certifications
1. Submit manufacturer's certification that Contract Documents have been examined by the manufacturer for proposed electrical, mechanical, and structural systems affecting performance of the equipment.
2. Submit manufacturer's certification that the maximum power requirement, if used, shall not exceed the motor rating under operating conditions.
3. Submit seal manufacturer's certification that the seal is designed for service and application specified and is installed and aligned properly.

F. Record Drawings
1. Submit record drawings under provisions of Section 01720 – Project Record Documents.

G. Operation and Maintenance Instructions
1. Submit operation and maintenance data under provisions of Section 01720 – Project Record Documents. Operation and maintenance manuals shall be prepared specifically for this installation and shall include, cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance manuals.

1.5 WARRANTY

A. For a period of 12 months from project substantial completion, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.6 QUALITY ASSURANCE

A. Equipment and enclosures shall be designed and rated for their intended service environments and area classifications.

B. Use only new, high-grade materials with properties best suited to the herein specified performance requirements and installation environment.

C. Coordinate all dimensions to ensure adequate clearances for maintenance, removal, or replacement.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver and store equipment as per Manufacturer's recommendations at a minimum.

B. Crate and protect all equipment against damage during shipment. Take proper measures to prevent rust and corrosion.

C. Accept units on-site. Inspect for damage upon delivery.

D. Store equipment off the ground in a secure, enclosed shelter where it is protected from the public. Store and maintain equipment in accordance with Manufacturer's recommendations. Protect all exposed surfaces.

E. Do not remove shipping blocks, plugs or caps installed to protect the equipment during shipment until the equipment is installed and permanent connections are made.

PART 2 – PRODUCTS

2.1 GENERAL

A. Actuators provided for weir gates shall be modulating, and actuators provided for slide gates shall be open-close.

B. Actuators provided for valves shall either be open-close or modulating as noted in the respective valve tables.

2.2 ELECTRIC ACTUATORS

A. General
   1. Furnish electric actuator consisting of:
      a. Motor
      b. Gearing
      c. Handwheel for manual override
      d. Limit and torque switches
      e. Lubricants
      f. Heating elements
      g. Wiring
      h. Terminals for motor power and controls
      i. Drive nut
   2. Provide space heating elements sized to prevent condensation in both motor and geared limit switch compartment(s).

B. Acceptable Manufacturers
   1. Provide the electric actuators from one of the following approved manufacturers:
      a. Bettis
         i. Quarter-Turn: M2CP Series
         ii. Multi-Turn: XTE3000 Series
      b. Limitorque
         i. Quarter-Turn: QX Series
         ii. Multi-Turn: MX Series
      c. Rotork
         i. Quarter-Turn: IQT Series
         ii. Multi-Turn: IQ Series
   2. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.
   3. All electric actuators shall be provided by the same Manufacturer.

C. Housing/Enclosure
1. Provide cast-iron gear housing and cast-iron load bearing enclosure.
2. Non load bearing enclosure and housing: aluminum or cast iron.
3. Rated for area classifications shown on Drawings.
4. Provide O-ring seals for covers and entries.
5. Terminal and limit switch compartment covers shall be fastened to gear housing by stainless steel fasteners with capture device to prevent loss.

D. Motor
1. Provide motors that are totally enclosed, high torque design made expressly for valve or gate actuator service and capable of operating the valve or gate under full differential pressure for complete open-close and reverse cycle of travel at least twice in immediate succession without overheating.
2. Design motors in accordance with NEMA MG 1 standards, with Class B insulation, and to operate successfully at any voltage within 10 percent above or below rated voltage.
3. Provide positive method to ensure motor bearings are permanently lubricated.
4. Provide three (3) thermal switches imbedded in windings:
   a. 120 degrees apart.
   b. Provide motor shutdown at high temperature.
5. Motor housing:
   a. Aluminum or cast iron.
   b. Totally enclosed nonventilated with cooling fins.
6. Provide motor capable of operating in any position.
7. Provide motor sealed from gearcase to allow any mounting position.
8. Provide motors suitable for 480 V, 3 phase, 60 Hz.

E. Gearing
1. Provide power gearing consisting of heat treated steel helical gears, carburized and hardened alloy steel worm, and alloy bronze worm gear, all grease or oil bath lubricated, designed for 100 percent overload, and effectively sealed against entrance of foreign matter.
2. Provide gearing mechanism constructed to permit field changes of reduction gear ratio.
3. Design actuators so that motor comes up to speed before stem load is encountered in either opening or closing operation.
4. Limit switch gearings and feedback device reduction gearing:
   a. Steel or bronze.
5. Support rotating shafts with anti-friction bearings.
6. Provide separate drive nut/thrust bearing assembly:
   a. Mounted to base of actuator.
   b. High tensile bronze.
   c. Quarter turn actuator: Provide 90 degree mounting intervals.
   d. Provide grease fitting on drive assembly.

F. Handwheel
1. Permanently attached for manual operation.
2. Positive declutch mechanism to engage and disengage handwheel.
3. Handwheel shall not rotate during motor operation.
4. Inoperable motor shall not prevent manual operation.
5. For multi-turn actuators the handwheel shall have a minimum diameter of 12 inches.

G. Torque Limit Switches
1. Limit torque and thrust loads in both closing and opening directions by torque limit switches.
   a. Provide torque switches with micrometer adjustment and reference setting indicator. Assure adjustment variation of approximately 40 percent in torque setting.
   b. Provide switches having rating of not less than 6 A at 120 Vac and 2.2 A at 115 Vdc.
   c. Torque limit switches shall have totally sealed contacts.

H. Position Limit Switches
1. Furnish electric actuator with two (2) geared position limit switch assemblies with each switch assembly having four (4) separate position limit switches:
   a. Each limit switch assembly shall be geared to driving mechanism and be independently adjustable to trip at any point at and between the fully open and fully closed valve position.
   b. Provide minimum of two (2) normally open contacts and two (2) normally closed contacts at each end of travel.
   c. Provide switches with inductive contact rating of not less than 6 A at 120 Vac, 3 A at 240 Vac, 1.5 A at 480 Vac, 2.2 A at 115 Vdc and 1.1 A at 230 Vdc.
   d. Limit switches shall be fully adjustable when power is applied to actuator.

I. Controls
1. General
   a. Provide integral control assembly with necessary holding relays, reversing starter, control transformers of sufficient capacity to provide control power, space heating element power and gate/valve position transmitter.
   b. Control assembly enclosure shall be rated for the defined area classification. Actuators shall be rated to NEMA 4/4X minimum, or the same as the gate/valve area classification, whichever is more stringent.
   c. Provide valve failure position as required per control diagrams.
2. Open-Close Actuators
   a. Provide prewired NEMA 4 stainless steel remote pushbutton station enclosure with:
      i. Open / Stop / Close / Auto Selector Switch.
      ii. Close pushbutton.
      iii. Full open light.
      iv. Full close light.
      v. Open and close relays as required.
   b. Provide control enclosure to accept:
      i. Remote open/close switches.
   c. Provide contacts in control enclosure:
      i. Remote/local contact.
      ii. Full open contact.
      iii. Full close contact.
   d. Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.
3. Modulating Actuators
   a. Provide all controls specified for Open-Close Actuators.
   b. Provide proportional position servo-amplifier mounted integral with the actuator control compartment.
   c. Positioning of gate/valve shall be proportional to a 4-20 mA signal input to the position servo-amplifier when remote control has been selected.
   d. Servo-amplifier adjustments shall include zero, span, gain, and dead-band.
   e. Provide 4-20 mA signal position control as shown on the drawings that interfaces with the position control/position feedback instrumentation wiring to and from PLC.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation.

C. Promptly report defects which may affect the Work to Engineer.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's written instructions.

B. Provide sufficient clearances for proper operation.

3.3 MANUFACTURER SERVICES

A. Furnish the services of a manufacturer's technical representative, who has complete knowledge of proper installation, startup, and operation of the actuators, and to inspect the final installation and supervise a test of the equipment. If there are difficulties in operation of the equipment due to the manufacturer's fabrication or Contractor's installation, additional services shall be provided at no additional cost to the Owner.

B. Train Owner's personnel in the proper operation and maintenance of all actuators.

END OF SECTION

SECTION 15600
PLANT PIPING

1.0 GENERAL

1.1 SCOPE

A. This section provides for plant piping at the wastewater treatment plant. The work includes furnishing all labor, equipment and materials and performing all operations required for proper fabrication and installation of all pipe, fittings and accessories required to complete the work as shown on the drawings and specified herein. The drawings show flange and push-on joint systems.

1.2 RELATED WORK

A. Division 2 – Excavation, Trenching and Backfilling for Utilities

B. Division 9 – Finishes

C. Division 15 – Gate and Valves

1.3 REFERENCE STANDARD

A. Except as otherwise specified or shown, the workmanship, methods of installation, construction procedures and materials furnished will be in strict accordance with the following publications of the Department of Public Works, City of Houston, Texas. Use the latest edition and any applicable amendments.
   1. Specifications for Water Main Construction and Materials.
   2. Specifications for Water Meters and Service Connections.

B. In using reference standards, wherever terms "City of Manor" and "Director of Public Works" are used, substitute "the Owner" and "the Engineer" respectively.

1.4 MISCELLANEOUS ITEMS

A. Include all supplementary parts necessary to complete each item even though such work may not be definitely shown or specified.

1.5 STANDARD MANUFACTURED PRODUCTS

A. Details and specifications, for which standard manufactured products are available, are representative guides for requirements of these items. Standard manufactured products conforming to these general requirements will be acceptable if details of construction and installation are approved by Engineer.

1.6 MEASUREMENTS

A. Make measurements of previously installed construction before fabrication of connecting work, so that all work will fit properly.

1.7 PROJECT RECORD DOCUMENTS

A. Upon completion of all work, furnish prints and tracings showing location and principal details and modifications of piping systems “as-built.”

1.8 SHOP DRAWINGS

A. Submit shop drawings, product data, and samples as specified in Division 1, General Requirements. The shop drawings shall include detailed dimensional drawings of piping, elevations and equipment layouts.

2.0 PRODUCTS

2.1 DUCTILE IRON PIPE

A. Provide ductile iron pipe thickness Class 52 manufactured in accordance with the latest revisions of ANSI A21.51, A21.15, A21.50/AWWA C-151, AWWA C-115. Both pipe and joints shall be rated for a working pressure of 150 psi plus a surge pressure of 100 psi. Flanged pipe shall be thickness class 53.

B. Joints.

1. All above ground piping shall have flanged joints with stainless steel bolts. In addition, the first underground fitting shall have flanged, restrained push-on, or restrained mechanical joints with stainless steel bolts and isolation kits (flanged joints) as manufactured by National Gasket or approved equal. All vertical underground fittings shall have flanged joints. All flanged joints shall conform to ANSI A-21.15/AWWA C-115.
2. All below ground piping underneath structures shall have restrained push-on joints such as Field Lok and TR Flex by U.S. Pipe; Flex-Ring or Lok-Ring by American Pipe; Super-Lock by Clow, or mechanical joints if approved by the Engineer on a case by case basis. Mechanical joints and restrained push-on joints shall conform to ANSI A-21.11/AWWA C-111. Underground mechanical joints shall have stainless steel bolts.
3. All other below ground piping shall have push-on joints unless otherwise specified. Push-on joints shall conform to ANSI A-21.11/AWWA C-111.

C. Interior Lining. The interior of all ductile iron pipe shall be cleaned to a SSPC-SP6 commercial blast and lined with any of the following:

1. Ceramic Epoxy: Protecto-401 or Ceramapure PL 90 by Induron Protective Coatings.
   The liner thickness for the pipe barrel shall be 35-40 mils, and 6-10 mils for the gasket groove, outer spigot for a distance of six-inches (6") from the end.

Test lining in accordance with ASTM G62, Method B for voids and holidays. Holiday testing shall be performed in the field prior to installation. Contractor shall supply equipment, materials, and labor to perform, in the presence of the Engineer or the Engineer's Representative, holiday testing of a minimum of 20 percent (20%) of the piping and fittings (1 out of every 5 pipe joints, pipe fittings, etc.) as selected by the Engineer or the Engineer's Representative. Additionally, any pipe showing visible coating defects or damage (including edges) shall be holiday tested in the presence of the Engineer or Engineer's Representative. For each single pipe joint or fitting that fails the holiday test, two additional pipe joints or fittings shall be holiday tested.

Piping and fittings that fail the holiday test shall be repaired by the piping and fitting supplier in the supplier's shop and will be retested in the field, in the presence of the Engineer or Engineer's Representative, prior to installation.

Alternatively, field holiday testing requirements may be waived by the Engineer if high voltage holiday testing at 2,500 volts and thickness readings are conducted for every piece of pipe or fitting upon initial application of the coating, are documented, and those records provided to the Engineer prior to installation of the pipe. Upon visual inspection of the coating onsite by the Engineer or Engineer's Representative, repairs may be required to any visual defects or damages detected at delivery.

All DIP air piping shall have no interior lining and the DIP piping dedicated for air line use shall be marked at the factory with a colored stripe or similar method to differentiate from wastewater pipe.

C. Exterior Coating.

1. All ductile iron pipe below ground shall be coated with an asphaltic base bituminous material in accordance with ANSI A21.10, A21.15, or A21.51.
2. All ductile iron pipe above ground shall be coated in accordance with Section 09920 or 09921 of these specifications.
3. All below ground ductile iron pipe shall be encased in two complete wraps of 8-mil virgin polyethylene film in accordance with ANSI A-21.5/AWWA C-105.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

A. Provide PVC pipe as manufactured by Certainteed, Johns-Manville, Clow, Gifford-Hill, Robintech, or approved equal. The pipe material shall conform to ASTM D-1784 and National Sanitation Foundation Standard No. 14 for a design stress of 2,000 psi. The pipe must also conform to quality control tests as described in ASTM 1599, ASTM 1598, ASTM 2152 and ASTM 2241.

1. For two-inch (2") and smaller, provide Schedule 80 PVC with solvent welded joints or pipe conforming to ASTM D-2241, SDR 21, Class 200 for a working pressure up to 200 psi.
2. For three-inch (3"), use Schedule 40 PVC with solvent welded joints.
3. For four-inch (4") through 24-inch (24"), provide DR-18, Class 235 PVC pipe fittings and joints with Rieber Joints as manufactured by JM Eagle or approved equal. The joints shall conform to ASTM D-3139. The pipe material shall conform to ASTM D-1784 and National Sanitation Foundation Standard No. 14 for a design stress of 2,000 psi. The gasket material shall conform to ASTM F-477.
4. PVC restraints, supplied as shown on the drawings and in addition to the Rieber Joints, shall be either internal or external.

2.3 STEEL PIPE

A. Provide all steel pipe, sizes six-inches (6") through 24-inches (24"), conforming with ASTM specifications and the latest revision of AWWA C-200. Provide four-inch (4") and smaller pipe in accordance with this specification.

B. Minimum wall thickness for carrier pipe must meet the following criteria:

Nominal Pipe Size (Inches)	Outside Diameter (Inches)	Minimum Wall Thickness (Inches)	Pounds per Linear Foot (Uncoated)
4	4.500	0.237	10.79
6	6.625	0.280	18.97
8	8.625	0.322	28.55
12	12.750	0.375	49.56
16	16.000	0.375	62.58
20	20.000	0.375	78.60
24	24.000	0.375	94.62

C. Furnish either flanged joint pipe or welded joint pipe as shown on the plans. Welded joint pipe shall have beveled ends for field butt welding.

D. Protective Coatings

1. For buried pipe, the exterior surfaces of the pipe with coal tar epoxy in accordance with AWWA C-210. Wrap the exterior with an asbestos felt wrap. Finish with a final wrap of kraft paper conforming with AWWA C-203, Section 4.3. Coat the exterior with one (1) coat of heavy-bodied, cold-applied, coal tar prior to installation. Field welds or disturbed areas shall be touch-up coated with cold-applied tape in accordance with AWWA C-209.
2. For above ground pipe, coat the interior surface with coal tar epoxy and coat the exterior in accordance with Section 09920 or 09921 unless otherwise specified on the plans.

E. Furnish new and unused pipe manufactured in compliance with Underwriters' Laboratories, Inc. (UL), Specifications, “Steel Pipelines for Underground Water Service.” Potable water piping must be acceptable, without penalty, to the Texas Fire Insurance Commission (TFIC) for use in potable water supply systems.

2.4 STAINLESS STEEL

A. Tube - Stainless steel tube 3" and larger shall conform to the requirements of ASTM A-778- 80 and shall be of the grade and wall thickness specified in table below. Tubing less than 3" shall conform to ASTM A-269 specification.

For service pressures to 150 psi with operating temperatures to 200 ºF the following wall thickness shall be specified as a minimum:

Tube O.D.	Wall Thickness
11/2" thru 10"	16 Ga.
12"	14 Ga.
14"	12 Ga.
16"	11 Ga.
18" & 20"	10 Ga.
24"	8 Ga.

For low-pressure air service (0-25 psig) the following wall thicknesses shall be specified as a minimum:

Diameter	Wall Thickness
10" O.D. & Less	16 Ga.
12" O.D.	14 Ga.
14" O.D.	12 Ga.
16" O. D.	12 Ga.
18" O.D.	12 Ga.
20" O.D.	11 Ga.
24" O.D.	10 Ga.

Note: These wall thicknesses are equal to or greater than are required for 150 psi service by a margin of safety of 4 to 1 as applied to theoretical bursting pressures to which has also been applied a weld joint efficiency of 70%. The total safety factor is approximately 5 to 1 considering worst-case wall thickness variation of 12 ½ % below nominal gauge or schedule thickness.

Wall thicknesses for pipe over 24" diameter are to be calculated using a factor of safety of 5 to 1 applied to Barlow's formula:

$$t \text{ (wall thickness)} = PD/2S$$

B. Fittings - Stainless steel tube size fittings 3" and larger shall conform to the requirements of ASTM A-774-80 and shall be of the grade and schedule (wall thickness) specified in table above. Elbows shall be die-formed, long (1½ x d.) radius through 18" size. Five-segment mitered elbows may be supplied above 18".

C. Joints - Stainless steel tube fabricated into spool pieces shall have shop welded circumferential butt weld joints, or Van Stone joints using angle face rings with backing flanges drilled to ANSI B16.1 Class 125 standards. Backing flange thicknesses to be ½" for 3" thru 8" diameter lines, 5/8" for 10" through 18" diameter lines, ¾" for 20" diameter lines, 1" for 24" thru 30" lines and 1 ¼" for 36" diameter lines. Backing flanges to be prime painted steel plate flanges except in the case of submerged joints in which case they are to be stainless steel plate flanges. (Galvanized back-up flanges are to be furnished where deemed necessary by the engineer.)

D. Gaskets - Flanged joints in air lines shall be provided with rubber or neoprene gaskets suitable for use at temperatures to 250º F.

E. Hangers and Supports – Hanger and support components in contact with tube or pipe lines shall be of stainless steel or fiberglass materials. See tables below for spacing.

Distance Between Supports or
Hangers for Air Line Service (Empty)

Tube Size	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24" Up
"D"	12.7	14.8	18.3	21.2	23.8	26.1	28.2	30.2	32.0	33.8	37

"D" = Max. distance between supports in feet.

Distance Between Supports or
Hangers for Lines Full of Water

Tube Size	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24" Up
"D"	9.8	10.3	11.0	11.3	11.6	12.8	15.0	16.1	17.0	17.2	19.0

F. General - Materials used in tube and fitting manufacture shall conform to ASTM A-240 furnished in the cold rolled sheet finish through ¼" thicknesses and in the #1 plate finish over ¼" thickness. Chemical and physical material certificates to be available upon request. All tubular products to be immersion pickled subsequent to manufacturing and fabrication operations and prior to shipping to point of installation. Only extra low carbon (ELC) materials with .03% max. carbon shall be used for pipe and fitting manufacture.

G. Tolerances - Diameter tolerances and wall thickness tolerances of tubular products are to conform to ASTM A-530.

H. Workmanship on spool fabrication shall be of the highest quality and appearance. Fabricators shall have had a minimum of five years experience supplying stainless steel fabrication.

1. Only weld procedures that have been qualified under ASME Section IX and only welders who have successfully completed performance qualification tests per ASME Section IX on is these qualified procedures shall be utilized in pipe spool fabrication.
2. Only inert gas shielded welding processes, namely, GTAW (TIG), GMAW (MIG), PAW (plasma arc welding) shall be used in spool fabrication.
3. Inert gas shielding shall be utilized on the back as well as the torch side of a weld joint to prevent atmospheric contamination of the molten and adjacent metal.
4. Filler metal shall be added to all welds to provide a cross section of weld metal equal to or greater than parent metal.

5. Butt welds shall have 100% penetration to the interior or back side of the weld joint.
6. Weld joints shall be accurately fitted and cleaned of all foreign material prior to welding.
7. Weld reinforcement on both sides of the weld shall be smooth, uniform and no more than 1/16" in height.
8. Weld concavity and undercut shall not be acceptable on either side of the weld.
9. Only extra low carbon (ELC) filler metals shall be used.
10. Each spool piece shall be marked with identification relatable to the spool drawing and or system line to facilitate job site assembly.
11. Spools shall be fabricated to the "Pipe Fabrication Institute" fabricating tolerances ES-3 (1981).
12. All spool pieces shall be immersion pickled after fabrication and prior to shipping in a pickling solution of 6-10% nitric acid and 3-4% hydrofluoric acid. Temperature and exact concentrations to be such that only a modest etch is produced but that all oxidation and ferrous contamination is removed from the metal surface. All residues of the pickling solution are to be neutralized after pickling.
13. Backing flanges shall be secured to pipe ends for shipping protection and pipes pools shall be loaded and blocked and lagged as necessary to ensure protection from damage during shipping.

2.5 STAINLESS STEEL DUCT

A. Manufacturer - Stainless steel duct shall be manufactured by Viron Internation Corporation.

B. Wall thickness

Nominal Pipe Size (Inches)	Duct Thickness (Gage)
4	22
6	22
8	22
10	20
12	20
14	20
16	20

C. Material - Stainless steel duct shall be constructed of 316L stainless steel.

D. Corrosion Resistance - All ducting shall be corrosion resistant and coated with VI-LAR brand ECTFE to a thickness of 12MILS.

E. Jointing:
1. Flanged Joints – Flanged connections shall utilize Van Stone Flanged ends.

D. Fittings – Fittings shall be manufactured by Viron International Corporation and shall coated with Vi-LAR brand ECTFE to a thickness of 12MILS.

E. Gaskets - Flanged joints in air lines shall be provided with rubber or neoprene gaskets suitable for use at temperatures to 250º F.

F. Hangers and Supports – Hanger and support components in contact with tube or pipe lines shall be of stainless steel or fiberglass materials.

2.6 CONCRETE PIPE

Provide reinforced concrete pipe conforming to ASTM C-76, Class III.

2.7 COPPER TUBING

Unless otherwise specified, all pressure sensing lines, ½-inch (½") diameter and smaller, shall be Type K soft annealed copper tubing installed underground and Type L rigid copper tubing installed above ground conforming to ASTM B-88.

2.8 HIGH DENSITY POLYETHYLENE TUBING

Unless directed otherwise by the Engineer, provide and install high density polyethylene tubing as indicated on the construction drawings. Tubing diameter indicated on the construction drawings, represents tubing interior diameter (I.D.). All tubing shall be, as much as possible, continuous without couplings from the source of pressure to the control device. Fittings to be HDPE or polypropylene sleeved compression fittings. Provide Schedule 40 PVC carrier conduits as shown on the construction drawings.

2.9 HIGH DENSITY POLYETHYLENE PIPE

A. Provide products manufactured by ADS, or approved equal.

B. Furnish dual wall gravity storm sewer with bell and spigot watertight joints conforming to ASTM D3212.

C. Pipe material shall be high density, high molecular weight polyethylene HDPE virgin compound material meeting requirements of cell class outlined in ASTM D 3350. Manufacturing shall meet requirements of ASTM F 2306.

D. All testing and material requirements shall be in accordance with ASTM F2306.

E. Do not store pipe uncovered in direct sunlight. Allow pipe temperature to approach ground temperature before each individual pipe section is terminally connected.

F. Joints: Join sections of HDPE pipe using bell and spigot joints in accordance with manufacturer's recommendations. The joint shall be watertight in according to the requirements of ASTM D3212. Testing shall be in accordance with manufacturer's recommendations.

G. Installation shall be in accordance with manufacturer's recommendation and ASTM D 2774. HDPE pipe is not approved in applications requiring augering of pipe.

H. Comply with manufacturer's recommendations for cutting pipe.

2.10 FITTINGS

Use fittings of same size as pipe they serve. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Reduction in piping size will be made by reducing fittings. Use galvanized fittings for galvanized pipe. Dissimilar metals shall require isolation kits on all bolts.

A. Ductile Iron Pipe.

1. Flanged Fittings. Provide flanged fittings of high quality ductile iron castings accurately machined and finished. Dimensions must conform to ANSI A21.10, AB16.1/AWWA C-110/AWWA C-115. Flanges shall be Class 125, pressure rated at 250 psig, and conforming to ANSI B16.1.
2. Mechanical Joint Fittings. Provide ductile iron fittings conforming to ANSI A-21.10/AWWA C-110/C-111. Compact DIP joints shall conform to the latest edition of AWWA C-153 and shall be rated for 350 psi. Install in accordance with the manufacturer's recommendations, ASTM C-443 and the latest revision of AWWA C-600. Use only with pipe and fittings designed for compression gaskets. Provide thrust blocking.
3. Push-on Fittings. Provide ductile iron fittings conforming to ANSI A-21.10/AWWA C-110 and ductile iron compact fittings conforming to ANSI A-21.53/AWWA C-153. All fittings shall be rated at 250 psig.

B. PVC Pipe. Provide fittings with a wall thickness equal to or greater than the wall thickness of the pipe to which the fitting is to be attached to.

1. For two-inch (2") and smaller, provide Schedule 80 PVC solvent weld fittings and couplings conforming to ASTM D-2467.
2. For three-inch (3"), provide Schedule 40 PVC solvent weld fittings and couplings conforming to ASTM D-2466.
3. For four-inch (4") and larger, provide DR-18, Class 150 DIP push-on gasketed fittings and couplings conforming to AWWA C900 & C905. All buried DIP fittings shall be lined, coated, and wrapped as described in this specification.

C. Steel Pipe.

1. Welded. Provide welded fittings conforming to physical and chemical requirements of ASTM specifications and dimensional standards of AWWA C-207/C-208. Provide standard weight, forged steel, long radius pattern, butt welding type fittings with full thickness of metal sustained at all points. Use welding tees when pipes are of same size. Use weld-o-lets to tee a smaller pipe into a larger.
2. Threaded. Provide 150 pound screwed fittings with American Standard taper pipe threads. For compressed air service use 300 pound fittings.
3. Flanged. Provide Class B flanges.

D. Copper Tubing. Use solder-type, wrought copper fittings meeting the same requirements as pipe material. Furnish high melting point solder of tin and lead, containing not less than 85 percent (85%) tin.

2.11 GASKETS

All gaskets on flanged piping shall be full-faced. Air piping gaskets (flanged or push-on piping) shall be rated for temperatures of 250 degrees Fahrenheit.

3.0 EXECUTION

3.1 EXCAVATION, TRENCHING, AND BACKFILLING

Conform to applicable provisions of the section on excavation, trenching and backfilling for utilities in Division 2, Site Work.

3.2 CONCRETE

Provide concrete in accordance with applicable provisions of sections in Division 3, Concrete.

3.3 JOINTING

A. Flanged Joints. When bolting, take care to ensure that there is no restraint on the opposite end of the pipe or the fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. Leave one (1) flange free to move in any direction while flange bolts are being tightened. Tighten bolts gradually and at a uniform rate, in such manner that gasket compression is uniform over the entire area of gasket.

1. Take special care when attaching suction and discharge piping flanges to pumping equipment. Ensure that no stresses are transmitted to or imposed on the pump suction and discharge flanges by connected piping. Install and permanently support piping to provide accurate matching of bolt holes and uniform contact over the entire flange. In addition, leave pump connection piping free to move parallel to its longitudinal center line while the bolts in pump connection flanges are tightened.

2. Provide maximum flexibility and ease of alignment correction by taking advantage of the slack between the flange bolts and bolt holes for slight angular rotation of connecting flanges. Assemble pump connecting piping with gaskets in place, with only a portion of the flange bolts (no fewer than four (4) per joint) installed. After final alignment and before final bolting, test pump connections for applied piping stresses by loosening flange bolts which, if piping is properly installed, should result in no movement of piping relative to the pump, or opening of the pump connection joints.

B. Mechanical Joints. Carefully assemble mechanical joints in accordance with the manufacturer's recommendations. If seal is defective, disassemble the joint, thoroughly clean it, and reassemble the joint. Do not over tighten bolts to compensate for poor installation practice.

C. Push-On Joints. Remove lumps, blisters, and excess coating from the exterior spigot and interior bell surfaces. Wire brush such surfaces and wipe them clean and dry (free from oil and grease) before placing the gasket and spigot in the bell. Keep joint contact surfaces clean until jointing is completed. Take every precaution to prevent foreign material from entering the pipe during installation. Do not place debris, tools, clothing, or other materials in the pipe. Observe and follow instructions of the manufacturer, relative to gasket installation and other jointing operations. Lubricate joint surfaces with heavy vegetable soap solution immediately before joint is completed. Suitably level each spigot end to facilitate assembly.

D. Restrained Push-on Joints. Follow the same instructions as for push-on joints.

E. Threaded Joints. Make threaded joints using suitable joint compound applied to male threads only. Thoroughly ream field cuts. Make connections carefully so that thread engagement will be secured. Machine cut threads to American National taper pipe thread sizes. After installation of galvanized piping, all exposed threads shall be wire brushed, degreased to remove cutting oil, and coated with a cold galvanizing compound.

F. Welded Joints. Make welded joints as recommended by standards of the American Welding Society. Insure

complete penetration of deposited metal with base metal. The filler metal must be suitable for use with the base metal. The inside of fittings must be free from globules of weld metal which would restrict the flow or become loose. Do not use mitered joints. Do not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld.

G. Soldered Joints. Prior to making solder joints, cut the pipe square and ream the pipe to full diameter. Thoroughly clean the exterior of the pipe and the socket of the fitting. Polish to bright metal, free from oxidized metal. Apply a thin coat of suitable fluxing compound to both pipe and socket. Fit the parts together immediately. Heat the assembled joint only as required to cause solder to flow. Run joint full with a slight bead on the outside. Wipe to remove excess solder.

H. Solvent Welded Joints. All PVC solvent welded joints are to be solvent welded using Type 80 P solvent cement and primer as manufactured by Celanese Corporation, or approved equal. Other coupling or jointing systems will be noted on plans.

1. When pipe is cut make sure all cuts are perpendicular to the centerline of the pipe. Remove all burrs, chips, and fillings.

2. Make sure pipe surface is clean and dry prior to priming.

3. Do not make solvent welds when the ambient air temperature is less than 40°F or greater than 90°F or when the relative humidity is such as to cause a condition of misting or raining.

3.4 HANDLING

Handle pipe, fittings, and accessories to insure their installation in a sound, undamaged condition. Use equipment, tools and methods to prevent damage in unloading, reloading, hauling, and laying pipe and fittings. When using hooks in pipe ends, be sure that the contact surfaces are broad and well padded.

3.5 CUTTING

Cut pipe in a neat manner, without damage to the pipe. Make cuts smooth, straight, and at right angles to the pipe axis. Use mechanical pipe cutters of an approved type, except in locations where the use of mechanical cutters would be difficult or impracticable. In such locations, cut the pipe with diamond point chisels, saws, or other tools which will cut pipe without damaging impact or shock. Field cut push-on joint pipe shall have the cut end beveled to a 30° angle before joining. Remove any burrs from beveling prior to joining.

3.6 CLEANING

Thoroughly clean the interior of the pipe and fittings of foreign matter before installation. Keep the interior clean until the work has been accepted.

3.7 INSPECTION

During installation, while the pipe is suspended and hanging free, inspect each pipe and fitting for defects. Tap the pipe with a light hammer to detect cracks. Reject defective, damaged, or unsound pipe and fittings and remove them from the site.

3.8 LAYING PIPE

A. Protect the pipe from lateral displacement by means of pipe embedment material installed as specified in Division 2, Site Work, and as shown.

B. Under no circumstances should pipe be laid in water. Do not lay pipe under unsuitable weather or trench conditions.

C. Lay pipe with bell ends facing in the direction of the laying except when making closures.

D. The Contractor is responsible for staking the plant piping, valves, and fittings unless directed otherwise by the Engineer.

E. Place pipe so that the full length of each section rests solidly upon the pipe bed, with recesses excavated to accommodate bells and joints. Take up and relay pipe when the grade or joint is disturbed after laying.

3.9 PIPE BEDDING AND BACKFILL

A. Regardless of the type of pipe being laid, provide six-inches (6") of sand bedding in the bottom of the trench, the trench having previously been cut six-inches (6") below grade. Provide sand bedding prior to laying the pipe and making up the joints. After making up and inspecting joints, place sand backfill around the pipe, extending the full width of the trench and to a minimum compacted depth of twelve-inches (12") over the top of the pipe to provide a compacted encasement surrounding the pipe. Take care that no dirt, clods or trench sides are allowed to fall on or to rest against the pipe prior to completion of the sand encasement.

B. Backfill remainder of the trench as described under Excavation, Trenching, and Backfilling for Utilities, except under pavement sections. Under existing or proposed paving sections, backfill trench in accordance with the geotechnical report.

C. Placing and Laying.

1. Bury lines 12-inches and smaller and leads to a minimum depth of four-feet (4'). Bury lines 16 inches and larger to a minimum depth of five-feet (5').

2. Do not exceed pipe manufacturer's recommendations for deflections from straight line or grade as required by vertical curves, horizontal curves, or offsets. If alignment requires deflections in excess of these limitations, furnish special bends or sufficient number of shorter lengths of pipe to provide angular deflections within the limits set or approved.

3. After a length of pipe is placed in the trench, hold packing material for the joint around the bottom of the spigot so that packing will enter the bell as the pipe is pushed into position, or a rubber gasket may be inserted in the bell before pushing the pipe into place. Center the spigot on the bell and push the spigot into required alignment and position. Except where necessary in making connections with other lines, lay pipe with bells facing the direction at least two (2) lengths of pipe ahead of each joint, with packing of pipe laying. Lay installed and earth fill tamped alongside pipe, before joint is poured.

3.10 REACTION ANCHORAGE AND BLOCKING

A. Install suitable reaction blocking, struts, anchors, clamps, joint harness or other adequate means for preventing movement of pipe caused by unbalanced internal liquid pressure. Pressure can be expected at unplugged tees, Y-branches, and bends deflecting 22½ degrees or more which are installed in piping subjected to internal hydrostatic heads in excess of 15-feet (15') in exposed, or 30-feet (30') in buried piping.

1. In trenches, fittings must be provided with concrete thrust blocking between the fitting and solid, undisturbed ground in each case, except where solid ground blocking support is not available. At tops of slopes, anchor vertical angle bends with concrete of sufficient weight to resist hydraulic thrust to which pipe will be subjected at maximum pressures. Install the concrete block and anchors so that joints between the pipe and the fittings are accessible for repair. The bearing area of the concrete reaction block against the ground or the trench bank shall be as shown or as directed by Engineer in each case. In the event that adequate support against undisturbed ground cannot be obtained, install metal harness anchorages consisting of steel rods or bolts across the joint and securely anchored to the pipe and fitting or other adequate anchorage facilities to provide necessary support. Should the trench lack a solid vertical excavation face due to careless or otherwise improper trench excavation, no additional payment will be made for furnishing and installing metal harness anchorage in excess of contract value of concrete blocking replaced by such anchorages.

2. For fittings in locations other than trenches and as shown, provide reaction blocking, struts, anchorages, or other supports. This includes but is not limited to fittings installed in fills or other unstable ground.

3. Adequately protect from corrosion all steel, clamps, rods, bolts, and other metal accessories used in reaction anchorage or joint harness where subject to submergence or contact with earth or other fill material and not encased in concrete. Apply not less than two (2) heavy coats of coal tar coating material to clean, dry metal surfaces. Allow the first coat to become dry and hard before the second coat is applied. Paint the metal surfaces exposed above grade or within structures in accordance with Division 9, Finishes.

B. Substitution. In lieu of reaction anchorages and blocking for underground pipe and fittings, use push-on, locking type joints. For ductile iron pipe use TR Flex and Field LOK manufactured by United States Pipe and Foundry Company; Flex-Ring or Lok-Ring manufactured by American Pipe; or Super-Lock by Clow Corporation. . Equip all joints with gaskets. One Bolt fittings by One Bolt, Inc. may be used on ductile iron and PVC pipe. Some installations may require a combination of restrained fittings, and restrained joints both upstream and downstream of the fitting. Anytime a substitution is requested, the Engineer shall evaluate the number of restrained fittings and joints to be installed.

4.0 TESTING

A. Pressure Test. Conduct hydrostatic tests in the presence of the Engineer, and in an approved manner. Apply test pressure of 125 psi (or 1.5 times the design pressure, whichever is greater) for small diameter water lines and stabilize the line pressure for at least 15 minutes. For large diameter water lines, apply 150 psi (or 1.5 times the design pressure, whichever is greater) and stabilize for a minimum of 15 minutes. After the line is stabilized, maintain the appropriate test pressure for a minimum of two (2) hours *when joints are exposed and a minimum of eight (8) hours when the pipe has been backfilled*. Do not permit line losses during the test to exceed the limits set forth in the table titled "Maximum Allowable Leakage" provided herein and as allowed in the following formula and table:

$$L = (S)\,(D)\,(P^{0.5}) / 133{,}200$$

Where: L = Leak in gallons per hour.
S = Length of pipe in feet.
D = Inside diameter of pipe in inches.
P = Pressure in pounds per square inch.

Duration of Test	Acceptable Loss as % of Maximum Allowable
2 hr. (Min.)	25%
4 hr.	50%
6 hr.	75%

MAXIMUM ALLOWABLE LEAKAGE
Gallons Per Hour Per 1,000 Ft. of Main

Pipe Size (Inches)	Type of Pipe and Joint: C.I. or D.I.	PVC
	Test Pressure – 125 psi	
2	0.34	0.05
4	0.68	0.10
6	1.01	0.15
8	1.35	0.20
12	2.02	0.30
	Test Pressure – 150 psi	
16	2.69	0.40
18	3.02	0.45
20	3.36	0.50
24	4.03	0.60
30	5.40	0.75

Where practicable, pipe lines shall be tested in lengths between line-valves or plugs of 4,000 feet or less.
Regardless of the rate of line loss, repair observed leaks. Replace faulty or defective materials at no charge in the contract sum. Provide all pumps, gages, meters, and other equipment necessary for performance of the tests.

END OF SECTION

SECTION 15700
HEATING, VENTILATING, AND AIR CONDITIONING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Heating, ventilating, and air conditioning systems.
      a. Package Vertical Air Conditioning Units.

B. Related Sections: All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relive the Contract, Supplier, or Manufacturer of complying with the requirements therein.

1.2 QUALITY ASSURANCE

A. Certifications: Each item of equipment available with capacity ratings certified by AMCA and/or ARI, shall be furnished with capacity ratings so certified.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Heating, Ventilating, and Air Conditioning Equipment Furnished By Owner and Installed By Contractor: Include in Contract Amount costs incurred for receiving, storage, and labor. Contractor shall be responsible for costs arising when replacement materials must be reshipped due to loss or damage on job site after acceptance of original shipment. Immediately upon award of Contract, coordinate release of units for delivery to site with contacts specified in this Section.

1.4 SCHEDULING

A. Milestone Completion Date: Complete Work of this Section on or before date specified in Contract Documents.

B. Coordinate Contract interface Work of this Section to provide for energy management system operation and testing in accordance with energy management system Milestone Completion date.

C. Schedule testing and balancing in accordance Section 15990 after completion of system start-up requirements.

1.5 WARRANTY

A. After acceptance by Owner, supply materials and labor warranty for components supplied under this Section, except as specifically noted for Owner furnished equipment.

B. Owner furnished equipment shall be turned over to Owner in good working order. Prior to acceptance by Owner, equipment failures are under manufacturer's warranty. Notify equipment warranty contact specified herein for replacement or reimbursement information prior to beginning repairs. After acceptance by Owner, Contractor is not responsible for warranty repair.

1.6 SYSTEM STARTUP

A. Follow unit manufacturer's printed installation and start-up instructions. Provide final connections for rotation sensitive compressors if motor leads are shipped unconnected. Mechanical failure, prior to acceptance by Owner, shall be repaired by Contractor through warranty agreement with manufacturer.

B. Schedule start-up, allowing Owner's representative to be present unless Owner directs otherwise. If start-up and testing cannot be completed due to seasonal weather conditions, perform remaining start-up at an appropriate time. Payment may be withheld until Work is complete. During start-up, operate each unit in every mode, separately and in conjunction with other units for sufficient period of time, demonstrating to Owner's satisfaction that each unit is operating properly.

C. Record designated start-up data on forms attached at end of this Section. Retain completed form on site and submit to Owner Independent Test and Balance Agency prior to start of balancing.

PART 2 - PRODUCTS

2.1 PACKAGE VERTICAL AIR CONDITIONING UNITS

A. Acceptable Manufacturers:
   1. Bard Manufacturing Co.

B. Where required for HVAC units, factory mount and wire smoke detectors in HVAC unit unless noted otherwise on HVAC schedule below.

C. Refrigerant: R454B A2L, non-ozone depleting.

D. Cooling Operation: Scroll compressors with seamless copper-tube, aluminum-fin coil.

E. Heating Operation: Single or two stage heating (per schedule below) using resistance heaters.

F. Exterior Cabinet: 316 Stainless Steel with exterior stainless steel hardware.

G. Special Coatings: Technicoat coated Evaporator coil, Condensor coil, and Condensor fan blades.

H. Accessories and options:
   1. Honeywell T6 Pro thermostat with cable for AC Unit control
   2. Barometric fresh air damper
   3. Fiberglass filter, 2-Inch Pleated, Merv 8
   4. High pressure switch, low pressure switch, compressor control module, refrigerant leak detector (RDS), low ambient control, and alarm relay (NO/NC Contacts)
   5. SG-5W-A series anodized aluminum supply air grille with two sets individually adjusted blades, 2” flange
   6. RG-5W-A series extruded anodized aluminum return air grille with fixes 90º angle blades, 2” flange

I. Controller: Industrial grade controller with Digital LCD screen per schedule below. Steel enclosure 20 Ga. Galvanized with ANSI 61 post-paint.

J. HVAC Equipment Schedule:

HVAC Equipment Schedule	
Unit ID	HVAC-14-001
Serves	Dewatering Electrical Room
Manufacturer	BARD
Model No.	W60AF-A0ZXPXXXJ
Power (Volts-Phase)	208/240-1
Minimum Circuit Ampacity (Amps)	38
Maximum Over Current Protection (Amps)	45
Air Flow (CFM)	1845
Cooling Capacity (BTUH)	54,728
Sensible Capacity (BTUH)	41,723
EER	11.00
Outside DB (ºF)	102
Entering DB (ºF)	80
Leaving DB (ºF)	59.1
Entering WB (ºF)	67
Leaving WB (ºF)	57.8
Weight (LBS)	553

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install equipment per manufacturers instructions and requirements of Authority Having Jurisdiction.

3.2 PACKAGE VERTICAL AIR CONDITIONING UNITS

A. Coordinate Work of this Section with energy management system installer for installation dates, testing dates, and completion dates.

B. Label units with 6 inch black permanent paint stencil. Number units as indicated on Drawings. Locate label for each unit so it can be read from front of unit or unit maintenance access panel.

C. Do not set equipment on walls until installation of wall flashing has been prepared.

D. Full testing and balancing shall be performed only on new or relocated units or units with modified ductwork.

E. Limited testing and balancing as follows shall be performed on existing units with ductwork not being modified. Record readings for inclusion into final report for owners' use, and label the units as "Existing":
1. Test and record fan speeds (rpm), CFM, and full load amperes. Record voltage at each unit.
2. Test and adjust system for a minimum of 10% of outside air.
3. Test and record suction and discharge external static pressures at respective plenums. Seal access holes with rubber or metal snap-in plugs. The use of duct tape to seal access holes will not be permitted.
4. Test and record entering air temperatures. (Dry Bulb heating and cooling; Wet Bulb cooling.)
5. Test and record leaving air temperature. (Dry Bulb heating and cooling; Wet Bulb cooling.)
6. Test and record outside air Dry Bulb and Wet Bulb temperatures.
7. Verify and record proper operation of all stages of gas or electric heating sections.
8. Verify proper Novar control operation of unit as applicable.

END OF SECTION

AIR CONDITIONING SYSTEMS START-UP REPORT

Page _____ of _____

PROJECT _____ UNIT NO.* _____

LOCATION _____ ALTITUDE IN FEET _____

MANUFACTURER _____ SIZE _____

MODEL NO. _____ SERIAL NO. _____

CONDENSER TEST DATA	ACTUAL
Low Amb. Control - set point	
Degrees F	
Suction Pressure - Stage 1/2	/
Head Pressure - Stage 1/2	/
Crank case Htr. Amps - No. 1/2	/
Compr. Amps - Stage 1/2	
T1	/
T2	/
T3	/
Compr. Voltage - Stage 1/2	
T1 - T2	/
T2 - T3	/
T3 - T4	/
Cond. Fan Volts - Number 1/2	/
Cond. Fan Amps - Number 1/2	/

* Unit Number shall correspond to marked number on Drawings.

** Most remote unit only. Read gas pressure when equipment in building is in full operation.

GAS HEATING DATA	ACTUAL
EAT/LAT Degrees F	/
Verify Ignition-Stage 1/2	/
Gas Line Pressure, In. WC	
Upstream of Unit Control **	
Gas Manifold Pressure,	
In. WC Downstream of	
Appliance Regulator **	
Burner Orifice Size	

ELECTRIC HEATING DATA	ACTUAL
EAT/LAT Degrees F	/
Voltage - Stage 1/2	
T1 - T2	/
T2 - T3	/
T3 - T4	/
Amps - Stage 1/2	
T1	/
T2	/
T3	/

START-UP DATE _____ TIME _____ READINGS BY _____

VERIFIED BY _____
(General Contractor)

REMARKS: _____

_____

_____

_____

SECTION 15767
ELECTRIC UNIT HEATERS

PART 1 - GENERAL

1.1 SCOPE

This section includes provision of all labor, materials, equipment and incidentals required to install, test and place in satisfactory operation electric unit heaters, as shown on the construction drawings and as specified herein.

1.2 RELATED SECTIONS

All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. Air Moving and Conditioning Association (AMCA)
2. National Electrical Code (NEC)
3. Factory Mutual (FM)
4. Underwriters Laboratories (UL)
5. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)

1.4 SUBMITTALS

A. Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for selected models, including specialties, and accessories.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Coordination drawings for wall penetration requirements including framing and support members.

E. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field- installed wiring.

F. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

G. Maintenance data for inclusion in Operating and Maintenance Manual.

1.5 QUALITY ASSURANCE

A. Fans and components shall be UL listed and labeled for corrosive areas and NEMA 4X hose down requirements.

B. Motors, electrical accessories, and installation shall comply with NEMA standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Electric unit heaters shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer's designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

1.7 SYSTEM START UP

A. Record designated start-up data on forms attached at end of this Section. Retain completed form on site and submit to Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Unit heaters shall be self-contained, factory-assembled, corrosion-resistant, forced-fan heating units suitable for washdown and corrosive areas. Each unit shall consist of a heating element, fan, motor, housing, outlet diffuser or vanes, and controls.

B. Units shall be rated NEMA 4X and can be suspended by threaded rods or wall-mounted with factory swivel brackets as shown on the drawings and schedules. All parts shall be heavily braced and stiffened to prevent vibration and to hold all working parts rigidly in line. Casings of suspended-type units shall be designed for direct attachment to hangers.

C. The entire unit heater shall be constructed of epoxy-painted stainless steel with a 16-gauge stainless steel housing. Heating elements shall be finned tubular, made of 316 stainless steel with stainless steel fins. Discharge grilles shall be adjustable and made of epoxy-painted stainless steel. Fans shall be epoxy-coated stainless steel. Motors shall be epoxy-coated, Totally Enclosed Fan Cooled (TEFC), UL-listed, with permanently lubricated ball bearings, resistant to corrosion and moisture.

D. Units shall have a single-point electrical connection. Furnish units with built-in manufacturer controls, including automatic overtemperature cutout, manual overtemperature cutout, heater standby fan selector switch, heater "on" pilot light, control transformer, fan delay relay, contactors, and terminal block for field wiring.

E. Provide units with a NEMA 4X power disconnect switch and either a built-in thermostat or a remote wall-mounted, adjustable, NEMA 4X rated thermostat as shown on the drawings. Temperature control shall be two-stage with an associated thermostat for two-stage control when units are 10 kW and larger. Disconnect by division 16.

2.2 PERFORMANCE REQUIREMENTS

A. Unit heaters shall conform to the following requirements:

ELECTRIC UNIT HEATER SCHEDULE		
Heater ID No.	EUH-14-001, EUH-14-002, & EUH-14-003	EUH-11-001
Location	Dewatering Building	Chemical Building
Total Capacity, KW per Heater	5	5
Airflow, CFM	700	700
Air Throw, Ft	26	26
Thermostat	1 Stage: 40-100°F 2 Stage: 40-120°F	1 Stage: 40-100°F 2 Stage: 40-120°F
Fan Type	Propeller	Propeller
Motor Enclosure	TEFC	TEFC
Terminal Enclosure	NEMA 4X	NEMA 4X
Rating	Washdown/Corrosion Resistant	Washdown/Corrosion Resistant
Volts/Phase/Hertz per Heater	240/1/60	240/1/60
Max Current Draw, Amps	23	23

2.3 ACCEPTABLE MANUFACTURERS

A. Indeeco
B. Chromalox
C. Markel
D. Reznor

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas to receive electric unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before electric unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install electric unit heaters level and plumb.

B. Equipment shall be installed in accordance with the manufacturer's recommendation. Provide piping and ductwork connections in accordance with the requirements of the other related Sections.

C. The Contractor shall start up each piece of equipment and system and shall make all adjustments so that the system is placed in proper operating condition.

3.3 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing and report results in writing:
   a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   b. Operate electric heating elements through each stage to verify proper operation and electrical connections.
   c. Test and adjust controls and safeties.

B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.4 CLEANING

A. After installing units, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. After installing units, clean electric unit heaters internally according to the manufacturer's written instructions.

C. Install new filters in each electric unit heater within 2 weeks after Substantial Completion.

END OF SECTION

ELECTRIC UNIT HEATER START-UP REPORT

Page _____ of _____

PROJECT _____ LOCATION _____

UNIT DATA	UNIT NO.*	UNIT NO.*	UNIT NO.*	UNIT NO.*	UNIT NO.*	UNIT NO.*
Manufacturer						
Area Served						
Model No.						
Serial No.						
Nameplate KW						
TEST DATA	**ACTUAL**	**ACTUAL**	**ACTUAL**	**ACTUAL**	**ACTUAL**	**ACTUAL**
Units have been cleaned (YES) (NO)						
EAT/LAT Degrees F	/	/	/	/	/	/
Voltage – Stage 1/2						
T1-T2						
T2-T3						
T3-T4						
Amps – Stage 1/2						
T1						
T2						
T3						

* Unit number shall correspond to number on Drawings.

START-UP DATE _____ TIME _____ READINGS BY _____

VERIFIED BY _____
(General Contractor)

REMARKS: _____

SECTION 15831
FANS

PART 1 - GENERAL

1.1 SCOPE

A. This section provides for the furnishing and installation of all supply and/or exhaust ventilation fans.

1.2 RELATED SECTIONS

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. Air Moving and Conditioning Association (AMCA)
2. American National Standards Institute (ANSI)
3. ASTM International (ASTM)
4. National Electrical Manufacturers Association (NEMA)
5. National Electric Code (NEC)
6. Underwriters Laboratories (UL)

1.4 SUBMITTALS

A. Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for selected models, including specialties, accessories, and the following:
1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound power ratings.
3. Motor ratings and electrical characteristics plus motor and fan accessories.
4. Materials gages and finishes, include color charts.
5. Full color samples.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Coordination drawings for wall penetration requirements including framing and support members.

E. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field- installed wiring.

F. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

G. Maintenance data for inclusion in Operating and Maintenance Manual.

1.5 QUALITY ASSURANCE

A. Fans and components shall comply with UL 705 and be UL listed and labeled.

B. Motors and electrical accessories shall comply with NEMA standards.

C. Electrical components and installation shall comply with NFPA 70 "National Electrical Code."

D. Propeller assembly shall be dynamically balanced in accordance with AMCA Standard 204 prior to shipping.

E. Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

F. Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Fans shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer's designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

D. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

B. Fans and Shafts shall be statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

C. Fans shall be compatible with all other associated ventilation equipment and shall be supplied by the same integrator as the louver supplier for a sole source of responsibility.

2.2 DESIGN CRITERIA

A. The fans shall meet the following conditions listed in the table below and as shown in the contract drawings:

	Units	Design Conditions		
Fan ID No.	-	**SFAN-11-001 & SFAN-11-002**	**SFAN-14-001, SFAN-14-002, SFAN-14-003, SFAN-14-004**	**FAN-14-001**
Type	-	Supply	Supply	Circulation
Location	-	Chemical Area	Dewatering Building	Dewatering Building
Volumetric Flow Rate (Each)	Standard Cubic Feet per Minute (SCFM)	5,615	2,000	5,529
Static Pressure	Inches of Water Gauge (W.G.)	0.38”	0.51”	N/A
Operating Voltage	Volts	460	460	115
Horsepower	HP	1	2	¼
Frequency	Hertz	60	60	60
Operating Speed	RPM	1,170	575	1,725
Phase	-	3-Phase	3-Phase	1-Phase
Corrosion Resistant?	-	Yes	Yes	No
Insect Screen?		Yes	Yes	No
Materials of Construction	-	Non-Metallic or Stainless Steel	Non-Metallic or Stainless Steel	Non-Metallic or Stainless Steel

2.3 ACCEPTABLE MANUFACTURERS

A. Hartzell Air Movement

2.4 SUPPLY FANS

A. Provide fans constructed of non-metallic, corrosion resistant materials where possible. Where metallic parts are required, provide stainless steel.

B. Fan assembly shall consist of propeller section, gravity damper section and accessories as described below.

C. Gravity Damper Section:
1. Blades and frame shall be of fiberglass construction.

D. Wall Housing:
1. Provide easy access to the motor from interior of the building/enclosure.
2. Constructed of fiberglass with heavy-duty mounting flanges and pre-punched mounting holes.
3. Provide 1/8” insect screen and FRP weather protective, UV-resistant hood.

E. Propeller Section:
   1. Provide direct-drive propeller supply fan with fiberglass blades and hubs
   2. Motors:
      a. Motor type: TEFC
      b. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and furnished at the specific voltage and phase
      c. Accessible for maintenance

F. Accessories: The following items are required:
   1. Disconnect Switches:
      a. NEMA rated: 4X stainless steel
      b. Positive electrical shut-off
      c. Wired from fan motor to disconnect switch

2.5 CIRCULATION FANS

A. Furnish and install one (1) Hartzell fans model number A22F-242NA-STFCD3 in the Dewatering Building.

B. All mounting hardware and installation shall be included.

C. Each fan shall be controlled by a NEMA 4X line voltage thermostat.

D. Each fan shall be equipped with a TEAO yoke mounted motor.

E. Each fan shall be equipped with a cast, low noise, aluminum impeller.

PART 3 – EXECUTION

3.1 ANCHORAGE

A. Install using flat flange method. Exposed anchoring devices shall be of noncorrosive material compatible with fan frame materials.

3.2 INSTALLATION

B. Install in compliance with reviewed shop drawings and manufacturer's instructions. Units shall be straight, plumb, and true to line. Caulk around entire frame and as recommended by manufacturer for a finished, neat installation. All fans shall be mounted in a square opening framed with treated wood and be weatherproof sealed.

C. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

END OF SECTION

SECTION 15860
LOUVERS & DAMPENERS

PART 1 - GENERAL

1.1 SCOPE

This section provides for the furnishing and installation of exhaust louvers.

1.2 RELATED SECTIONS

All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCES

A. Referenced Standards:
1. Air Moving and Conditioning Association (AMCA)
2. American National Standards Institute (ANSI)
3. ASTM International (ASTM)
4. Underwriters Laboratories (UL)

1.4 SUBMITTALS

A. Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for selected models, including specialties, accessories, and the following:
1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound power ratings.
3. Motor ratings and electrical characteristics plus motor and fan accessories.
4. Materials gages and finishes, include color charts.
5. Dampers, including housings, linkages, and operators.
6. Full color samples.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Coordination drawings for wall penetration requirements including framing and support members.

E. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

F. Maintenance data for inclusion in Operating and Maintenance Manual.

1.5 QUALITY ASSURANCE

A. Establish flow rate, pressure, power, air density, and by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

1.5 DELIVERY, STORAGE, AND HANDLING

B. Lift and support units with the manufacturer's designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide louvers that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

2.2 DESIGN CRITERIA

	Units	**Design Conditions**	
Louver ID No.	-	**LVR-11-001, LVR-11-002 & LVR-11-003**	**LVR-14-001, LVR-14-002 & LVR-14-003**
Location	-	Chemical Area	Dewatering Building
Total Free Area w/ Insect Screen per Louver	ft^2	0.93	1.10
Total Static Pressure Drop	Inches of Water Gauge (W.G.)	0.17”	0.27”
Width	in	48	36
Height	in	30	48
Corrosion Resistant?	-	Yes	Yes
Insect/Bird Screen?	-	Yes	Yes
Materials of Construction	-	Fiberglass	Fiberglass

2.2 ACCEPTABLE MANUFACTURERS

A. Ruskin

2.3 DEWATERING FACILITY EXHAUST LOUVERS

A. Provide three (3) wall-mounted fixed blade exhaust louvers in the Dewatering Facility at the locations and heights shown on the construction drawings. Each louver shall be 36” x 48” in size and shall be supplied with an 1/8” insect screen and backdraft damper. Provide louvers constructed of non-metallic, corrosion resistant materials where possible. Where metallic parts are required, provide stainless steel.

2.4 CHEMICAL AREA EXHAUST LOUVERS

A. Provide three (3) wall-mounted fixed blade exhaust louvers in the Chemical Area at the locations and heights shown on the construction drawings. Each louver shall be 48” x 30” in size and shall be supplied with an 1/8” insect screen, box frame, and backdraft damper. Provide louvers constructed of non-metallic, corrosion resistant materials where possible. Where metallic parts are required, provide stainless steel.

PART 3 – EXECUTION

3.1 ANCHORAGE

A. Install using flat flange method. Exposed anchoring devices shall be of noncorrosive material compatible with louver and fan frame materials.

3.2 INSTALLATION

A. Install in compliance with reviewed shop drawings and manufacturer's instructions. Units shall be straight, plumb, and true to line. Caulk around entire frame and as recommended by manufacturer for a finished, neat installation. All louvers and fans shall be mounted in a square opening framed with treated wood and be weatherproof sealed.

B. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

END OF SECTION

SECTION 15990
TESTING, BALANCING AND ADJUSTING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplementary Conditions and all Division 15 Specification Heating Ventilation and Air Conditioning (HVAC) sections apply to all Work herein.

1.2 SUMMARY

A. Provide all testing, balancing, and adjusting of mechanical systems as indicated on the Drawings and as specified herein. Tests shall include, but not be limited to, the items specified in this Section.

B. Testing, balancing and adjusting shall in no way relieve the Subcontractor of the warranty requirements.

C. The Subcontractor shall furnish all fuel, water and electricity required in performing the testing, balancing and adjusting of mechanical systems.

1.3 REFERENCE STANDARDS

A. All testing, balancing, and adjusting shall be performed in accordance with the latest applicable industry standards, those standards referenced in the applicable Division 15 specifications, including the following:

1. NFPA 13.
2. NFPA 14.
3. NFPA 20.
4. NEBB “Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems”.
5. AABC National Standards.

B. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authorities having jurisdiction and suitable for its intended use on this Project.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the Mechanical General Provisions, Section 15011 and in accordance with the Subcontractor Scheduling Procedures therein, and shall include, but not be limited to:

1. Water and Air Balance Procedures, Recording Forms and Test Equipment.
2. Water and Air Balance Test Reports.
3. Vibration and Alignment Readings.
4. Sound Level Reading Test Equipment and Reporting Forms.
5. Pump Test Data.
6. Hydrostatic Test Logs.
7. Final Air and Water Balance Readings.

B. The manufacturer shall include a Specification Compliance Review as described in Section 15011 with his bid proposal. The Compliance Review will be a paragraph-by-paragraph review of the Specifications with the designations “C”, “D”, “E”, or “N/A” marked in the margin beside each paragraph.

1.5 WARRANTY

A. Comply with the requirements of the General Conditions and Section 15011.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. All factory testing shall be performed in accordance with the latest applicable industry standards, with the manufacturer's recommendations and as specified in the applicable Division 15 specifications.

3.2 FIELD TESTING - GENERAL

A. During the progress of the Work, tests shall be made as specified herein and as required by authorities having jurisdiction, including local authorities Inspection Department, Owner, Owner's Insuring Agency, Owner's Representative or Engineer. Tests shall be conducted by the Mechanical and Subcontractor as part of the Work of this Division and shall include all qualified personnel, equipment apparatus and services required to perform the tests.

B. The Subcontractor shall submit proposed test procedures, recording forms and test equipment for review in accordance with the Manufacturers Quality Assurance specifications.

C. Leaks, damage, or defects discovered or resulting from tests shall be repaired or replaced to a like new condition. Leaky pipe joints, ductwork, etc. shall be removed and replaced with acceptable materials.

D. All equipment and instruments required for tests as well as additional thermometer wells, gauge and instrument connections shall be installed at no additional cost to the Owner.

E. All instruments used for testing and balancing must have been calibrated within a period of three (3) months prior to balancing.

F. Submit copies of each complete testing and balancing report to the Engineer for review and send copies of the report to the Owner in accordance with Section 01300, Submittals. The Subcontractor shall submit individual testing and balance reports for each individual each ventilation system.

3.3 TESTING, BALANCING AND ADJUSTING OF MECHANICAL SYSTEMS

A. Air Balance and Adjusting:
   1. All air systems shall be air balanced by an AABC or NEBB certified balancing Subcontractor acceptable to the Owner and Engineer. The proposed Air Balancing Subcontractor shall be identified in the bidding proposal to the Owner.
   2. The Air Balancing Subcontractor shall visit the Project Site as often as necessary prior to the start of balancing procedures to verify that the duct systems have been properly installed complete with all grilles, dampers, ducts, coils, etc. and that the return air paths through walls, grilles, lighting fixtures and slot diffusers are completely open and unobstructed. The Air Balancing Subcontractor shall also verify

that adequate access to equipment and balancing devices has been provided and that the temporary plastic coverings on the lighting fixtures used for supplying conditioned air and returning air through the lamp cavities have been re-moved. The building area being tested must be thoroughly cleaned by the General Contractor prior to testing to prevent dust and debris from entering the lighting fixtures and fan powered terminal units. The Air Balancing Subcontractor shall submit a written report to the Engineer and Owner within one (1) week after each visit.

3. Where an air flow measuring device is available in the inlet to the air distribution device, this device shall be utilized by the Air Balancing Subcontractor to determine the air quantity as specified hereinafter.
4. Where an air flow measuring device is not available, the Air Balancing Subcontractor shall use a flow hood kit by Alnor Instrument Company or Shortridge Instruments, Inc. for the air balance. The flow kit shall be complete with flow hood tops specifically designed to accurately measure the air distribution devices specified for this Project. The flow hood's accuracy and the instrument calibration for measuring the air flow from the air distribution device specified for this Project shall be verified in an independent testing laboratory acceptable to the Owner and Engineer.
5. Air systems shall be balanced with clean air handling unit filters or with the electronic air cleaner fully operational. Fan belt tension shall be checked prior to balancing and adjusted as required. Air handling units and fans with duct pressure controls or automatic flow control systems shall have the controllers adjusted to maintain the specified pressure or flow prior to balancing.
6. Supply air systems installed in finished areas of the building (except for finished areas with inaccessible ceiling construction) shall be balanced and adjusted as follows:
    a. After duct systems have been installed complete with all grilles, dampers, ducts, coils, automatic temperature controls and other items hereinafter specified, the Subcontractor shall make adjustments as required to deliver the volume of air at each interior and perimeter air outlet within ten (10%) percent of design flow as shown on the Drawings with design cold duct temperatures. After the finished area is occupied, the air volumes shall be readjusted if required to properly balance the cooling and heating loads throughout the conditioned areas.
    b. Air outlets shall be adjusted and balanced with air pattern as shown on the Drawings.
7. Supply air systems installed in finished areas with inaccessible ceiling construction shall be balanced and adjusted as follows:
    a. After duct systems have been installed complete with all dampers, ducts, coils and other items hereinafter specified, except for final connection to grille or air outlet and prior to inaccessible ceiling installation, the Subcontractor shall make adjustments, as required, to deliver the volume of air at each interior and perimeter air tap proportionally within ten (10%) percent of design flow as shown on the Drawings.
    b. After each duct system has been adjusted the Subcontractor shall securely lock each manual damper, splitter, spin-in damper, etc. with sheet metal screws prior to installation of ceiling.
    c. The Subcontractor shall submit balancing reports to the Engineer for review and comment as specified hereinafter, prior to the installation of the inaccessible ceiling. No duct system shall be concealed prior to the Subcontractor being in receipt of a “Final Reviewed” air balance report for the system.
    d. After ceiling installation, each air outlet shall be in-stalled with air patterns as shown on the Drawings. Final air balance adjustment shall be made by increasing or decreasing the air handling unit fan rpm.
8. After all pressurization, ventilation, supply and exhaust systems, and exhaust air systems have been installed complete with all duct, grilles, louvers, dampers, fans and other items as hereinafter specified, the Subcontractor shall make adjustments, as required to deliver the volumes of air or differential static pressures in the case of the pressurization fans, at each air inlet and/or outlet within ten (10%) percent of design flow.
9. All tests shall be performed as specified herein and in accordance with the procedures and test criteria established by the local authorities having jurisdiction. The mechanical, fire protection, fire alarm,

electrical, Subcontractors and the Contractor shall be present and shall participate during the entire testing procedures.

10. All balancing must be accomplished with diffuser air patterns as indicated on the Contract Drawings.
11. The Subcontractor shall submit detailed balancing and performance testing procedures, recording forms and test equipment for all testing specified herein for the Engineer's review.
12. Submit copies of complete reports to the Engineer for review and comment, and send copies of the reports to the Owner.

B. The Subcontractor shall demonstrate to the Engineer and the Owner, prior to acceptance by the Owner, that all systems and/or equipment has been balanced and adjusted properly and that the system and/or equipment is in compliance with the Contract Documents.

END OF SECTION

SECTION 16011
GENERAL PROVISIONS WITH EXISTING FACILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Except as modified in this section, General Conditions, Supplementary Conditions, applicable provisions of Division 1, General Requirements, and other provisions and requirements of the contract documents apply to work of Division 16, Electrical.

B. Applicable provisions of this section apply to all sections of Division 16, Electrical.

C. This specification applies to the existing Wilbarger Municipal Utility District No. 2 Wastewater Treatment Plant located at 12217 Old Highway 20, Manor, TX 78653.

1.1 WORK INCLUDED

A. Scope. Provide all labor, material and equipment required for the installation of complete and functioning electrical systems as specified and shown on the drawings.

B. Intent. The intention of the drawings and specifications is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system. In case of doubt as to the work intended or if amplification or clarification is needed, request instructions from the Engineer.

C. Principal Systems. The work includes, but is not limited to, the following principal systems and equipment:
1. 480/277 volt distribution
2. 120/240 volt distribution
3. Automatic Controls
4. Lighting fixtures and lamps
5. Receptacles
6. Grounding system
7. All other electrical work and materials to provide for a complete and working installation.

D. Demolition. Refer to Division 2, Site work for other demolition requirements.
1. Remove all unused conduit to the extent necessary to accommodate new work and where conduit is visible above the floor line. Existing unused conduit which is concealed, or which does not interfere with the work may remain in place. Seal abandoned lines that remain in place behind walls or floor surfaces. Remove all existing unused wires.
2. Remove light fixtures, receptacles, wall switches, panel boards, switch gear, transformers, motor controllers, conduit, and wire from all areas indicated to be demolished.
3. All materials and equipment to be demolished, except items specifically listed to be relocated or delivered to the Owner, become the property of the Contractor.
4. Existing electrical services and controls to items to be removed by others must be disconnected as a requirement to this section.
5. Removal of any equipment must not interfere with operations in the existing facility.

1.2 RELATED WORK

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 CONTRACT DRAWINGS

A. Intent. The electrical drawings are generally diagrammatic and indicate only the general character and approximate location and extent of the work. Install all work complete, including minor details necessary to perform the function indicated.

B. Discrepancies. Review all pertinent drawings and adjust the work to conditions shown thereon. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify Engineer for his interpretation.

C. Outlet and Equipment Locations. Coordinate the actual locations of electrical outlets and equipment with building features and mechanical equipment as indicated on mechanical drawings. Review with the Engineer any desired changes in outlet location. Relocation, before installation, of up to three feet (3') from the position indicated may be directed without additional cost. Coordinate location of light fixtures with ceiling construction.

1.4 CODES, STANDARDS, AND PERMITS

A. Codes and Standards. All work materials and equipment shall comply with latest rules, regulations, and standards of the following:
1. National Electrical Code (NEC)
2. National Electrical Safety Code (NESC)
3. Underwriters' Laboratories (UL)
4. American National Standards Instituted (ANSI)
5. National Electrical Manufacturers Association (NEMA)
6. National Fire Protection Association (NFPA)
7. Occupational Safety and Health Act (OSHA)

B. Discrepancies. The drawings and specifications are intended to comply with all the aforementioned rules, regulations, and standards. Where discrepancies occur, immediately notify the Engineer in writing of these discrepancies and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.

C. Permits. Obtain Certificates of Inspection and all other permits required as a part of the work.

1.5 CONTRACTOR QUALIFICATIONS

A. An acceptable Contractor for the electrical work must be a specialist in this field, having a personal experience, training, skill, and organization to provide a practical working system. The Contractor may be required to furnish acceptable evidence of having contracted for and installed not less than three (3) systems must have served satisfactorily for not less than three (3) years. The foreman for this work, who must be approved before work is begun, must have had experience in installing not less than three (3) such systems.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Specific Products. When a product is specified by a manufacturer's name, this shall be the basis of the contract, without substitution or exemption, except as indicated below. Other products are specified by manufacturer's name, model number, and/or trade name, or by reference standards. When specified by a reference standard, the Contractor may select the product of any manufacturer meeting the standard.

2.2 PRODUCTS

A. Quality. All products provided under this division shall be new and the standard products of manufacturers regularly engaged in production of such material, equipment, and/or apparatus, and shall be manufacturer's latest standard design.

B. NEC. All products used shall conform to the National Electrical Code as applicable.

C. UL. Where the UL has set standards, lists products, and issues labels, the products used shall be so UL listed and labeled.

D. Space Limitations. Architectural and structural features of building and space limitations shall be considered in selection of all products. No product shall be provided which will not suit arrangement and space limitations indicated.

E. Protection. Products shall be kept clean and protected from corrosion and damage. Failure to do so shall be sufficient cause for rejection of the product.

F. Factory Finish. Where applicable, all products shall have a factory applied hard surface finish, such as baked on enamel, which will not require additional field painting. The Contractor shall protect this finish from damage due to construction operations until acceptance of the work. He shall satisfactorily restore any such finishes that become stained or damaged.

2.3 EQUIPMENT

A. Raceways.
1. Indoor Non-Corrosive Area – Galvanized Rigid Steel Conduits and Cast Iron Fittings.
2. All Outdoor above Grade Area and Transition from Below Grade to Above Grade – PVC Coated Rigid Galvanized Steel Conduit, Elbows, Couplings and Fittings.
3. Below Grade and Encased in Concrete – PVC Schedule 40 Conduit and Couplings. Underground 90º Elbow shall be PVC Coated Rigid Galvanized Steel Long Sweep Elbows.

4. Indoor Corrosive Chemical Building – PVC Schedule 80 Conduits, Fittings, Boxes and Elbows. Pulling elbows must be used for all 90º turns.
5. Electrical Metallic Tubing. Not Allowed.

B. Conductors. 600 Volt Insulated Conductors shall be soft drawn, annealed copper wire with factory color coded NEC insulation as follows:
1. Conductors #14 and Larger shall be stranded THHN/THWN-2 or XHHW-2

C. Motor Starters. Starters shall be across-the-line, magnetic type rated in accordance with NEMA standards, unless otherwise stated on the plans. Contacts shall be double break silver alloy. Coils shall be of molded construction and overload relays shall be melting type with a replaceable control module.

D. Circuit Breakers. Circuit breakers shall be molded case type with trip settings and frame sizes shown on plans. Enclosures shall be NEMA rated as shown on plans. The breaker shall have a push-to-trip button on the circuit breaker such that during assembly the operating mechanism can be adjusted to assure that the breaker may be reset by the operating handle if it has tripped. The Main Circuit Breaker shall have phase failure relay and surge protection devices.

PART 3 – EXECUTION

3.1 INSTALLATION

A. NEC. Electrical work shall meet or exceed NEC requirements.

B. Workmen. The work of this division shall be performed by workmen skilled in their trade.

C. Completeness. Installation shall be consistent in completeness whether concealed or exposed.

D. Coordination. Work under this division shall be properly coordinated with work under other divisions, in order to effect timely and accurate installation of products and to bring together all work under this contract in proper and correct sequence.

E. Field painting of conduit shall be as specified in the plans.

3.2 EQUIPMENT MARKING

A. This section includes all equipment marking supplementary to a manufacturer's required nameplate or tag. Nameplate used in this section means a three (3) ply black and white laminated plastic nameplate not less than $^{1}/_{16}$-inch ($^{1}/_{16}$") thick. Engrave nameplate with white letters $^{5}/_{32}$-inch ($^{5}/_{32}$") high minimum of a simple and easily legible style, with rest of visible nameplate black. Nameplates are required for the following items:

B. Electrical Panels:
1. All new or modified indicators or controls on the exterior front panel shall have nameplates identifying the piece of equipment they operate or control.

2. All lights, switches, pressure switches, relays, and each individual device except tubing and wiring shall have a nameplate as such. Any information that a workman should know to safely work on any component should be included on a nameplate for that component.
3. Each control wire shall be numbered every six inches (6") from end to end by heat embossing or brady tags.
4. All Electrical Panels shall have one (1) nameplate located on the front panel which states power supply information.

C. Boxes and Small Equipment.
1. In each pull or junction box inside control buildings or anywhere on the site, mark each feeder wire to identify its circuit number and phase.
2. Any control or safety components found individually on the site shall have a nameplate.

3.3 EQUIPMENT SUPPORTS

A. Metal Framing.
1. Provide hot-dip galvanized steel framing to support large or heavy wall mounted equipment and where otherwise required.
a. Provide concrete inserts and rods which are hot-dip galvanized to support equipment where indicated and where otherwise required.

3.4 SUBMITTAL DATA AND SHOP DRAWINGS

A. Substitution Provision. Prior to submission of shop drawings and within 30 days after contract award, deliver a complete list of all proposed materials and equipment to the Engineer for review. If list is not submitted within time allotted, use exact material as specified with no substitution.

B. Data Required. Submit shop drawings as specified in Division 1, General Requirements. Submittal data and shop drawings must show published ratings or capacity data, detailed equipment drawing for fabricated items, panel diagrams, installation instructions and other pertinent data. Where literature is submitted covering a group of series of similar items, the applicable item must be clearly indicated.

C. Form of Submittal. Make the submittal for review before orders are released for manufacturer. Submit data and drawings at one time in an indexed binder. Show any revisions to equipment layouts required by use of selected equipment. Reference specification paragraphs or drawings for all data submitted.

D. Items Required. Submittal data and shop drawings are required for, but are not limited to, the following items:
1. See Specification 01300 – Submittals for requirements.

3.5 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Owner's Manual. Furnish to the Engineer in binders four (4) sets of approved written instructions and parts lists for operating and maintaining all equipment and systems installed as electrical work. Instructions shall describe all normal adjustments, a list of items to be lubricated with the type and frequency of lubrication required. Furnish to the Owner all special servicing tools required for this equipment.

B. Operation. Instruct the Owner's operating personnel in the operation and maintenance of all equipment and systems furnished as electrical work. Before proceeding with this instruction, prepare a typed outline in triplicate listing the subjects that will be covered in this instruction and submit the outline for review by the Engineer. At the

conclusion of the instruction, obtain the signature of the person being instructed on each copy of the approved outline to signify that he has a proper understanding of the operation and maintenance of the system and resubmit the signed outlines with the required guarantees.

3.6 PROJECT RECORD DOCUMENTS

A. Preparation. Maintain at the job site a separate set of white prints of the contract drawings for the sole purpose of recording the field changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Record installed feeder conduits, dimensioning the exact location and elevation of the conduit.

B. Deliver. Record drawings to the Engineer as specified in Division 1, General Requirements.

3.7 TESTING

A. Test Conditions. Place all circuits and equipment into service under normal conditions, collectively and separately, as may be necessary to determine satisfactory operation. Certain tests hereinafter specified must be performed in the presence of the Engineer. Furnish all instruments, wiring, equipment, and personnel required for tests. Demonstrate that the equipment operates in accordance with requirements of the drawings and specification.

B. Test Dates. Schedule final acceptance tests sufficiently in advance of the contract date to permit any necessary adjustment or alterations to be completed within the number of days allotted for completion of the contract.

C. Retest. Conduct retests if so directed by the Engineer, of such time duration as may be necessary to assure proper functioning of adjusted or altered parts or items of equipment. No resultant delay or consumption of time as a result of such necessary retests relieves the Contractor of his responsibility under contract.

END OF SECTION

SECTION 16013
ELECTRIC MOTORS

PART 1 - GENERAL

1.1 SCOPE

A. This section gives requirements for electric motors specified in various sections of these specifications and shown on the drawings. Provide all electric motors specified, shown or otherwise required.

1.2 RELATED WORK

A. All sections of the contract documents and technical specifications are related sections. Failure to review contract documents and technical specifications does not relieve the Contractor, Supplier, or Manufacturer of complying with the requirements therein.

1.3 REFERENCE STANDARDS

A. American National Standards Institute/Anti-Friction Bearing Manufacturers Association (ANSI/AFBMA): Load Ratings and Fatigue Life for Ball Bearings.

B. American National Standards Institute/national Electrical Manufacturers Association (ANSI/NEMA): MG 1 - Motors and Generators.

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA): NFPA 70 - National Electrical Code (NEC).

D. American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
1. IEEE112 – Standard Test Procedure for Polyphase Induction Motors and Generators
2. IEEE114 – Standard Test Procedure for Single-Phase Induction Motors

E. American National Standards Institute/Underwriters Laboratories, Inc. (ANSI/UL)
1. UL547 – Thermal Protectors for Motors
2. UL674 – Electric Motors and Generators for Use in Hazardous Locations, Class I Groups C and D, Class II Groups E, F and G

1.4 SUBMITTALS

A. Submit the following under the provisions of Section 01300 – Submittals:
1. Outline drawings
2. Completed motor data sheets
3. Assembly drawings
4. Anchor bolt location drawings
5. Electrical schematics and wiring diagrams
6. Equipment performance curves and data
7. Bill of installation/assembly materials
8. Equipment weights
9. Catalog data
10. Operating instructions

11. Maintenance and lubrication recommendations
12. Recommended spare parts for startup including prices
13. Special maintenance tool requirements
14. Recommended spare parts list for one year operation
15. Quality control procedures
16. Nondestructive test procedures
17. Acceptance test procedure
18. Surface preparation and painting procedure
19. Shipping, handling, and storage procedures
20. Installation/erection procedure
21. Code compliance certificate
22. Electrical equipment heat run test records
23. Nameplate data
    a. Number of Phases
    b. Frequency in Hertz
    c. Amperes at full load
    d. Nominal speed at full load
    e. Winding insulation system as defined by IEEE
    f. NEMA design letter and code letter
    g. Temperature rise (reference NEMA MG-1, Part 12)
    h. Bearing Type
    i. Motor dimensions and frame number
    j. NEMA machine type classification
    k. Data necessary for the programming of the Multilin protective relay if applicable.
    l. Space heater voltage and wattage.
24. Performance/acceptance test report
25. Size of the largest three phase power factor correction capacitor unit which can be connected to three phase motors.

B. Instruction Books. At project completion, provide three (3) sets of bound "Motor Instruction Books." Include service and maintenance manual, renewal parts catalog, and outline drawing for each different type and size of 3-phase motor.

1.5 QUALITY ASSURANCE

A. Inspect and Test motors in accordance with specified NEMA standards. Test polyphaser motors to the requirements of ANSI/IEEE 112. Test single phase motors to the requirements of ANSI/IEEE 114.

1.6 DELIVERY, STORAGE AND HANDLING

A. Prepare each unit for the type and mode of shipment specified. The preparation shall be suitable for at least six months of outdoor storage from time of shipment requiring no disassemble prior to operation (except for bearing and seal inspections).

B. Provide instruction as necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite.

C. Coat exterior machined surfaces with a suitable rust preventative.

D. After drained and cleaned, coat internal areas of bearings and auxiliary equipment in oil lubrication systems fabricated from carbon steel with a suitable oil-soluble rust preventative.

E. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic plugs or caps.

F. When sleeve bearings are furnished, block the rotor to prevent axial and radial movement.

G. When space heaters are furnished, make heater leads accessible without disturbing the sipping package. Tag the leads for identification.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Provide electric motors by any of the following manufacturers:
1. U.S. Motors/Nidec Motor Corporation
2. ABB/Baldor
3. General Electric
4. TECO-Westinghouse Motor Company
5. Toshiba
6. WEG

2.2 SIZES

Horsepower sizes shown are maximum acceptable continuous ratings. Determine service factors according to NEMA MG-1 12.47. Service factor is to be a minimum of 1.15.

2.3 VOLTAGE, FREQUENCY AND SPEED

A. Voltage Ratings.
1. Single Phase: 230 volts where the source voltage is 240 volts.
2. Three Phase: 460 volts where the source voltage is 480 volts.

B. Frequency. 60 Hertz

C. Speed. As specified or required for driven equipment.

2.4 DESIGN TYPE

A. This specification defines the minimum requirements for low-voltage, random-wound, squirrel-cage, induction motors in the NEMA frame sizes for non-classified electrical area service. Use this specification for the selection and purchase of induction motors purchased separately or furnished with driven equipment as a package.

B. Motors shall perform satisfactorily for the application and installation conditions. Motors shall be suitable for operation in an outdoor corrosive and wet environment. Single speed and polyphase motors shall have efficiencies which equal or exceed those in ANSI/NEMA MG-1 (latest edition) for “NEMA Premium Efficiency” motors. Motor nameplate shall indicate that motor is a “NEMA Premium Efficiency” motor.

C. For 3/4 Horsepower and Smaller. Use single phase motors of the resistance split-phase type and equipped with thermal protectors for motors smaller than 1/6 horsepower. For motors of 1/6 horsepower to ½ horsepower, provide single phase motors of NEMA Design N capacitor start type.

D. For Motor Over 1 Horsepower. Provide three-phase, NEMA B, squirrel cage, induction type motors. Motor efficiencies shall be equal or exceed ANSI/NEMA MG-1 (latest edition) table 12-12. Motor efficiency shall be measured in accordance with IEEE Standard 112 Test Method E. Provide motors designed to operate at a maximum of 80 degrees C rise above an ambient temperature of 40°C and at an elevation of up to 1000 m/3300 ft above sea level.

2.5 MOTOR INSULATION

A. Use motor insulation that will sustain temperature rises according to NEMA MG-1, 12.41 for fractional horsepower and universal motors and according to NEMA MG-1, 12.42 for integral horsepower motors.

B. Unless otherwise required, use a NEMA MG-1, 1.65, Class "F" insulation system made of non-hygroscopic material.

C. In addition, provide two (2) epoxy dip and bake applications to windings as suitable for Gulf Coast Environment.

2.6 LEADS

A. For motor leads, use Class I stranded copper conductors with insulation the same or better as specified in the preceding paragraph. Provide permanent identification numbers on leads according to NEMA MG-2. Use crimp-on, solder - less copper terminals on leads and place shrunk insulation sleeves or covers between leads and terminals.

2.7 ENCLOSURES AND FRAME

A. Unless otherwise required, provide motors of totally enclosed fan cooled (TEFC) construction.

B. Motors frames, enclosures, terminal boxes, fan cover guards and air passages shall be cast iron or heavy fabricated steel of such design or proportions as to hold all motor components rigidly in proper position and shall meet all NEMA requirements for the type of enclosure employed. End bells shall be cast iron. Steel sheet or plate used shall have a thickness of at least 1/8 in. Fans, breathers, drains, screens, covers, and hardware shall be corrosion-resistant materials. Fractional horsepower motors may have rolled steel stator frame and cast iron brackets with integral mounting feet.

C. Make motor enclosure fans non-sparking type, low inertia, and suitable for bidirectional rotation and mount on hub with stainless steel bolts.

D. Furnish each enclosure with a stainless steel automatic breather/drain located at the low point of the enclosure.

E. Motor frame and enclosure shall have provisions for grounding to the main grounding system. Drill and tap rear foot on horizontal motors and the flange base on vertical motors on the junction box side for a service post ground connector.

F. Provide motors weighing more than 300 lbs. with lifting eyebolts, rings or lugs capable of supporting the weight of the motor.

2.8 BEARINGS

A. Provide oil-lubricated anti-friction (sleeve) bearings with a ring oil lubrication system for motors 200HP and larger. Provide grease lubricated bearings for motors less than 200HP.

B. Motors shall have proper bearing insulation to prevent circulation of shaft currents and resulting damage. Provide also insulting means for any oil-supply connections and monitoring equipment to prevent electrical bypassing of the bearing insulation.

C. Oil and Grease lubricated bearing shall have a life of at least 100,000 hours.

D. Provide oil-lubricated bearing housings and a reservoir of sufficient depth, to serve as a settling chamber for foreign materials, with a drain plug, and vents as required, accessible from the exterior of the motor. Drains shall be extended clear of the motor housing a minimum of 2½-inches with a gate valve and pipe plug on each oil drain. Furnish oil-lubricated motors with a constant oil-level sight gauge mounted on the motor housing and marked with running- and stopped-oil levels.

E. Provide motors with suitable seals to prevent moisture from entering through the shaft openings. Provide an Inpro/Seal isolator (Labyrinth seal) on the shaft end of the motor.

F. For in-line pumps, special high thrust bearings are required for drive motors, except for pumps where the thrust bearings are provided as an integral part of the pump.

2.9 VERTICAL MOTORS (ADDITIONAL REQUIREMENT)

A. Solid shaft vertical motors are acceptable for all applications except when the connection to the driven equipment consists of sectional driven shaft which may unscrew and lengthen in the event of reversal of direction.

B. Design vertical motor thrust bearings conservatively to carry maximum axial thrusts (up and down) imposed by driven equipment.

C. Vertical motors shall have oil-lubricated, top and bottom bearings and motor base shall be NEMA type P.

D. Provide vertical motors with a positive, non-reversing, corrosion-resistant (“anti-ratchet”) mechanism. Do not equip well motor with an anti-reverse ratchet. Provide a time-delay relay that does not allow the motor to be energized while the shaft is spinning backwards.

E. Where new motors are being provided for existing pumps, motor mounting must match the existing pump and new shaft couplings shall be provided to couple the pump to the new motor.

2.10 COUPLINGS

A. The manufacturer of the equipment to be driven will provide all necessary coupling devices required between the motor and the driven equipment.

2.11 HARDWARE

A. All structural bolts, washers, nuts, pins and similar items must be manufactured of high strength steel. Protect hardware from corrosion by galvanizing or chrome plating.

2.12 NAMEPLATES

A. Provide each motor with a stainless steel nameplate meeting the requirements of NEMA MG-1, 10.37 and the National Electric Code, Section 430-7. When the motor and equipment are installed, the nameplate must be in full view in accordance with the intent of NEC requirements. Attach the nameplate to the motor with stainless steel fastening pins or screws.

2.13 ACCESSORIES

A. Terminal Boxes. Provide each motor with a diagonally split conduit box amply dimensioned for the motor lead terminations, including a grounding lug. Supply a gasket suitable for the enclosure type and motor location. Make motor terminal boxes weatherproof and with threaded conduit entrances with water-resistant seals between boxes and motor frame. Design the line-terminal box to allow box to be rotated in four 90 degree steps for bottom, side or top entry of conduit or cable. The line terminal box shall match the location indicated on project drawings. Locate a separate terminal box for space heaters adjacent to the line terminal box. Provide a separate terminal box for RTD's, space heater, current transformer, and other similar accessories when supplied.

1. Size the line terminal box so that feeder cables can be connected to motor leads for terminals without damage to the cable or the leads. Oversize the terminal box to exceed the minimum volumes shown in the NEC Section 430-12 by 100% and provide adequate space to mount and enclose all devices mounted within.
2. Furnish the line terminal box with suitable compression ring-type, permanently numbered, cable connectors for incoming bolted-cable connections and one clamp-type ground terminal lug of sufficient size to contain a conductor the same size as motor leads.

2.14 NOISE AND VIBRATION

A. Determine motor noise level in accordance with IEEE 85. Levels or noise generated by a motor shall not exceed 85dbA at a distance of 1 m/3.3 ft unless specified otherwise on the data sheet. Noise level requirement may be also covered by a separate noise requirements specification included with the driven equipment specification.

PART 3 – EXECUTION

3.1 INSTRUCTION BOOKS

Provide five (5) sets of bound "Motor Instruction Books," including service and maintenance manual, renewal parts catalog and outline drawing for each different type of motor rated 40 horsepower or more.

3.2 SETTINGS

A. Where GE Multilin Motor Protection Relays are provided for motor protection, provide all setting for the Multilin Relays.

B. Where PMC/Beta Vibration Switches are required, provide all settings.

3.3 INSTALLATION

A. Install each motor in accordance with the Manufacturer's published instruction using the necessary tools and instrument to ensure proper fit and alignment with the driven machine.

B. Before coupling up with the driven machine, the following work should be performed.
1. Test the motor winding insulation resistance in accordance with IEEE 43.
2. Terminate cables to the motor leads.
3. Energize motor momentarily to check rotation.
4. Check shaft of driven machine to ensure free movement.
5. Perform motor vibration tests.

C. Couple motor up with driven machine and perform motor vibration tests.

END OF SECTION

SECTION 16014
ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.

B. Disposal of materials.

C. Storage of removed materials.

D. Identification of utilities.

E. Removal of salvaged items and delivery to Owner.

F. Protection of items to remain as indicated on Drawings.

G. Relocate existing equipment to accommodate construction.

1.2 SUBMITTALS

A. Submit the following in accordance with Specification 01300-Submittals.
   1. Shop Drawings: Indicate demolition, location and construction of temporary work. Describe demolition removal procedure and schedule.
   2. Project Record Documents: Record actual locations of capped conduits and equipment abandoned in place at the existing Wastewater Treatment Plant.

1.3 REGULATORY REQUIREMENTS

A. Conform to requirements of the National Electrical Code (NEC), OSHA, and NFPA 70E – Standard for Electrical Safety Requirements for Employee Workplaces.

B. Each person performing electrical demolition shall be a “qualified person” as defined by NFPA 70E and the NEC.

1.4 COORDINATION

A. Conduct demolition to minimize interference with adjacent and occupied building areas.

B. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.

C. Shut-down Periods:
   1. Arrange timing of shut-down periods of in service panels with Engineer. Do not shut down any utility without prior written approval.
   2. Keep shut-down period to minimum or use intermittent period as directed by Engineer.
   3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum 3 days in advance.

D. Identify salvage items in cooperation with Engineer.

PART 2 –PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Provide materials and equipment for patching and extending work as specified in the individual Sections.

PART 2 – EXECUTION

3.1 EXAMINATION

A. Before work begins on the demolition or salvage of electrical equipment, wiring, or systems:
   1. Inspect the site to identify any hazardous materials such as PCBs, asbestos, lead, mercury or other heavy metal, or toxic, flammable or explosive materials, or radioactive materials that may be handled, disturbed or removed. Typical locations of hazardous materials include:
      a. Lead: Batteries in emergency lighting, exit signs, fire alarm panels, security systems; some circuit breakers.
      b. PCBs: Transformers, capacitors, lighting ballasts.
      c. Asbestos: Pipe insulation, electrical insulation.
      d. Mercury: Fluorescent lamps, HID lamps, thermostats, silent switches, relays.
      e. Radioactive materials: Self-luminous exit signs, smoke detectors.
   2. Verify whether or not PCB ballasts exist in light fixtures which will be removed or relocated. If PCB light fixture ballasts exist, then follow requirements in PCB BALLAST HANDLING AND DISPOSAL below.
   3. Have the inspection results available at the worksite, including any drawings, plans or specifications, as appropriate, to show the locations of any hazardous substances.
   4. Ensure that any hazardous materials found are safely contained or removed.
   5. During demolition work, if hazardous materials are discovered that were not identified in the initial inspection required above, stop work in the area and notify the Engineer. Do not resume work in the area until directed by the Engineer.

B. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.

C. Verify termination points and lockout-tagout device locations for services, circuits, and systems to be disconnected or removed.

D. Demolition Drawings are based on casual field observation and/or existing record documents. Report discrepancies to the Engineer before disturbing existing installation.

E. Beginning of demolition work means Contractor accepts existing conditions.

3.2 PREPARATION

A. Protect existing materials, appurtenances and equipment which are not to be demolished. Repair or replace existing materials, appurtenances and equipment, building exterior and interior, and landscaping altered or damaged during demolition work to match existing undisturbed conditions at no additional cost to Owner.

B. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Engineer, Contractor’s employees, and existing improvements to remain.

C. Use covered debris bins to remove and temporarily store materials. Location of bins shall be approved by the engineer

D. Maintain parking areas, driveways, exterior walkways, exit paths, and landscaping in a clean, undisturbed condition.

E. Coordinate utility service outages with the Engineer and Owner.
1. Request underground utilities to be located and marked within and surrounding construction areas.
2. All work on energized electrical utilities will be performed by the local utility company.
3. Protect utilities indicated to remain, from damage.

F. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits use qualified personnel in such operations.

G. Existing Electrical Service: Maintain existing system in service until bypass system is complete and ready for service. Obtain permission from the Engineer at least 48 hours before partially or completely disabling system.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish, relocate, and extend existing electrical work to installations to accommodate new construction.
1. Remove all abandoned conductors.
2. Remove all conduit to 6” below grade and cap.

B. Establish an electrically safe work condition in areas where electrical work is to be removed.
1. Perform work on energized equipment or circuits with qualified personnel as defined by the National Electrical Code.
2. Disconnect or shut off service to areas where electrical work is to be removed. Properly lockout and tag disconnecting means. Verify zero-voltage before beginning demolition.
3. Disconnect, remove, and cap designated utility lines within demolition areas. Mark locations of disconnected utilities. Identify utilities and indicate capping locations on Project Record Documents.

C. Protect and retain power to existing active equipment that is to remain.
1. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
2. Install temporary wiring and connections to maintain existing systems in service during construction.

D. Carefully remove equipment, materials, or fixtures which are to be reused. Store and protect to prevent damage.
1. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.

E. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.
1. Remove items in an orderly and careful manner.
2. Remove abandoned wiring to panelboard circuit breaker or source of supply.
3. Remove exposed abandoned raceways. Cut raceways flush with walls, floors, or slabs, seal openings, and patch surfaces.
4. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
5. Remove lamps from abandoned luminaires. Refer to LAMP HANDLING AND DISPOSAL below.

6. Disconnect and remove abandoned luminaires. Refer to PCB BALLAST HANDLING AND DISPOSAL below. Remove brackets, stems, hangers, and other accessories.
7. Remove abandoned cable tray systems.
8. Disconnect and remove abandoned panelboards and distribution equipment.
9. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
10. Remove exposed abandoned fasteners and supports, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.
11. Disconnect and remove all unused electrical equipment at the existing Wastewater Treatment Plant. Lights and Receptacles shall remain unless otherwise indicated in the drawings.
12. Cap abandoned empty conduit at both ends.
13. If certain raceways and boxes are abandoned but not scheduled for removal, identify those items on the "As Built Drawings".

F. Provide proper and permanent support to adjacent structure for all raceways, cable trays, luminaires, and equipment to remain.

G. Repair adjacent construction and finishes damaged during demolition and extension work.
1. Patch and seal unused existing wall penetrations to match existing conditions and to restore fire rating.

H. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. This includes the extension of the circuit from the last active device to the next device in the system to be activated.
1. Reconnect equipment being disturbed by renovation work and required for continued service to the nearest available panel.

I. Investigate and measure the nature and extent of unanticipated items that conflict with intended function or design. Submit written report with accurate detailed information to Engineer. While awaiting instructions from Engineer, rearrange selective demolition schedule as necessary to continue overall job progress without delay.

J. Stop work and notify Engineer immediately if structure or other items to remain appear to be endangered. Do not resume work until directed by Engineer.

K. Remove demolished materials as work progresses.

3.4 EXISTING PANELBOARDS

A. Verify and identify loads served by circuits in existing panelboards affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new circuit breakers as required.

B. Tag unused circuits as spare.

C. Where existing circuits are indicated to be reused, use measuring devices to verify circuits feeding Project area are not in use.

D. Remove existing wire no longer in use from panel to equipment.

E. Provide new updated directories where more than three circuits in a panelboard have been modified or rewired.

3.5 PCB BALLAST HANDLING AND DISPOSAL

A. Generally, high power factor fluorescent light ballasts manufactured before 1978 and some HID ballasts contain PCB compounds in their capacitors. PCB ballast handling, storage, and disposal shall be in accordance with 40 CFR Part 761 and other applicable EPA PCB regulations.

B. Inspect all ballasts in all light fixtures (which will become the property of the Contractor and will be removed from the project site as part of this project) and take the actions described below.
   1. All ballasts labeled as "NON-PCBs" or "NO PCBs" shall become the property of the Contractor. If the PCB content is not stated on the ballast label, handle the ballast as a PCB ballast.
   2. Remove PCB ballasts from the light fixtures and cut the wires off. However, before removal, carefully inspect PCB ballasts for leaks. If ballast appears to be leaking (evidenced by potting compound leaking out or by an oily film on the ballast surface) handle the ballast per 40 CFR Part 761 and other applicable EPA PCB regulations. Basically, this means the ballast is to be carefully removed from the fixture and placed in an approved drum. See paragraph below for the drum specifications. The person removing the ballast from the fixture shall wear neoprene protective gloves, eye protection, and protective clothing as necessary.
   3. If the fixture has also been contaminated, it will require cleaning to less than 10 micrograms/100 square centimeters contamination before disposal. This cleaning must be done by an approved PCB contractor and is not considered a part of this contract. Contact the Engineer to arrange cleanup by the Owner.
   4. Place the ballasts in US DOT approved type 17C or type 17H drums (barrels) furnished by the Contractor. 55 gallon and 30 gallon drums that meet the requirements of 49 CFR Part 178 are available from most drum suppliers. The quantity and size of the drums will be determined by the Contractor at the time of construction.
   5. Place these barrels in storage with the cover that came with the barrels, in a location within a building, as designated by the Engineer. Do not place the barrels outside where they are exposed to weather.
   6. THESE BALLASTS ARE NOT TO BE REMOVED FROM THE WORK SITE BY THE CONTRACTOR. To do so would violate DOT hazardous waste regulations and may result in a fine to the Contractor.
   7. Label and mark the PCB storage drums with EPA approved PCB labels and the storage area with signs, marks and lines to meet state and federal regulations.
   8. Provide approved PCB absorbent materials to be stored immediately adjacent to the drum storage area. Do not place loose absorbent material in the drums.
   9. Provide to the Engineer, in written form, a total count of these ballasts (or their total weight by barrel) and where they are stored.

C. When the ballast demolition is completed and all PCB ballasts are placed in drums ready to be picked up for disposal, notify the Engineer. The Engineer will make arrangements for the Owner to pick up the PCB ballasts.

3.6 LAMP HANDLING AND DISPOSAL

A. All lamps (fluorescent, incandescent, and HID) contain mercury and/or lead (in the base) as well as other heavy metals and compounds which are regulated by the EPA during the disposal process. The handling, storage, and disposal of lamps shall be in accordance with 40 CFR Part 273.

B. Handle lamps which have been removed from service for disposal as follows:
   1. Very carefully remove all lamps (fluorescent, incandescent, and HID) from light fixtures before removal of the fixture from its mounted position. This is to reduce the likelihood that the lamp(s) will be broken. If the Contractor breaks more than 1% of the total lamps removed for the project, the Contractor will be

charged the cost difference between disposal of broken lamps and disposal of unbroken lamps for all lamps broken in excess of 1% of the total lamps removed in the project.

2. Provide containers large enough to fully conceal the removed lamps and appropriate for lamp transportation. Place removed lamps in containers and mark container with the number and type of lamps. Place containers in storage in a location on the Owner's property (this may be in another building) arranged by the Engineer. The Contractor shall label the area as "Hazardous Material Storage - Mercury".
3. Provide to the Engineer, in written form, a count of all stored lamps by type at the completion of the project.
4. The Engineer will make arrangements for the lamps to be picked up by the Owner.

3.7 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide approved closure plates for vacant positions.

C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts (if required) and broken electrical parts. Test for proper operation.

3.8 DISPOSITION OF MATERIAL AND EQUIPMENT

A. Remove and protect items indicated on Drawings to be salvaged and deliver in good condition to the Owner at the location designated by the Engineer.

B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

C. Unless indicated otherwise, material removed under this Contract which is not to be salvaged or reused in the Project shall become the property of the Contractor.

D. Unless indicated otherwise, immediately remove demolished material from site. Do not store or permit debris to accumulate at the site. Dispose of materials legally off site. Do not burn or bury materials on site.

E. Upon completion, clean the entire area of demolition residue satisfactory for the continuation of the Work. Remove temporary work.

3.9 INSTALLATION RELOCATED EQUIPMENT

A. Install relocated materials and equipment under the provisions of the applicable sections of these Specifications.

END OF SECTION

SECTION 16060
GROUNDING SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding electrodes and conductors

B. Equipment grounding conductors

C. Bonding

D. Power system grounding

E. Communication system grounding

F. Electrical equipment and raceway grounding and bonding

G. Control equipment grounding

1.2 REFERENCES

A. Referenced Standards
   1. American Society for Testing and Materials (ASTM)
      a. ASTM B3: Soft or Annealed Copper Wires
      b. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft
      c. ASTM B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes
   2. Institute of Electrical and Electronics Engineers (IEEE)
      a. IEEE 142-82: Recommended Practice for Grounding of Industrial and Commercial Power Systems
      b. IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.
   3. Underwriters' Laboratories (UL)
      a. UL 83: Thermoplastic Insulated Wire and Cables
      b. UL 467: Grounding and Bonding Equipment
   4. National Fire Protection Association (NFPA), NFPA No. 70 - National Electrical Code (NEC), Article No. 250 - Grounding.

1.3 SUBMITTALS

A. Submit the following under the provisions of Section 01300 - Submittals:
   1. Manufacturer's cut sheets and catalog data
   2. Installation, terminating and splicing procedure
   3. Instruction for handling and storage
   4. Dimensions and weight

1.4 QUALITY ASSURANCE

A. Tests
1. Use insulated cable conforming to requirements of the vertical tray flame test as described in IEE 383-2.5.
2. Test grounding system in the field in accordance with procedures outlined in Part 3 - Execution.

1.5 DELIVERY, STORAGE AND HANDLING

A. Ship grounding cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Pack and crate other materials specified to withstand normal abuse during shipping, handling and storage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cable
1. American Insulated Wire Company
2. Cablec Continental Cables Company
3. General Cable Company
4. Okonite Company
5. Pirelli Cable Corporation
6. Rome Cable Corporation
7. Triangle Wire and Cable, Inc.

B. Ground Rods and Connectors:
1. Blackburn
2. Copperweld
3. Thomas & Betts

C. Exothermic Connections:
1. Burndy Corporation (Therm-O-Weld)
2. Erico Products (Cadweld)

D. Grounding Connectors:
1. Burndy Corporation
2. O.Z. Gedney
3. Thomas & Betts

2.2 MATERIALS AND EQUIPMENT

A. Design. Provide grounding cable and materials with the following characteristics:
1. Use a grounding system designed in accordance with NEC Article No. 250 Grounding, and the IEEE 142-82 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

B. Materials

1. Use grounding conductors, bare or insulated, which are manufactured and tested in accordance with applicable standards ASTM B3, ASTM B8 and ASTM B33.
2. Provide a main ground loop of #4/0 AWG, Class C stranded, bare copper cable. Small groups of isolated equipment may be grounded by a No. 2 AWG minimum insulated conductor connected to the main loop. Generally, taps shall be sized as follows:
   a. Main ground loop or grid #4/0 minimum
   b. Switchgear, motor control centers and power transformers #4/0
   c. Motors 200 hp and above #4/0
   d. Power panels - AC and DC #2/0
   e. Control panels and consoles #2
   f. Building columns #4/0
3. Where single conductor insulated grounding conductors are called for, use 600 volt insulation. Use ground conductors identified with green insulation or green tape marking.
4. Supply identifying ribbon which is PVC tape, 3 inches wide, red color, permanently imprinted with "CAUTION BURIED ELECTRIC LINE BELOW" in black letters as specified in Section 16195, Electrical Identification.
5. Utilize flexible copper braid across hinged chain link or fence gates to bond the movable portion to the grounded fence post.

PART 3 - EXECUTION

3.1 PREPARATION

A. Complete site preparation and soil compaction before trenching and driving ground rods for the underground grid.

B. Verify from Drawings the exact location of stub-up points for grounding of equipment, fences and building or steel structures.

3.2 CONSTRUCTION CRITERIA

A. Install the main ground loop at a depth of at least 30 inches below earth surface. Connect the ground loop to ground rods and to tap connections to form a complete system as indicated on the electrical Drawings. The Contractor shall give special attention to the grounding of service equipment, structures and fences to comply with the current NEC, local authorities and the serving utility company.

B. Electrical equipment, buildings, tanks, and other structures and equipment shall be grounded as indicated on the Drawings. Where ground rods are required, the rods shall be 10 feet long, 3/4 inch diameter, copper-clad steel ground rods. Rods shall be driven vertically, and the top of the rods shall be a minimum of 18 inches below finished grade, or as specified on the Drawings.

C. Local pushbutton and selector switch stations, two-wire control devices, disconnect switches, lighting transformers, panelboards, operator panels, benchboards, and the enclosures of other electrical apparatus shall be grounded through and equipment grounding conductor run with the power supply or control circuit conductors or shall be grounded as shown on the Drawings.

D. Ground medium voltage motors, in addition to the grounding conductors in the motor feeder cable, with a separate No. 4/0 AWG cable to motor frame.

E. Motors having power supplied by multiconductor cable shall be grounded by a separate grounding conductor in the cable and where supplied by single conductor cable in conduit by a grounding conductor pulled in the conduit. Connect ground conductors to the ground bus in the motor control center and to the ground terminal provided in the motor conduit box.

F. Do not ground the insulated bearing pedestals of large motors.

G. Connect ladder-type cable trays to the grounding electrode system.

H. Install a warning ribbon approximately 12 inches below finished grade directly above the ground grid.

I. Connect fence posts of chain link and metal fences to the main ground loop at least every 50 feet.

3.3. INSTALLATION

A. Equipment Grounding
1. Make grounding connections to surfaces which are dry and cleaned of paint, rust, oxides, scales, grease and dirt to ensure good conductivity. Clean copper and galvanized steel to remove oxide before making welds or connections.
2. Use the exothermic welding process for below-grade grounding connections, except at ground rods. Use mechanical connectors or thermal connections for above-grade grounding connections as shown on the Drawings.
3. Make grounding connections to electrical equipment, vessels, mechanical equipment and ground rods in accordance with the Drawings.
4. Ground tanks and vessels by making connections to integral structural supports or to existing grounding lugs or pads, and not to the body of the tank or vessel.
5. Leave ground connections to equipment visible for inspection. Protect them with PVC non-metallic conduit as indicated on the Drawings.
6. Make connections to motor frames and ground buses with lugs attached to the equipment by means of bolts. Do not use motor anchor bolts or equipment housing for fastening lugs of grounding cable.
7. Where the wiring for lighting systems consists of single conductor cables in conduit, provide each conduit with an equipment grounding conductor. Use a grounding conductor with green colored insulation and ground equipment in the lighting system.

B. Raceway and Support Systems Grounding
1. Install raceway, cable rack or tray and conduit so that it is bonded together and permanently grounded to the equipment ground bus, according to the Drawings. Connection to conduit may be grounding bushing or ground clamp.
2. Install raceway at low voltage motor control centers or other low voltage control equipment so that it is bonded and grounded, except that any conduit that is effectively grounded to the sheet metal enclosure by bonding bushing or hubs need not be otherwise bonded.
3. Where a grounding conductor is run in or on a cable tray, bond the grounding conductor to each section of cable tray with a cable tray ground clamp.
4. Where only grounding conductor is installed in a metal conduit, bond both ends of the conduit to the grounding conductor.
5. Provide flexible "jumpers" around raceway expansion joints. Use copper bonding straps for steel conduit. Install jumpers across cable tray joints that have been parted to allow for expansion and any hinged cable tray connections.

C. Fences and Gates. Ground fences, fence posts and gates to the underground grid as shown on the Drawings.

D. Power System Grounding
1. Solidly ground the secondary neutral of the main power supply transformer either to the ground grid or through an impedance. See Drawings for details.
2. Solidly ground the neutral of lighting, instrument and control transformers.

E. Cable Armor and Shields
1. For shielded control cable, terminate and ground the shield at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables. Maintain shield continuity by jumpering the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground.
2. Connect the ground wire in power cable assemblies at each terminal point to a ground bus, if available, or to the equipment enclosure. Do not carry these ground wires through a "doughnut" current transformer (CT) used for ground fault relaying; do carry ground leads from stress cones through CTs. Ground power cable armor and shield at each terminal point.

F. Test Wells
1. Provide access (test wells) for testing the ground grid system at one or several ground rod locations. Make test wells of a pipe surrounding the rod and connections with a cover placed on top at grade level. See Drawings for details.
2. Install a test well at the service entrance pole to serve as the service entrance grounding electrode.

G. Test
1. Perform ground resistance tests after underground installation and connections to building steel are complete, unless otherwise noted on applicable Drawings.
2. Make tests at each ground test well using a "fall of potential" test method. Each ground test well shall not exceed a maximum resistance of 5 ohms. Where measured values exceed this figure, install additional ground rods as required to reduce the resistance to the specified limit.

H. Inspection. Inspection of the grounding system by the Engineer and the local Code Inspector must take place before the grid trenches are backfilled.

END OF SECTION

SECTION 16105
POWER SYSTEM STUDY

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall provide a Power System Study for the electrical power system, including a Short Circuit Study, Coordination Study, Load Flow Study, Arc Flash Hazard Study and Motor Starting Voltage Drop Study. The studies shall include Load Flow current, voltage drop, demand load and design load. This power system analysis shall be limited to this project.

B. The electrical power system shall be deemed to include the utility company's transformer, the Owner's entire power distribution system, all existing and new system components, including any on-site standby generation. The short circuit and coordination study reports shall provide an evaluation of the electrical power systems and the model numbers and settings of the protective relays or devices and metering or motor monitoring devices for setting by the Contractor. The Study shall include settings for all circuit breakers, feeder relays, all motor protective relays and electric system monitoring devices.

C. The Contractor shall include the use of his own forces to obtain all pertinent data necessary for the successful completion of the Power System Studies, including information on all existing and new equipment and wiring pertinent to the Study. This shall be interpreted to include all cable and raceway data, data for new and existing motors, data from all existing and/or new switchgear, motor control centers, panel boards, and separately mounted fuses, starters and circuit breakers. Obtain all existing or new protective device information to include all present settings. The Contractor shall obtain any needed data or information from Contract Documents, various suppliers, the Electric Utility and from conducting his own field investigations. Obtain from the Utility company the available fault current and system impedance, X/R ratio etc. If, in his field investigations, the Contractor encounters conflicts between the Contract Documents and the field conditions, the Contractor shall immediately notify the Owner/Engineer for a resolution to the conflict. Copies of the data obtained, shall be organized and submitted to the Owner/Engineer at the same time of transmittal to the Study Engineer, to show that all the requested data gathering work has been completed.

1.2 RELATED WORK

A. The related work, associated with this Section, shall include all Sections of the Specifications, and the Contract Drawings.

B. The Contractor shall diligently prosecute the work of providing the information required, to the Study Engineer, particularly that information required from the Contractor's electrical equipment suppliers.

1.3 SUBMITTALS

A. The Contractor shall, not later than three (3) weeks after Contract Award, provide a submittal of the name and qualifications of the Study Engineer.

B. The Contractor shall provide two individual submittals:
   1. The first submittal shall be considered a Preliminary Submittal, in that it shall consist only of the Short Circuit Study results, based upon sound engineering reasonable assumptions, where known values are not available. This submittal shall be used by the Study Engineer to ascertain the short circuit current rating of the related equipment. This submittal shall be made for approved prior to any shop drawing submittal being reviewed for electrical equipment for which the results of this preliminary study are required.
   2. The final submittal shall be the Final Submittal as defined in this Section. The Contractor is hereby advised that, no electrical equipment for which the results of the final study are required, shall be energized until such results have been applied to such electrical equipment, and certified as Settings Complete by the manufacturer's field representative.

C. The Contractor shall, upon completion of the studies, submit the studies for approval to the Owner/Engineer. The study submittal shall include all of the input and output data files in electronic format for use directly with the specified study software. The Study shall include an actual size sample of an Arc Flash and Shock Hazard label with typical information shown. The Contractor shall allow not less than three (3) calendar weeks for review of the studies by the Owner/Engineer. The submittal shall not contain unresolved questions, conflicts or selective device coordination conflicts. A submittal containing such questions or conflicts will be returned unreviewed and shall not be resubmitted until such questions or conflicts have been resolved.

D. The completed, sealed, and signed studies, with all known issues resolved, shall be submitted to the Owner/Engineer for approval, not less than thirty (30) days prior to site delivery of any equipment containing protective devices requiring selections and settings for certification by the manufacturer. Final copies shall be in electronic form (Adobe PDF formatted files). Data files shall be provided at the same time in electronic format.

1.4 REFERENCE CODES AND STANDARDS

A. The specified studies shall be in accordance with the latest versions of the following codes and standards.
   1. IEEE Standard 1584 – 2018 IEEE Guide for Performing Arc-Flash Hazard Calculations, Including All Amendments.
   2. NFPA-70E – 2021 Standard for Electrical Safety Requirements for Employee Workplaces.
   3. ANSI/NFPA 70 – 2020 National Electrical Code

1.5 QUALITY ASSURANCE

A. The studies shall be performed by an Electrical Engineering Services firm, who is regularly engaged in power system studies. The studies shall be performed by a Licensed Professional Electrical Engineer of the firm with proficiency in electrical power systems engineering and shall seal and sign the final completed power system studies. The Study Engineer shall be licensed to practice engineering in the state where the electric equipment is to be installed.

B. The studies shall be performed using SKM, E-Tap, or approved Power Tools Electrical Engineering Analysis Software for Windows.

1.6 SCHEDULE OF WORK

A. The selection of the Study Engineer shall be performed in a timely manner, in accordance with the time specified, and the Study performed and submitted as specified above.

B. The completed studies, with all known issues resolved, shall be submitted to the Owner/Engineer for approval, as specified above.

PART 2 – STUDIES

2.1 ELECTRICAL ENGINEERING SERVICES FIRMS

A. Subject to compliance with the Contract Documents, the following services firms are acceptable:
1. Eaton Engineering Services
2. General Electric Co. Engineering Services
3. Schneider Electric Engineering Services
4. ABB Electrification Services
5. Approved Equal

2.2 SHORT CIRCUIT AND COORDINATION STUDY

A. Provide a complete short circuit study. Include three phase, phase-to-ground calculations and X/R ratios. Provide an equipment interrupting or withstand evaluation based on the actual equipment and model numbers provided on this project. Generic devices are not acceptable. Normal system operating method, alternate operation, and operations that could result in maximum fault conditions, shall be thoroughly addressed in the study. Provide single phase to ground and three- phase to ground fault information. The study shall assume all motors are operating at rated voltage with the exception that motors, identified as "standby," shall not be included. Electrical equipment bus impedances shall be assumed as zero. Short circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at the switchgear busses, switchboard busses, motor control centers and panelboards. The study shall be performed using actual available short circuit currents and system impedance as obtained from the Electric Utility. An assumption of infinite bus for the purposes of the study is not acceptable.

B. Provide a protective device coordination study. The study shall include all electrical equipment provided under this contract, including control panels containing power and protection equipment, lighting panels and power panels. The study shall include any up-stream or downstream equipment that has an impact on the coordination study. The study shall show transformer damage curves, cable short circuit-withstand curves and motor curves. The phase over current and ground-fault protection shall be included, as well as settings for all other adjustable protective devices. All motor monitoring relays and protective or monitoring devices that are a part of a supplier's equipment, such as soft starters or adjustable frequency drives, shall be included. Include the last protective device in the Electric Utilities system feeding each facility being considered.

C. An equipment evaluation study shall be performed to determine the adequacy of the fault bracing of all bus from the panel board level up to the main switchgear or protective device. Include circuit breakers, controllers, surge arresters, busway, switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the available fault currents.

D. Selective device coordination is required between protective devices in equipment specified in each Section of the Electrical Specifications, and between each piece of electrical equipment, including existing equipment, supplied for this project. If the Study Engineer, in the course of his work, determines that selective coordination cannot be obtained in or between pieces of existing and new equipment as specified, he shall immediately notify the Contractor, provide his supporting information to the Contractor, who shall transmit the information to the Owner/Engineer for resolution of the problem.

E. As a minimum, each short circuit study shall include the following:
1. One-Line Diagram:
a. Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.
b. Type designation, current rating, range or adjustment, manufacturer's style and catalog number for

all protective devices.

c. Power and voltage ratings, impedance, primary and secondary connections of all transformers. Use the ratings of the actual transformers being provided where available.

d. Type, manufacturer, and ratio of all instrument transformers energizing each relay.

e. Nameplate ratings of all motors and generators with their sub transient reactance.

f. Sources of short circuit currents such as utility ties, generators, synchronous motors, and induction motors. Provide short circuit studies using each source of power separately. The study shall determine if there is sufficient short circuit current to adequately cause interruption of a protective device using the weaker power source (typically local generation) and shall determine if the equipment can safely interrupt the fault if the greater power source is connected. Additional short circuit calculations shall include emergency as well as normal switching conditions as well as normal and emergency power sources described herein.

g. All significant circuit elements such as transformers, cables, breakers, fuses, reactors, etc. shall be included.

h. The time-current setting of existing adjustable relays and direct-acting trips, if applicable.

2. Impedance Diagram:

a. Available MVA or impedance from the utility company.

b. Local generated capacity impedance.

c. Transformer and/or reactor impedances.

d. Cable impedances.

e. System voltages.

f. Grounding scheme (resistance grounding, solid grounding, or no grounding).

3. Calculations:

a. Determine the paths and situations where short circuit currents are the greatest. Assume bolted faults and calculate the 3-phase and line-to- ground short circuits of each case.

b. Calculate the maximum and minimum fault currents.

F. Provide Time-Current Curves on 8-1/2 X 11 log-log paper. Do not put more than one branch of protective devices on any one coordination curve. Include a one-line diagram and the names of each protective device in the branch on the coordination curve drawing. Provide separate drawings for ground fault coordination curves. Use the names designated in the Contract Documents. Include motor and transformer damage curves, and cable short circuit withstand curves.

2.3 ARC FLASH HAZARD STUDY

A. The Power System Study shall include an Arc Flash Hazard Study that shall present the level of arc flash hazard for each item of electrical equipment, and the appropriate level of protection required per OSHA standards.

B. The analysis shall be performed with the aid of computer software intended for the purpose, in order to calculate Arc-Flash Incident Energy (AFIE) levels and flash protection boundary distances.

C. The analysis shall be performed under worst-case Arc-Flash conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

D. The calculations shall be performed in accordance with IEEE 1584-2018 and safe approach requirements determined in accordance with NFPA-70E-2021.

E. Results of the Analysis shall be submitted in tabular form, and shall include, device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment and AFIE levels.

F. After approval of the Study, The Study Engineer shall provide and affix labels as may be required for each item of electrical equipment furnished on the project. A typical warning sign shall be submitted with the Studyfor approval, and as shown below.
1. Flash Hazard Protection Boundary.
2. Limited Approach Boundary.
3. Restricted Boundary.
4. Prohibited Boundary.
5. Incident Energy Level.
6. Required Personal Protective Equipment Class.
7. Type of Fire Rated Clothing.

G. Size of each label shall be not less than 8 inches wide and 6 inches tall. Include the date of study in the label.



2.4 MOTOR STARTING VOLTAGE DROP STUDY

A. The motor starting study shall be provided for motors 100 HP and above, full voltage started. Include tables and bus voltages in one-linediagram

B. The study shall select the largest motor on a bus and shall assume all other motors on that bus are running. Where a Main-Tie-Main bus configuration is present, the study shall be done with both Main breakers closed and the Tie breaker open, and with one Main open and the Tie breaker closed.

C. Where the Utility feeders are feeding the switchgear, the study shall be done for each feeder based on the actual system impedance for each utility feeder.

D. A motor starting analysis shall be made where on-site standby generation is available to power the MCC using only the available power from the generator. If the generator has been sized to run only part of the load, then the system shall be modeled with only that part of the load running.

PART 3 – EXECUTION

3.1 FIELD SERVICES

A. Arc Flash Label Sign and Other Sign Installation Certification

1. When the sign installation is complete, the Contractor and the Owner/Engineer shall jointly inspect the locations and provide to the Owner/Engineer's satisfaction that all required signs are installed in all of the recommended locations indicated in the Study.

B. Training

1. The Contractor shall provide the services of the Arc-Flash Training Engineer, for a period of not less than one four (4) hour working day, to conduct a training program for the Owner's personnel, in the care, application and use of protective personal equipment, described by the warning signs installed on the project. The training program shall be conducted at a location onsite determined by the Owner and shall include specific equipment locations as may be required for instruction. Applicable information from the Study shall be provided to the attendees.

C. The cost of Field Services shall be included in the Contract Price.

D. The Owner reserves the right to video tape the training for the Owner's use.

END OF SECTION

SECTION 16111
CONDUIT, FITTINGS, AND BODIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specification for conduit, fittings and bodies.

1.2 REFERENCES

A. American National Standards Institute (ANSI).
   1. ANSI C80.1: Rigid Steel Conduit - Zinc Coated.
   2. ANSI C80.4: Fittings for Rigid Metal Conduit.
   3. ANSI C80.5: Rigid Aluminum Conduit.

B. Federal Specifications.
   1. W-C-58C: Conduit Outlet Boxes, Bodies Aluminum and Malleable Iron.
   2. W-C-1094: Conduit and Conduit Fittings Plastic, Rigid.
   3. WW-C-54C: Rigid Aluminum Conduit.
   4. WW-C-566C: Flexible Metal Conduit.
   5. WW-C-581D: Coatings on Steel Conduit.

C. National Electrical Manufacturers Association (NEMA).
   1. NEMA RN1: Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.
   2. NEMA TC2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
   3. NEMA TC3: PVC Fittings for Use with Rigid PVC Conduit and Tubing.

D. National Fire Protection Association (NFPA), ANSI/NFPA 70 - National Electrical Code (NEC).

E. Underwriters' Laboratories (UL).
   1. UL 1: Flexible Metal Electrical Conduit.
   2. UL 6: Rigid Metal Electrical Conduit.
   3. UL 6A: Rigid Aluminum Conduit.
   4. UL 514B: Fittings for Conduit and Outlet Boxes.
   5. UL 651: Schedule 40 and 80 Rigid PVC Conduit.
   6. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit.
   7. UL 886: Electrical Outlet Boxes and Fittings for Use in Hazardous Locations.

1.3 SUBMITTALS

A. Submit the following under the provisions of Section 01300, Submittals:
   1. Manufacturer's cut sheets, catalog data, with selected products clearly marked.
   2. Installation, terminating and splicing procedure.
   3. Instruction for handling and storage.
   4. Dimensions and weight.

1.4 QUALITY ASSURANCE

A. Tests
1. Rigid steel conduit shall pass the bending, ductility, and thickness of zinc coating tests described by ANSI C80.1.
2. Flexible conduit shall pass the tension, flexibility, impact, and zinc coating test described by UL 1.
3. Nonmetallic conduit and fittings shall pass the test requirements of NEMA TC2, UL 651 and 651A and Federal Specification W-C-1094A.

1.5 DELIVERY STORAGE AND HANDLING

A. Package conduit in 10-foot bundles maximum with conduit and coupling thread protectors suitable for indoor and outdoor storage. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage. Package plastic-coated rigid conduit, fittings, and bodies in such a manner as to protect the coating from damage during shipment and storage.

B. Store conduit above ground on racks to prevent corrosion and entrance of debris.

C. Protect plastic conduit from sunlight.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. PVC Coated Rigid Aluminum Conduit.
1. Allied Tube and Conduit
2. Wheatland Tube Company
3. Republic Conduit
4. Sapa Company
5. Blackguard

B. PVC Coated Steel Conduit.
1. Occidental Coating Company (O-Cal Blue)
2. Perma-Cote
3. Kor-Kap
4. Plasti-Bond
5. Blackguard
6. Atkore Calbond

C. PVC Rigid Conduit.
1. Cantex
2. Prime Conduit, Inc.
3. Robroy Industries, Inc.
4. Blackguard

D. Conduit Fittings and Bodies.
1. Appleton Electric
2. Crouse-Hinds

3. Killark Electric Manufacturing Company
4. O-Z/Gedney
5. Blackguard

E. Liquidtight Flexible Conduit.
1. Anamet, Inc.
2. Electriflex Company
3. International Metal Hose
4. Blackguard

2.2 MATERIALS AND EQUIPMENT

A. Design Conditions. Use electrical conduit, fittings, and bodies designed for service in areas as specified in Section 16011 – General Provisions with Existing Facilities and this section to form a continuous support system for power, control, and instrument cables.

B. Conduit and Fittings
1. Rigid Steel Conduit and Fittings.
   a. Rigid steel conduit, rigid steel conduit bends, nipples, and bodies shall be hot-dipped galvanized and shall comply with the latest ANSI C80.1, UL 6, Federal Specification WW-C-581D, and NEC Article 344.
   b. Mild steel tubing shall be used for conduit, nipples, and couplings, and shall be free of defects on both the inner and outer surfaces.
   c. Fittings, bodies, and covers for rigid steel conduit shall be steel or cast-iron and shall comply with ANSI C80.4, UL 514B, and Federal Specification W-C-58C.
2. PVC-Coated Rigid Steel Conduit and Fittings.
   a. PVC-coated conduit, fittings, bodies, and covers shall conform to NEMA RN1 (Type A). Rigid steel galvanized conduit and fittings before coating shall conform to Federal Specification WW-C-581D, ANSI C80.1, and UL 6. Conduit bodies shall conform to UL 514B and Federal Specification W-C-58C. Provide sufficient coating for touch up after installation.
   b. PVC-coated couplings shall be of the ribbed type.
   c. Condulet covers shall have encapsulated stainless steel thumbscrews.
   d. Condulets and covers shall be of malleable iron or ferroalloy material before coating.
   e. PVC coating shall be a minimum of 2 mil thickness on the interior of conduit and the interior of fittings, condulets, covers and bodies.
3. Flexible and Liquidtight Flexible Metal Conduit and Fittings.
   a. Use liquidtight flexible metal conduit manufactured in accordance with UL 1 and Federal Specification WW-C-566C.
   b. Fittings used with liquidtight flexible metal conduit shall be the PVC- coated type and of such design as to thoroughly ground the conduit to the fittings, and through it to the box or enclosure to which it is attached.
   c. Flexible couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501-4 (a&b), and Federal Specification W-C-586C.
4. PVC Sch 40 and 80 Conduit and Fittings. Use PVC conduit, bends, and fittings, which comply with NEMA TC 2, W-C-A, and NEC Article 348-17 for above ground and underground installation. Conduit shall be schedule 40 and 80.
5. Electrical Metallic Tubing (EMT) – Not allowed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Confirm submittal of shop drawing with conduit and conduit fitting, sizes, types and routing shown.

B. Ensure that the conduit system to be installed is sized properly for the cable and wire requirements.

C. Verify the actual physical conduit route from the conduit plan drawings and prepare the conduit support system.

D. Verify the equipment locations to which the conduit will be connected and determine detail requirements for connections.

3.2 INSTALLATION

A. Install PVC Sch 80 conduits in all inside valve vaults; in lift station wet well slabs; in all indoor areas where chemicals are stored, metered, pumped or processed and in corrosive, wet environments and outdoor location.

B. Install rigid galvanized steel (RGS) conduits in dry, inside, air-conditioned location only. Install PVC-coated rigid galvanized steel conduits in all wastewater plants outdoor and dry environments.

C. Install Schedule 40 PVC conduits for all underground applications including all single conduits, duct banks, and where conduits are encased in concrete slabs. The minimum bending radius for underground Schedule 40 PVC conduits shall be: 24” for conduits 2” and smaller; 36” for 2-½” and 3” conduits; and 48” for conduits larger than 3”. For stub-ups, use PVC-coated elbows with an appropriate length PVC-coated nipple to extend the conduit to the surface of the concrete or 12” above grade where concrete will not be poured. Install a conduit adapter with threaded plug flush with the top surface of the concrete or 12” above grade in dirt areas where concrete will not be poured. The threaded plug shall be removed when the conduit is extended. Where stub-ups are in dirt, concrete encase PVC conduits 6” above grade.

D. Conduit size to be minimum 1”, unless otherwise noted on plans.

E. Run exposed conduit parallel or perpendicular to walls, ceilings or main structural members. Group multiple conduits together where possible. Do not install conduit where it interferes with the use of passageways, doorways, overhead cranes, monorails, equipment removal areas or working areas. In no case shall conduit routing present a safety hazard or interfere with normal plant operating and maintenance procedures. Maintain a minimum overhead clearance of 8'-0" in passageways.

F. Installation and support of conduit shall be from steel or concrete structures in accordance with the standard detail drawings. Furnish necessary conduit straps, clamps, fittings and support for the conduit in accordance with the standard details and consistent with the grade and type of conduit being installed. If grade and type is not specified use Type 316 stainless steel Unistrut P1000 (or equivalent by other vendors) attached with Type 316 stainless steel bolts, expansion anchors and associated hardware. Furnish necessary Type 316 stainless steel conduit straps, clamps, fittings, rods and supports for the conduit in accordance with standard construction practices.

G. Identify conduit at termination points like MCC, light fixtures, control panels, receptacles, and junction boxes.

H. Not more than 3 equivalent 90 degree bends will be permitted between outlets. Provide bonded expansion fittings at building expansion joints.

I. Install conduit runs so that they are mechanically secure, mechanically protected from physical harm, electrically continuous, and neat in appearance. The interiors of conduit shall provide clean, smooth raceways through which conductors may be drawn without damage to the insulation. Make threaded connections wrench tight.

J. Cut conduit square with a power saw or a rotary type conduit cutter designed to leave a flat face. Do not use plumbing pipe cutters for cutting conduit. Ream the cut ends of conduit with a reamer, designed for the purpose to eliminate rough edges and burrs. Cut threads with standard conduit dies providing 3/4-inch taper per foot, allowing the proper length so that joints and terminals may be made up tight and the ends of the conduit not deformed. Keep dies sharp and use a good quality threading oil continuously during the threading operation. Remove metal cuttings and oil from the conduit ends after the threads are cut and paint threads before connections are made. Use zinc rich, brush-on compound on the threads of steel conduit before connections are made. Use only tools specifically made for bending and installing PVC-coated or PVC conduit when installing these materials.

K. Use strap wrenches only to tighten joints in plastic coated rigid steel conduit. Replace all conduit and fittings with damage to the plastic coating, such as cuts, nicks and threader chuck jaw marks.

L. Make up changes in direction of conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise.

M. Field fabricated bends shall be free of indentations or elliptical sections. The radius of the bend shall not be less than 6 times the smallest diameter of the raceway.

N. Protect all conduit terminations from mechanical injury. Prevent the entry of moisture and foreign mater into the conduit system by properly capping terminations.

O. Avoid trapped runs of conduit, if possible. When they are necessary, provide drainage using a "tee" condulet equipped with a drain. Conduit is likely to pass through areas with a temperature differential of 20 degrees F or more. Seal penetrations with a proper seal fitting at the wall or barrier between such areas. For conduit passing through walls separating pressurized areas from non-pressurized areas, install sealing fittings at the wall on the non-pressurized side.

P. Fit conduit crossing building or structure expansion joints with approved expansion fittings, except that fittings will not be required when conduit crossing an expansion joint is supported on trapeze hangers in such a way that at no time will the conduit be under stress due to expansion. Install bonding jumpers around expansion joint fittings.

Q. Where conduit terminates in sheet metal enclosures and where no threaded hubs are provided, fit the conduit with double locknuts and bushings. Sheet metal enclosures located outside or in any other wet, damp or corrosive areas shall be furnished with threaded hubs. Restrict side penetrations to the lower one third of the enclosure.

R. Provide flexible metallic conduit where necessary to allow for movement or to localize sound or vibration, at transformers, at motors and any other rotating equipment unless shown otherwise on Drawings.

S. Seal openings or holes where conduits pass through walls or floors. When conduits are passing through a firewall or fire-rated floor into different rooms, cabinets, or enclosures, use a fire-rated seal as shown in the typical detail included in the Drawings. Certain walls, as indicated on the Drawings, require environmental (air-tight) seals; seal as shown.

T. Install explosion-proof seals in conduit runs crossing or entering a hazardous classified area, as shown on Drawings. Install type CSBE removable sealing fittings to seal pump cables in the wet well and at the first junction box outside the well.

U. Unless otherwise indicated on the Drawings, install expansion fittings every 300 feet within a straight conduit run and where conduit crosses building expansion joints, using bonding straps to ensure ground continuity.

V. Parallel runs of conduit may be supported by structural steel racks. When two or more racks are arranged one above the other, provide vertical separation of not less than 12 inches between racks, unless otherwise indicated on the Drawings. Space conduits on the racks at least enough to provide 1/4-inch clearance between hubs on adjacent conduits at terminations and to allow room for fittings.

W. Fill conduit racks no more than 75 percent of their capacity, providing usable space for future conduit. To ensure this, conduits leaving the rack horizontally shall be offset up or down so that future conduits may be installed in the space remaining. Construct conduit racks to permit access for wire or cable pulling at all pull points, even when future conduits are added to fill the racks.

X. Where conduit racks are supported on rods from beam clamps or by some other non-rigid suspension system, install rigid supports at no more than 50-foot intervals to give lateral stability to the rack.

Y. Conduit racks or hangers must in no way interfere with machinery (or its operation), piping, structural members, process equipment, or access to anticipated future equipment. Refer to architectural, structural, equipment layout and piping drawings to ensure that this requirement is met. Label high voltage conduit with the circuit phase-to-phase voltage by means of a firmly attached tag or label of approved design at each conduit termination, on each side of walls or barriers pierced and at intervals not exceeding 200 feet along the entire length of the conduit.

Z. Support conduit sizes 2 inches and larger at spacings not exceeding 10 feet and conduit sizes 1-1/2 inches and smaller at spacings not exceeding 8 feet.

AA. The means of fastening conduit to supports shall be: by one hole malleable iron conduit straps secured by wood screws to wood and by bolts with expansion anchors to concrete or masonry; by "Korn" clamps or U-bolts to other surfaces. Use "clamp backs" when strapping conduits to walls, column faces, or other such surfaces.

BB. Support conduit runs with conduit clamps, hangers, straps and metal framing channel attached to structural steel members. Conduits of 1-1/2 inch size or less may be supported by one-hole conduit straps on concrete, tile or steel work, but for larger size conduit, use 2-hole straps. Use clamps of galvanized malleable iron for rigid galvanized conduit and PVC-coated or stainless steel for PVC-coated conduit. Metal framing channel straps used for PVC-coated conduit shall be type 3/16 stainless steel.

CC. Install conduits supported from building walls with at least 1/4-inch clearance from the wall to prevent the accumulation of dirt and moisture behind conduit.

DD. Size and space embedded conduits in structural slabs in accordance with the Uniform Building Code. Conduits should occupy no more than one-third the thickness of the slab and should not be closer than 3 times the largest diameter on center without additional reinforcement.

EE. Unless otherwise indicated on the Drawings, seal all conduit runs crossing or entering a corrosive area with duct seal.

END OF SECTION

SECTION 16120
RACEWAY SYSTEMS

PART 1 – GENERAL

1.1 SCOPE

A. This section provides requirements for electrical raceways systems, including fittings.

B. All applicable requirements of Section 16011 – General Provisions with Existing Facilities are hereby made a part of this section.

1.2 REFERENCE STANDARDS

A. The latest editions of standards listed below form a part of this specification.
   1. ANSI.
      a. C 80.1: Specification for Rigid Steel Conduit, Zinc Coated.
      b. C 80.4: Specification for Fittings for Rigid Metal Conduit and Electrical Metallic Tubing.
      c. C 80.5: Specifications for Rigid Aluminum Conduits.

PART 2 – PRODUCTS

2.1 CONDUIT AND FITTINGS

A. Rigid Steel Conduit and Fittings. To be PVC coated rigid galvanized steel, including threads. Cadmium-plated malleable iron fittings are also acceptable.

B. Liquid-tight Flexible Metallic Conduit. Use for motors exposed to weather, water, or grease, and for all pump motor connections. Make the conduit grounding system continuous at such points by manufacturer installed, UL approved, copper grounding strap or by jumpers sized in accordance with NEC Table 250-95.

C. Rigid Non-metallic Conduit and Fittings. To be Schedule 40 PVC, UL rated for use with 90C cable.

D. Ground Bushing. Provide grounding-type bushings on all conduits entering MCC from below grade. Bond to ground bus with code size individual jumper.

E. Expansion Fittings. Provide fittings of OZ type EX, or approved equal where conduits cross expansion joints.

F. Acceptable Manufacturers.
   1. PVC Coated Aluminum Conduit. Allied, Wheatland Tube, Republic, Sapa Co. or Blackguard.
   2. PVC Coated Rigid Steel Conduit. O-CAL Blue, Perma-Cote, Schlumberger (Kor-KAP), Plasti-Bond, Atkore Calbond or Blackguard.
   3. Liquid-Tight Flexible Metallic Conduit. Anamet, Electric-Flex, International Metal Hose or Blackguard.
   4. Rigid Non-Metallic Conduit. Cantex, Prime Conduit, Robroy Industries or Blackguard.
   5. Fittings for Rigid Conduit. Appleton, Crouse-hinds, Killark, O-Z/Gedney or Blackguard.

2.2 WIREWAYS

A. Provide wireways as indicated or required. Fabricate wireways of no less than 16-gage sheet steel and to dimensions no smaller than 4" x 4".

PART 3 – EXECUTION

3.1 CONDUIT

A. General. All runs of conduit except those runs inside the chemical area shall be PVC Coated rigid galvanized steel or PVC Coated rigid aluminum conduit. Conduit runs inside chemical area shall be Schedule 80 PVC pipe. Install all wiring in conduit to proper size to contain number of conductors required in accordance with latest edition of National Electric Code (NEC). Where conduit sizes shown on drawings are larger than those required by NEC, provide larger size. Unless otherwise specified or noted, all conduit, fittings, and accessories shall be hot-dip galvanized rigid steel.

B. Other Requirements.

1. Conduits must be electrically continuous from outlet to outlet, and from outlet to cabinets, junction boxes, and pull boxes. The conduit must enter and be secured to all boxes so that each system is electrically continuous throughout. At conduit terminals provide double lock nuts and insulated bushings or terminate on conduit hubs. Use of running threads is prohibited. Supply conduit terminating in motor control center with a grounding-type bushing and connect to ground bus.
2. Run concealed conduit directly and with as long bends as possible. Run exposed conduit parallel or at right angles to the lines of the building.
3. No conduit shall be less than 1-inch (1") diameter.
4. Underground runs of all conduits shall be encased all around with three-inch (3") layer of red concrete and installed not less than 24-inches below grade.

C. Installation Methods.

1. Install each entire conduit system complete before drawing any conductors. Finish every run of conduit before drawing up to guard against obstructions and omissions.
2. Cut all joints square, ream smooth, and draw tight.
3. Make all bends with standard ells or conduit bent to not less than same radius. All bends must be free from dents or flattening. Use no more than the equivalent of four quarter bends in any run between terminals and cabinets, or between outlets and junction boxes or pull boxes.
4. Condulets may be used in lieu of conduit ells where ease of installation and appearance warrants their use.
5. Securely fasten and support all conduits using stainless steel, one-hole pipe straps or other approved means. Tie wires may be used for securing or supporting conduits less than 1½-inch (1½") if the conduit is installed through the web of bar joists. Do not use tie wires to secure or support any conduit from bottom of bar joists. Branch circuit raceways which are one-inch (1") or smaller may be attached to ceiling support hangers by use of caddy clips.
6. Clean and swab all conduit runs to remove foreign matter and moisture prior to pulling in wire and cable. Clean boxes in which conduits terminate of all concrete, mortar, and other foreign matter.

3.2 WIREWAYS

A. Wiring in wireways must be neatly bundled, tied, and suitably tagged.

END OF SECTION

SECTION 16121
INSTRUMENTATION CABLE

PART 1 – GENERAL

A. Specifications for instrumentation cable.

1.1 REFERENCES

A. American Society for Testing and Materials (ASTM).
   1. ASTM B3: Soft or Annealed Copper Wires.
   2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft.
   3. ASTM B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.

C. Insulated Cable Engineers Association (ICEA):
   1. ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).
   2. ICEA S-66-524: Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-7).
   3. ICEA S-68-516: Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-8).

D. Underwriters' Laboratories (UL):
   1. UL 44: Rubber Insulated Wires and Cables.
   2. UL 83: Thermoplastic Insulated Wire and Cables.

E. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Chapter No. 3 - Wiring Methods and Materials, Article 725 - Class 1, Class 2, and Class 3 Remote Control, Signaling, and Power-Limited Circuits.

1.2 SUBMITTALS

A. Submit the following under the provisions of Section 01300 - Submittals:
   1. Completed engineer's data sheets from this specification or manufacturer's data sheets, cut sheets, and catalog data.
   2. Installation, terminating and splicing procedure (including bending radius and pulling tension data).
   3. Instruction for handling and storage.
   4. Dimensions and weight.

1.3 QUALITY ASSURANCE

A. Tests:

1. Cable shall be tested at the factory to confirm that the cable complies with requirements of ICEA Section 7.7.9 of S-66-524 or 7.5.9 of S-68-516. Refer to data sheet for additional test requirements.

2. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5.

1.4 DELIVERY, STORAGE AND HANDLING

A. Ship cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Reels shall be of the type specified on the data sheets. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Alpha Wire Corporation

B. Belden Division, Cooper Industries, Inc.

C. Cablec Continental Cables Company

D. General Cable Company

E. Manhattan Electric Cable Corporation

F. Okonite Company

2.2 MATERIALS AND EQUIPMENT

A. Design: Provide cable with the following design characteristics. The cable shall consist of multiple conductors. The cable assembly shall be UL listed, flame, oil and sunlight resistant, and certified for continuous operation at the temperature specified on the Instrumentation Cable Data Sheets in wet or dry locations while installed in underground duct, conduit, or cable tray. The number and size of conductors supplied in each cable shall correspond to the quantities specified on the Instrumentation Cable Data Sheets. Each conductor shall be individually insulated. Pairs and triads shall have conductors, which are twisted together with a drain wire, shielded, and covered with a jacket. Multi-pair/triad cables shall consist of the required number of electrically isolated, shielded pairs or triads, which are bundled together and covered by an overall jacket as specified on the Instrumentation Cable Data Sheets.

B. Conductors: Provide conductors which are Class B, concentric stranded, annealed tinned copper whose physical and electrical properties comply with ASTM B3, B8 or B33 and Part 2 of ICEA S-61-402, S-66-524, or S-68-516, unless otherwise specified on the Instrumentation Cable Data Sheets.

C. Insulation: Each conductor shall be insulated as specified on the Instrumentation Cable Data Sheets in compliance the requirements of Part 3 of ICEA S-61-402, S-66-524, or S-68-516. The average insulation thickness shall not be less than the dimensions shown in Table 7-32 or 7.5.1 of ICEA S-66-524 or S-68-516 for 600-volt insulation unless otherwise specified on the Instrumentation Cable Data Sheets. The minimum insulation thickness shall not be less than 90 percent of the value given in the table.

D. Drain Wire: Provide drain wire which is Class B, seven-stranded, tin-coated copper in accordance with ASTM B3, B8, or B33 and as specified on the Instrumentation Cable Data Sheets. The drain wire shall not be less than two AWG sizes smaller than the insulated conductor's size, except for multiple pair triad drain wires, which shall not be less than the insulated conductor size.

E. Shielding: Provide shielding consisting of laminated, nonburning, mylar-backed aluminum tape applied helically around a twisted pair or triad with the aluminum side in continuous contact with the drain wire unless otherwise specified on the Instrumentation Cable Data Sheet. Wrap the tape around each twisted pair or triad with a 25 percent minimum overlap unless otherwise specified on the Instrumentation Cable Data Sheets.

F. Jacket: The physical and electrical properties of the jacket used to cover single or multi-pair or triad cables shall meet the requirements of section 7.7.7 or ICEA S-66-524 or section 7.5.6 of ICEA S-68-516. Jacket material is specified on the Instrumentation Cable Data Sheets. The jacket thickness shall be equal to the dimensions shown in Table 7-33 or 7.5.2 of ICEA S-66-524 or S-68-516. The jacket material is specified on the Instrumentation Cable Data Sheets. The jacket thickness shall be equal to the dimensions shown in Table 7-33 or 7.5.2 of ICEA S-66-524 or S-68-516.

G. Armor: Where requested, use instrumentation cables protected by an interlocked metal tape armor coating made of galvanized steel which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524, unless otherwise specified on the Instrumentation Cable Data Sheets.

H. Conductor Identification: Use individual conductors in single-pair and single-triad cables which are color coded black and white; and black, white and red, respectively. Multi-pair-triad cables shall have one conductor in each pair or triad colored white, and all other conductors are color coded in sequence according to Table L-2 of Appendix 2 of ICEA S-66-524, and as specified on the Instrumentation Cable Data Sheets.

I. Cable Marking: Print cable-marking information on the jacket of each cable at 2-foot intervals. Use a permanent printing method with color sharply contrasting the jacket color. See the Instrumentation Cable Data Sheets for the minimum information required.

PART 3 – EXECUTION

3.1 PREPARATION

A. Complete cable raceway systems, underground duct banks and cable support systems before installing cables.

B. Verify sizing of raceways and pullboxes to ensure proper accommodation for the cables.

C. Check the length of the cable raceway system against the length of cable on the selected reel.

D. Do not install or work on PVC insulated or jacketed cables in temperatures below 32 degrees F.

E. Clean conduits of foreign matter before cables are pulled.

F. When drawing calls for more than one pair, provide at least 30 percent spare conductors or pairs.

3.2 INSTALLATION

A. Cable in Conduit and Ductbank
1. Install cables in accordance with the manufacturer's instructions and NEC Article 725 - Class 1, Class 2, and Class 3 Remote Control, Signaling and Power Limited Circuits. Do not exceed maximum wire tension, maximum insulation pressure and minimum bending radius.
2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation or cable jacket.
3. Do not install instrument cable in the same conduit as power cables. If instrument cable must enter the same junction box or pull box as power cables, provide and install a galvanized steel, aluminum, or stainless steel divider to separate.
4. Where conduits do not terminate at an enclosure, provide a conduit sealing bushing for cables exiting the conduit.

B. Cable in Tray: Install instrument and signal cable in cable tray only when the tray is dedicated for this type cable and cables are approved for tray installation.

C. Termination:
1. Do not splice conductors. For termination use crimp-on type ring tongue non-insulated tin-plated copper lugs.
2. For shielded control cable, terminate the shield and ground it at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables. Shield on ungrounded cable end to be wrapped cylindrically around cable end and thoroughly insulated with Scotch 33 electrical tape. Grounded end to be of sufficient length to reach ground screw or terminal strip and insulated with transparent tubing.
3. If splicing is required, maintain shield continuity by jumpering the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground.
4. Mark wiring on both ends with circuit numbers or loop tag numbers. Heat shrink wire markers after the ring tongue terminal has been installed. Extend the marker over the crimp or base of the terminal.

D. Tests:
1. Before connecting the cables, test insulation integrity and conductor continuity.
2. Test shielded cable shields with an ohmmeter for continuity along the length of the cable and for shield continuity to ground.
3. Connect shielded instrumentation cables to a calibrated 4-20 milliamp DC signal transmitter and receiver. Test at 4, 12, and 20 milliamp transmitter settings.
4. Test each electrical circuit after permanent cables are in place to demonstrate that the circuit and connected equipment perform satisfactorily and that cables are free from improper grounds and short circuits.

E. Termination: After the instrumentation cable has been tested with satisfactory results, the cable can be terminated at both ends to their designated terminal points.

END OF SECTION

SECTION 16122
WIRE AND CABLE 600 VOLT AND BELOW

PART 1 – GENERAL

1.1 SECTION INCLUDES

Specifications for 600-volt power cable.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).
   1. ASTM B3: Soft or Annealed Copper Wires.
   2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft.
   3. ASTM B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.

C. Insulated Cable Engineers Association (ICEA).

   1. iICEA S-95-658 Power cable s rated 2000 volts or less for distribution electrical energys(NEMA 70)

D. Underwriters' Laboratories (UL).
   1. UL 44: Thermoset-Insulated wire and cables.
   2. UL 83: Thermoplastic Insulated Wire and Cables.

E. National Fire Protection Association (NFPA), No. 70 - National Electrical Code (NEC), Chapter No. 3 - Wiring Methods and Materials.

1.3 SUBMITTALS

A. Submit the following under the provisions of Section 01300 – Submittals:
   1. Completed engineer's data sheets from this specification or manufacturer's data sheets, cut sheets and catalog data.
   2. Installation, terminating and splicing procedure (including bending radius and pulling tension data).
   3. Instruction for handling and storage.
   4. Dimensions and weight.

1.4 QUALITY ASSURANCE

A. Tests - Cable shall be tested at the factory to confirm that the cable complies with requirements

B. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5.

1.5 DELIVERY STORAGE AND HANDLING

A. Ship cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Reels shall be of the type specified on the data sheets. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cerro Wire LLC

B. Encore Wire Corporation

C. General Cable Company

D. Okonite Company

E. Republic Wire, Inc.

F. Southwire Company, Inc.

G. United Copper Industries

2.2 MATERIALS AND EQUIPMENT

A. Design. Provide cable with the following design characteristic. Cable shall be UL 44 or UL 83 listed, rated 600 volts and certified for continuous operation at the temperature as specified while installed in underground duct, conduit, or cable tray. Cables shall be single-conductor or multi-conductor (with ground) as specified on the Drawings.

B. Conductors. Provide conductors which are Class B, concentric stranded, annealed copper coated, unless otherwise specified.

C. Jacket.
1. When power cables are to be enclosed in conduit, ducts or in other raceway systems, multiconductor power cables shall be of the non-metallic type and shall be covered by an overall nonmetallic jacket
2. Single-conductor cables shall have a jacket thickness

D. Armor. When power cables are to be exposed in a cable tray, cable channel or other cable support systems, the multiconductor power cables shall be protected by an interlocked metal armor made of galvanized steel which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524 unless otherwise specified on the plan sheets. An over-all jacket shall be provided as specified in the plan sheets.

E. Cable Marking. Print cable marking information on the overall cable jacket at 2-foot intervals. Use a permanent printing method color with a sharply contrasting the jacket color. Identify individual conductors as specified on the plan sheets in conformance with Part 5 of ICEA S-61-402, S-66-524, and S-68-516.

PART 3 – EXECUTION

3.1 PREPARATION

A. Complete cable raceway systems, underground duct banks, and cable support systems before installing cables.

B. Verify sizing of raceways and pullboxes to ensure proper accommodation for the cables.

C. Check the length of the cable raceway system against the length of cable on the selected reel.

D. Do not install or work on PVC insulated or jacketed cables in temperatures below 32 degrees F.

3.2 INSTALLATION

A. Cable in Conduit and Ductbank.
1. Clean conduits of foreign matter before cables are pulled.
2. Install cables in accordance with the manufacturer's instructions NEC Chapter 3 - Wiring Methods and Materials. Do not exceed maximum wire tension, maximum insulation pressure and minimum bending radius.
3. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation.

B. Cable in Tray (Not Applicable)
1. Install medium voltage (5 Kv and 15 Kv) and 600V cables in separate trays or separate cables by a barrier in a single tray in accordance with NEC 318-6(f).
2. Install cables in trays in a neat and orderly manner. Tie cables to the tray rungs at approximate 15-foot intervals by use of cable ties.
3. Only one layer of 3-conductor No. 4/0 AWG and larger 600-volt power cables are allowed in a cable tray per NEC 318-9(a).
4. Using cable ties, make a triplex of single conductors used for 3-phase systems. Install in cable tray in accordance with NEC 318-10.

C. Splicing.
1. No splices are allowed unless shown explicitly on drawings or pre-approved by Engineer.
2. For approved cable taps, use ILSCO insulated lugs or approved equal.

D. Tests.
1. Before connecting the cables, test insulation integrity.
2. Use a 500 VDC megohmmeter and perform the cable insulation test in accordance with the operating instructions.

E. Termination.
1. After the 600-volt cable has been tested with satisfactory results, terminate the cable at both ends to designated terminal points.
2. Tighten connection bolts with a torque wrench to specified torque levels.

END OF SECTION

SECTION 16135
ELECTRICAL EXTERIOR UNDERGROUND

PART 1 - GENERAL

1.1 SUMMARY

A. Requirements for underground electrical concrete duct banks.

1.2 REFERENCES

A. National Fire Protection Association (NFPA): No. 70 - National Electrical Code (NEC) Appendix B.

1.3 SUBMITTALS

A. Submit all products covered under this specification for Engineer's approval.

B. Catalog cut sheets of the ducts and spacers.

1.4 DELIVERY, STORAGE AND HANDLING

A. Have duct spacers and associated hardware packed and crated to avoid damage during shipment and handling.

B. Clearly mark packages or crates stating that the material is for electrical duct banks only.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Thomas and Betts.

B. Underground Devices Inc.

C. Walker Division, Butler Manufacturing Company.

2.2 MATERIALS AND EQUIPMENT

A. Conduit. Construct ducts using schedule 40 rigid PVC conduit. Refer to Section 16111 - Conduit, Fittings and Bodies.

B. Spacers. Secure conduit with non-magnetic, universal, interlocking-type spacers for both horizontal and vertical duct arrangements.

C. Concrete. Use steel reinforced, red concrete as duct encasement.

PART 3 – EXECUTION

3.1 PREPARATION

A. Verify from Drawings and field survey that the location of ductbanks does not interfere with any existing or new underground facilities.

B. Verify that materials are on site in proper condition and that sufficient quantity is on hand for the work.

C. Verify that trenches are in the correct places and prepared with sufficient depth and width to accommodate the duct banks, reinforcing rod, and concrete.

D. Be prepared for inspection of the duct banks before reinforcing rod is installed.

E. Before pouring concrete, verify that the ducts are free of debris and properly installed in the support and spacer systems and that the ducts are properly fitted together and firmly held in place by the hold down hardware.

F. Provide 24-hour notice to Engineer and the Local Code Inspector for cover-up inspection before pouring electrical conduit ductbanks.

3.2 INSTALLATION

A. Use the size and types of conduit as indicated on the Drawings for the various duct banks required for the project.

B. Make duct bank installations and penetrations through foundation walls watertight.

C. Assemble duct banks using non-magnetic saddles, spacers and separators. Position separators to provide 2-inch minimum concrete separation between the outer surfaces of the conduits.

D. Provide a 3-inch minimum concrete covering on both sides, top and bottom of concrete envelopes around conduits. Add red dye at the rate of 10 pounds per cubic yard to concrete used for envelopes for easy identification during subsequent excavation.

E. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to ensure filling of spaces between ducts.

F. Make bends with sweeps of radius not less than 6 times the smallest diameter of the raceway.

G. Make a transition from non-metallic to metallic rigid conduit where duct banks enter structures or turn upward for continuation above grade.

H. Make bends of 30 degrees or more using rigid galvanized steel.

I. Reinforce duct banks throughout, where indicated on the Drawings.
   1. Unless otherwise noted on the Drawings, reinforce with No. 5 longitudinal steel bars placed at each corner and along each face at a maximum parallel spacing of 12 inches on centers, and No. 5 tie-bars transversely placed at 18-inch maximum longitudinal intervals.
   2. Maintain a maximum clearance of 2 inches from bars to the edge of the concrete encasement.

J. Where ducts enter structures such as handholes, manholes, pullboxes, or buildings, terminate the ducts in suitable end bells, insulated L-bushings, Meyers hubs or couplings on steel conduits. Tag conduit entering pull boxes with stamped, stainless steel tags. Identify as designated in cable and conduit schedule.

K. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials which can damage or contribute to corrosion of ducts or prevent adequate compaction of fill.

L. Install a bare stranded copper duct bank ground in each duct bank envelope for ungrounded feeders or as required on construction plans. Make ground electrically continuous throughout the entire duct bank system. Connect ground to switchgear and MCC ground buses and to steel conduit extensions of the underground duct system.

M. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately one-fourth inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to remove any particles of earth, sand or gravel that may have been left in the duct. Repull the rag or sponge swab until the swab emerges clean.

N. Use hemp rope to pull conductors into PVC conduit. Do not use nylon or wire cable for this purpose.

O. Install a warning ribbon approximately 12 inches below finished grade over underground duct banks. Refer to Section 16195 - Electrical Identification.

P. For manholes and pull boxes below grade, install wire racks to support cables properly around the perimeter and keep them dry.

Q. For manholes and pull boxes below grade, construct a french drain, or other drainage as detailed on the Drawings.

END OF SECTION

SECTION 16136
PULL, JUNCTION, AND TERMINAL BOXES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Specifications for device, pull, and junction boxes.

1.2 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA).
   1. FB1 - Fittings and Support for Conduits and Cable Assemblies
   2. 250 - Enclosures for Electrical Equipment (1000 volts maximum)

B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA70 - National Electrical Code (NEC) - Article 370 - Outlet Device, Pull and Junction Boxes, Conduit Bodies and Fittings.

C. Underwriters Laboratories (UL):
   1. 50 - Safety Cabinets and Boxes
   2. 508 - Safety Industrial Control Equipment
   3. 514B - Safety Fittings for Conduit and Outlet Boxes
   4. 886 - Safety Outlet Boxes and Fittings for Use in Hazardous Areas

1.3 SUBMITTALS

A. Submit the following under provisions of Section 01300 – Submittals:
   1. Manufacturer's cut sheets, catalog data
   2. Instruction for handling and storage
   3. Installation instructions
   4. Dimensions and weights

1.4 DELIVERY, STORAGE AND HANDLING

A. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Sheet Metal Boxes
   1. Hoffman Industrial Products
   4. ABB
   5. Tejas
   6. Eaton-Cooper

B. Cast Device Boxes
   1. Appleton Electric Company
   2. Crouse-Hinds, Division of Cooper Industries
   3. Killark Electric Manufacturing Company

2.2 MATERIALS AND EQUIPMENT

A. Sheet Metal Boxes
   1. Provide UL-approved junction boxes and pull boxes manufactured from stainless steel sheet metal and meeting requirements of NEMA 4X for corrosive and wet area, NEMA 250 and NEC Article 370.
   2. Provide boxes with a stainless steel continuous hinge, closure hasps and all- stainless steel hardware.
   3. Furnish the door with neoprene gasket and provision for padlock.
   4. Single-door enclosures shall have a quarter-turn slotted latch.

B. Device Boxes
   1. Provide UL-approved boxes designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC Article 370.
   2. Supply boxes that are hot-dip galvanized on cast iron suitable for corrosive and wet atmosphere.

C. Hardware
   1. Mounting Hardware: Stainless steel
   2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 – EXECUTION

3.1 PREPARATION

A. Review the drawings and determine how many boxes of each kind are required and check if supplied quantity is sufficient.

3.2 INSTALLATION

A. Boxes described in this specification shall be used both in dry and wet, corrosive areas, both inside and outside locations.

B. Install boxes in accordance with NEC Article 370 in locations indicated on the Drawings.

C. Install junction and pull boxes in readily accessible places to facilitate wire pulls, maintenance and repair.

D. Plug unused conduit openings.

E. Make conduit connections to sheet metal boxes with watertight conduit connectors.

END OF SECTION

SECTION 16137
OUTLET BOXES

PART 1 – GENERAL

1.1 SCOPE

A. This section describes requirements for outlet boxes, pull boxes and floor boxes.

1.2 REFERENCE STANDARDS

A. National Electric Code

B. Federal Specification W-J-800.

1.3 SUBMITTALS

Submit shop drawings as specified in Division 1, General Requirement. Drawings must show holes, construction and finish.

PART 2 – PRODUCTS

2.1 OUTLET BOXES

A. All outlet boxes to be Crouse-Hinds FS/FD or equal in malleable iron with cast or stainless steel covers.

B. Acceptance manufacturers are Adalet, Appleton, Crouse-Hinds and OZ-Gedney.

2.2 PULL BOXES

A. Furnish boxes of galvanized steel, at least four (4) inches deep, built to the requirements of Article 370 of NEC (indoors only).

B. Provide the cast, vapor-tight type in areas exposed to rain or in wet locations.

C. Acceptable manufacturers are Hoffman, Keystone and Stahlin.

PART 3 – EXECUTION

3.1 OUTLET BOXES

A. Unless otherwise indicated, surface mount all outlet boxes. Securely fasten boxes to wall or structure with extension anchors and S.S. screws.

3.2 PULL BOXES

A. Provide pull boxes as required to facilitate cable installation in raceway systems. Generally provide pull boxes in conduits of more than 100 feet or with more than three (3) 90 degree turns. Locate boxes strategically and make them of such shape to permit easy pulling of wire or cables.

B. Provide boxes so that covers are readily accessible and easily removable after completion of the installation. Provide suitable access doors for boxes above suspended ceilings. Select a practical size for each box and cover.

C. Tag each conductor in a pull box to clearly indicate electrical characteristics, circuit number, and destination coming and going. Secure all conductors in a neat and orderly fashion to permit easy identification, and without exceeding 30 inches of unsupported length.

D. Indicate location and size of all pull boxes As-Built on the project record drawings.

END OF SECTION

SECTION 16140
WIRING DEVICES

PART 1 – GENERAL

1.1 SCOPE

A. This section describes requirements for wiring devices, including wall switches, receptacles, and plates. Provide exactly as specified unless otherwise indicated.

1.2 REFERENCE STANDARD

A. Switches. U.L. 20-General Use Snap Switches

B. Receptacles. U.L. 498 - Electrical Attachment Plugs and Receptacles.

1.3 PRODUCT DATA

A. Submit complete description of each device to be provided.

PART 2 – PRODUCTS

2.1 WIRING DEVICES

A. All wiring devices shall be Industrial heavy duty, specification grade.

B. Two-pole, 3-wire grounding 20A/125V, NEMA 5-20R duplex receptacle shall be Cooper Wiring Devices #5362, Hubbell #5362, or equal.

C. Two-pole, 3-wire grounding 20A/250V, NEMA 6-20R single receptacle shall be Cooper Wiring Devices #5462, Hubbell #5461, or equal.

D. Two-pole, 3-wire grounding 30A/250V, NEMA 6-30R single receptacle shall be Cooper Wiring Devices #5700, Hubbell #9330, or equal.

E. GFCI devices shall be a duplex 5-20R, 20 amp, 125 V, 3-wire outlet with reset and test pushbuttons Cooper Wiring Devices Catalog #WRVGF20, or equal. Wet location enclosure shall consist of metal weather box while in-use weather protective cover Cooper Wiring Devices Catalog #WIUMH-1.

G. Weatherproof/corrosion resistant single, 20 Amp, 125 Volt, 2 Pole, 3 Wire, with cover shall be Crouse-Hinds Co. No. WLRS-5-20, Appleton Electric FSKJ520, or equal.

H. Weatherproof/corrosion resistant duplex, 20 Amp, 125 Volt, 2 Pole, 3 Wire, with cover shall be Crouse-Hinds Co. No. WLRD-5-20, Appleton Electric FSKD520, or equal.

I. Explosion-proof duplex, 20 Amp, 125 Volt, 2 Pole, 3 Wire; Appleton Electric, Catalog No. CPC22350 and plug, Appleton Electric Catalog No. CPP2023; Cooper; Hubbell, or equal.

J. Single-pole, single-throw, 20 Amp, 120/277 Volt toggle switch shall be Cooper Wiring Devices #1991, Hubbell #1221, or equal.

K. Single-pole, double-throw (three-way) 20 Amp, 120/277 Volt toggle switch shall be Cooper Wiring Devices #1993, Hubbell #1223, or equal.

L. Double-pole, double throw (four-way) 20 Amp, 120/277 Volt toggle switch shall be Cooper Wiring Devices #1994, Hubbell #1224, or equal.

M. Momentary contact, three position, 2 circuit, center off - Cooper Wiring Devices: Hubbell Wiring Devices, or equal.

N. Explosion-proof single pole factory sealed switches shall be for 20 Amps, 120/277 volts, mounted in copper free aluminum or malleable iron cast boxes and shall be Crouse-Hinds EDS Series, Appleton Electric Co. EDS, Hubbell HBL or equal.

O. Manual motor controller shall be Allen Bradley Bulletin 600, Square D Class 2510, or equal. Select overloads to be 1.15 times motor FLA.

P. Covers for wiring devices located out-of-doors in damp or wet locations shall have weatherproof covers, gaskets, and stainless steel cover screws.

Q. Covers for surface wiring devices located indoors and in dry locations shall be stainless steel type with beveled edges.

2.2 ACCEPTABLE MANUFACTURERS

A. Products of the following are acceptable:
1. Hubbell
2. Pass & Seymour
3. Cooper Wiring Devices, A Division of Eaton
4. Appleton Electric, A Division of Emerson
5. Arrow-Hart

PART 3 – EXECUTION

3.1 DEVICE PLACEMENT

A. Where outlets of different services are indicated adjacent to each other, mount all outlets in a symmetrical pattern.

B. Where items of equipment are provided under other sections of this specification, provide a compatible receptacle for the cap or plug and cord of the equipment.

3.2 WALL SWITCHES

A. Set wall switches in an FS outlet box centered at the height of 48 inches from the floor, except as otherwise shown. Install on the strike side of the door as finally hung.

3.3 RECEPTACLES

A. Mount receptacles vertically in a cast steel outlet box centered at the height of 24 inches from the floor, except as otherwise shown. Owner's representative reserves the right to make reasonable changes in receptacle locations without changing the contract sum.

3.4 DEVICE PLATES

A. Provide device plates for each outlet box of the type required for service and device involved.

END OF SECTION

SECTION 16150
WIRE AND WIRING

PART 1 - GENERAL

1.1 SCOPE

A. This section specifies requirements for wire and wiring installation.

1.2 REFERENCE STANDARDS

A. The latest editions of the standards listed below form a part of this specification.

1. NEMA. WC-5 - Thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy.

2. U.L. 83-Thermoplastic-insulated wires.

1.3 SUBMITTALS

A. Submit all conductor sizes, insulations, and ratings for review.

PART 2 – PRODUCTS

2.1 IDENTIFICATION

A. Provide new wire and cable with voltage class, NEC type letters manufacturer's name and trademark, and conductor size and material permanently marked on outer covering per NEC Section 310-11.

2.2 600 VOLT CONDUCTORS

A. Provide soft drawn, annealed copper wire with factory color coded NEC insulation as follows:
1. Conductors No. 14 and larger, THHW, XHHW, THW, THWN or as shown on plans.

B. Use stranded wire for all conductors.

C. No. 14 AWG is limited to control wiring; No. 12 AWG minimum size for power and/or lighting circuits. Provide pressure type connectors for all splices and joints.

D. Contractor at his option may install solid conductors wire for branch lighting circuits.

2.3 ACCEPTABLE MANUFACTURERS

A. 600 Volt Conductors. Cerro Wire, Encore Wire, Generale Cable Co., Okonite Co., Republic Wire, South Wire or United Copper Industries.

B. 600 Volt Connectors. Buchanan, Burndy, Ideal, Kearney, 3M Company, 0Z, and Thomas & Betts.

C. Color Coding. Dymo, E-Z Code, and Brady.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Conductors in Raceways. Unless otherwise indicated, mechanically protect all conductors for all systems by installing in raceways. Do not install the conductor until raceway system is complete. Use of an UL approved wire¬pulling compound when pulling conductors is permitted. Do not bend any conductor to radii less than four (4) times the outer diameter and do not exceed manufacturer's recommended values for maximum pulling tension.

B. Use proper lugs or connectors for terminations of all stranded conductors.

C. Neatly and securely bundle or cable all conductors in an enclosure using either marlin twine, 2 or 3 ply lacing, or nylon straps. If nylon straps are provided, use type constructed with a locking hub or head on one end and a taper on the other.

3.2 600 VOLT CONDUCTORS

A. Install conductor sizes as indicated. Unless otherwise shown, No. 12 XHHW is minimum size. Provide No. 10 conductor for 120 volt, single phase, 20 ampere circuits for which the distance from panel board to outlet is more than 100 feet.

B. Install each conductor complete without a splice from point of service connection to lighting fixtures and power outlets, as indicated. Leave ample slack in conductors for motor loops, service connections, splice or pull boxes and other locations as needed.

C. Provide auxiliary control devices and wiring for all control equipment requiring line voltage connections and interlocks as indicated on approved wiring diagrams. Check Division 13 for additional requirements.

D. Use factory color code or color code with approved tape as listed below. Use different colors for control wiring.

120/240, 1PH	Phase or Line	480/277V
Black	A or L1	Brown
Red	B or L2	Orange
	C or L3	Yellow
White	Neutral	Grey
Green	Ground	Green

END OF SECTION

SECTION 16165
DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Specifications for disconnect switches including:
   1. Fusible disconnect switches.
   2. Non-fusible disconnect switches.
   3. Circuit breaker type disconnect switches.
   4. Fuses
   5. Circuit breakers

1.2 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)
   1. NEMA AB1: Molded Case Circuit Breakers
   2. NEMA KS1: Enclosed Switches

B. Underwriters Laboratories (UL)
   1. UL 98: Standard for safety enclosed switches and Dead Front Switches
   2. UL 198C: High Interrupting Capacity Fuses, Current Limiting type
   3. UL 198E: Class R Fuses

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Article 404 - Switches.

1.3 SUBMITTALS

A. Submit the following under provisions of Section 01300 - Submittals:
   1. Manufacturer's cut sheets and catalog data
   2. Switch internal arrangement.
   3. Breaker or fuse characteristic curves.
   4. Instructions for handling and storage.
   5. Installation instructions.
   6. Dimensions and weights.

1.4 DELIVERY, STORAGE AND HANDLING

A. Have disconnect switches packed and crated to permit ease of handling and to provide protection from damage during shipping, handling, and storage.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Disconnect Switches and Circuit Breakers:
1. Eaton
2. Siemens Energy and Automation
3. Schneider Electric
4. ABB

B. Fuses
1. Bussman Division, Cooper Industries
2. Gould Shawmut
3. Littelfuse Incorporated

2.2 MATERIALS AND EQUIPMENT

A. Disconnect Switches
1. Characteristics: Horsepower rated, 600-volt, heavy-duty type with an interlocked door, positive quick-make, quick-break mechanism, and visible blades.
2. Use switches and components designed, manufactured, and tested in accordance with NEMA AB1, NEMA KS1, UL 98, and NEC Article 404.
3. Enclose switch in a NEMA 12 type enclosure for indoor application and NEMA 4X 304 or 316 Stainless Steel Only in outdoor locations or other wet or corrosive areas.
4. Provide switches with provisions for padlocking the operating lever in OFF position and door in closed position.
5. Select switches having the number of poles and general size conforming to the Drawings.
6. Conform to fusible, non-fusible or circuit breaker type switch requirements as shown on Drawings or one-line diagrams.
7. Provide auxiliary contact, normally open when handle is in the open position and normally closed for handle in the closed position, as shown on the Drawings.
8. Select fuses or circuit breakers with current interrupting duty as calculated for the points of switch application or as indicated on the Drawings or one-line diagrams.

B. Fuses: Unless otherwise noted on Drawings, for fuses used in disconnect switches, provide the dual-element, time-delay type with the maximum interrupting rating of 200,000 amperes, conforming to the NEC.

C. Circuit Breakers: When circuit breakers are used in disconnect switches, provide the thermal-magnetic type with current interruption ratings as required at the point of application.

D. Conduit Hub Connectors: Watertight hubs as manufactured by Myers Hubs, or equal.

PART 3 – EXECUTION

3.1 PREPARATION

A. Review the Drawings and verify that the disconnect switches are correct for the applications.

B. Make sure that the correct fuses or breakers are being used regarding size and short circuit interrupting capability.

C. Prepare adhesive labels on the inside door of each switch indicating UL fuse class and size or breaker type and size for replacement.

3.2 INSTALLATION

A. Install the disconnect switches in accordance with NEC Article 380.

B. Mount switches 6'-6" (to top of cabinet) above finished floor or grade.

C. In wet and corrosive areas, including outdoor locations, install switches on spacers to provide a space of approximate 1/4-inch between the back of cabinet and the mounting surface.

D. In wet and corrosive areas, including outdoor locations, connect conduits to the bottom of enclosure and to the lower 30 percent of the sides using watertight connectors.

E. Top penetrations are not allowed for outdoor installations.

END OF SECTION

SECTION 16175
VARIABLE FREQUENCY DRIVE

PART 1 - GENERAL

1.1 SUMMARY

A. This section provides for furnishing and installing variable frequency drives of sizes sphown on the construction drawings. The Variable Frequency Drives shall be a low harmonic voltage source, advanced Pulse-Width Modulated, space vector technology motor controller which utilizes the latest IGBT technology and meets IEEE 519 Guidelines.

1.2 RELATED WORK

A. Division 15, Mechanical.

B. Division 16, Electrical.

1.3 SUBMITTALS

A. Shop Drawings. Submit shop drawings, product data and samples as specified in Division 1, General Requirements.

B. Operation and Maintenance Instructions. Submit operating and maintenance instructions, service manuals, and parts list applicable to each item of equipment furnished and deliver four (4) sets to the Engineer's office for the Owner's use, as a condition of final acceptance.

1.4 GUARANTEE

A. For a period of 12 months from Final Acceptance of the plant, the manufacturer shall warrant that equipment, when properly installed, shall be free of defects in material and workmanship under normal use and service. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer.

1.5 ACCEPTABLE MANUFACTURERS

A. Provide variable frequency drives as manufactured by Eaton (Culter-Hammer), Danfoss, ABB, Schneider Electric (Square "D"), Toshiba, or approved equal. Local factory service must be available for the units.

PART 2 – PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

A. Variable frequency drives furnished under this specification shall be rated for service on 460 volt, 3 phase, grounded wye electrical systems with plus or minus 10 percent (10%) voltage variation and two (2) percent (2%) frequency variation. Motors are assumed to be induction type NEMA design B of the submersible type or of the TEFC type.

B. Standard features shall include:
   1. Pulse width modulation technology.
   2. High efficiency--97 percent (97%) at full load.

3. Constant power factor at all speeds: 95 percent (95%).
4. Quick response time.
5. Fully compatible with NEMA frame or submersible pump motors.
6. 4-20 Ma speed control if required including process card.
7. External contact on-off.
8. Automatic short circuit shut-off.
9. Ammeter with adjustable contacts for control.
10. Overvoltage, undervoltage and overcurrent protection.
11. Run/stop and manual/auto selector switch.
12. Manual speed control pot and selector switch.
13. Diagnostic and operation control and programming panel.
14. Constant torque, minimum 10 HP rating.

C. It shall be understood that this is a basic specification. Sizing and selection of the VFD is the responsibility of the Contractor. (See equipment specifications for application requirement.)

2.2 SUBMERSIBLE PUMPS VARIABLE FREQUENCY DRIVE

A. Variable frequency drives for submersible pumps shall be designed for application with submersible pumps. Ratings shall be able to provide for required horsepower through the pumping range of the pump.

2.3 INSTALLATION

A. Installation of the variable frequency drives in equipment or individually shall be done in accordance with the manufacturer's recommendation. Equipment enclosures shall be designed so that the ambient temperature will not exceed the manufacturer's recommendation. Provide forced draft cooling or refrigerated air as required to maintain the operating temperatures recommended by the manufacturer. For the purposes of design, assume an ambient air temperature of 95°F.

2.4 RADIO FREQUENCY RADIATION

A. Radio frequency radiation from the unit shall meet the latest published standards of the IEEE and NEMA. Particular attention shall be given the wiring and installation of the VFD equipment to minimize radiation from the system.

END OF SECTION

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Specification for electrical identification including:

1. Nameplates and labels
2. Wire and cable markers
3. Conduit markers
4. Cable tray markers
5. Underground warning tape
6. Warning labels

1.2 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

B. NFPA 70 - National Electrical Code (NEC)

   1. Article 110 - Requirements for Electrical Installation
   2. Article 430 - Transformers and Transformer Vaults

C. City of Houston Building Code

D. Other applicable Codes and Standards as referenced in other Sections.

E. Underwriters Laboratories. U.L. Standards No. 224 - Extruded Insulated Tubing

1.3 SUBMITTALS

A. Submit the following under the provisions of Section 01300 – Submittals:

   1. Manufacturer's cut sheets and catalog data
   2. Description of materials used
   3. Label or nameplate dimensions
   4. Engraving or imprint legends
   5. Instruction for handling and storage
   6. Installation instructions

1.4 DELIVERY, STORAGE AND HANDLING

Pack materials to permit ease of handling and to provide protection from damage during shipping, handling and storage.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Almetek Industries Incorporated

B. Brady U.S.A. Incorporated

C. Ideal Electric Company

D. Raychem Corporation

E. 3M Electrical Products Division

F. Thomas & Betts

G. Tyton Corporation

2.2 MATERIALS AND EQUIPMENT

A. Nameplates and Labels

1. Provide an identification tag for each item of electrical equipment showing its item number and service or application. Use the description shown on the electrical Drawings.
2. For nameplates, use 3-ply phenolic material engraved to show black lettering on a white background. Size the nameplates approximately 1 inch wide and 3 inches long for 3 lines of 3/16 inch - 16 letters with a 0.8 condensed factor.
3. Generally, provide large pieces of equipment with engraved nameplates; provide additional nameplates at pushbuttons and other local devices; as detailed. Provide identification for all other electrical equipment, device or enclosure not furnished with readily noticeable tag, nameplates or other means of identification.
4. Install nameplates on the front cover of transformers stating the transformer service location number or identification number, the panelboard or device served, and main breaker feeding the transformer (MCC No. and compartment), and the drawing number on which the transformer schematic is shown.
5. Furnish equipment, such as motor starters, safety switches, welding receptacles and circuit breakers, with 1" x 3" plastic nameplates stating description of item served.
6. Provide nameplates for motors giving the driven equipment description, the service location number, and the MCC number with compartment number when applicable. Nameplates will normally be mounted adjacent to the motor at the motor pushbutton when one is furnished.
7. Install nameplates on the outside and inside of doors to circuit breaker panelboards (i.e., lighting, instrument or receptacle panels). State the panelboard name, the drawing number on which the panelboard schedule shows, and the main breaker feeding the panel (MCC No. and compartment).
8. Type panelboard directories and insert them inside the panelboard doors.
9. Place a large nameplate approximately 3"x5" on control panels, relay panels, junction boxes or enclosures with electrical devices mounted inside or on the outside of the enclosure indicating the purpose of the cabinet.
10. Provide a nameplate on MCC motor starter doors duplicating motor nameplate data.
11. Attach nameplate with self-tapping stainless steel screws.

B. Wire and Cable Markers
1. Use pre-printed tubular heat-shrink type wire and cable markers.
2. Select markers manufactured so that the heat-shrink process makes the imprint permanent and solvent-resistant.
3. Use markers that are self-extinguishing, conforming to U.L. Standard No. 224 for print performance, heat shock and flammability.
4. Provide marker material that is flexible, radiation cross-linked polyolefin with 3 to 1 shrink ratio, rated 600 volts, and white in color.

C. Conduit Markers
1. Provide conduit markers made of stainless steel tags approximately 2 inches x 1 inch x 19 gage.
2. Stamp the caption on the tag and have it black filled.
3. Punch tags for tie fasteners. Fasten tags to the conduits with stainless steel braided wire.

D. Cable Tray Markers
1. For high visibility and contrast, use cable tray markers that are yellow with black legend.
2. Use markers made of vinyl impregnated cloth, suitable for exposure to corrosive, wet and abrasive environment.
3. Make markers of pre-cut individual letters or numbers with pressure sensitive adhesive backing.
4. Size legend characters to 4 inches high on a total marker height of approximately 5 inches, suitable for applying to 6-inch side rails of a cable tray.

E. Underground Warning Tape
1. Provide warning tape made of 4 mil thick polyolefin film, 3 inches wide, suitable for direct burial and resistant to alkalis, acids and other common soil substances.
2. Use red tape with black legend printed in permanent ink.

F. Warning Labels
1. Place OSHA safety labels on enclosures and boxes 100 cubic inches or more containing electrical equipment or terminations.
2. Provide OSHA color codes for the labels. Use labels made from 4 mil vinyl with pressure sensitive adhesive backing.
3. The warning label caption is DANGER - 480 VOLTS or as indicated on the Drawings.
4. Size labels either 5 inches x 3-1/2 inches or 10 inches x 7 inches, as indicated on the Drawings.

PART 3 – EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces where adhesive labels will be applied.

B. Drill holes for nameplates to be fastened with stainless screws.

C. Prepare the cable ends for termination and conductor markings.

D. Identify conduits at terminating points and select tags accordingly.

3.2 INSTALLATION

A. Install nameplates and labels in accordance with the manufacturer's instructions and the Drawings.

B. Apply wire and cable markers in accordance with manufacturer's instructions using a heat gun with properly sized nozzle for the application. Tag the wires at both ends with the same notation.

C. Tag conduits at junction boxes, pull boxes and at other termination points.

D. Identify cable trays at the time of installation with the alphanumeric number shown on the Drawings. Label cable trays on the outside rail. Place the tray identifier at each point where the tray designation changes and at 200 foot intervals in between, but not less than two per run.

E. Identify underground conduits, cables or duct banks using the underground warning tape. Also use underground warning tape on the underground grounding grid, including the laterals. Install one tape per trench at 12 inches below grade or as indicated on the Drawings. For wide trenches or duct banks, install one warning tape per 24 inch width.

F. Apply the 5 inches by 3-1/2 inches warning labels to disconnect switches, panelboards, terminal boxes, and similar devices in accordance with manufacturer's instruction and the Drawings. Apply the 10 inches x 7 inches warning labels to larger control panel enclosures, motor control centers and to entrance doors to buildings containing electrical power and control equipment.

END OF SECTION

SEECTION 16441
PANELBOARDS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Specifications for panelboards.

1.2 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)
   1. NEMA AB1: Molded Case Circuit Breakers
   2. NEMA PB1: Panelboards
   3. NEMA PB1.1: Instruction for Safe Installation Operation and Maintenance of Panelboards rated 600 volts or less.
   4. NEMA PB1.2: Application Guide for Ground-fault Protective Devices for Equipment

B. Federal Specifications, FS W-C-375A: Circuit Breakers, Molded Case, Branch Circuit and Service.

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Article 408 – Switchboards, Switchgear and Panelboards.

1.3 SUBMITTALS

A. Submit the following under provisions of Section 01300 – Submittals:
   1. Manufacturer's cut sheets and catalog data
   2. Breaker arrangement
   3. Breaker characteristic curves
   4. Instruction for handling and storage
   5. Installation instructions
   6. Dimensions and weights

1.4. DELIVERY, STORAGE AND HANDLING

A. Have panelboards packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Sheet Metal Boxes
   1. Eaton
   2. ABB
   3. Siemens Energy and Automation
   4. Schneider Electric Company

2.2 MATERIALS AND EQUIPMENT

A. Basic Requirements
1. Use panelboards manufactured and tested in accordance with NEMA PB 1.
2. Provide circuit breakers of industrial grade, manufactured and tested in accordance with NEMA AB 1 and Federal Specification FS W-C-375.
3. Do not exceed 42 available single pole branch circuits in any one panelboard.

B. Rating
1. Voltage rating, current rating, number of phases, number of wires, number of poles, and interrupting current (AIC) are indicated on Drawings.
2. If AIC is not shown on the Drawings, main and branch circuit breaker interrupting capacity shall be minimum 10,000 (AIC) ampere RMS symmetrical for 120/240V, single phase; 22,000 (AIC) ampere RMS for 120/208V or 120/240V, 3 Phase; and 42,000 (AIC) ampere RMS symmetrical for 277/480V.

C. Circuit Breakers: Molded case, bolt-on thermal magnetic type with number of poles and trip ratings as shown on the Drawings. Provide ground fault interrupters with trip rating where shown on the Drawings.

D. Bus System
1. Bus Bars: 98 percent conductivity copper. Provide a solid neutral bar in 4-wire panelboards. Include ground bus in all panels. Provide split-bus panels where shown on Drawings.
2. Main: Circuit breaker or main lugs only as indicated on the Drawings or as required to meet the current interrupting ratings.

E. Box and Trim
1. Construction: Code grade steel, ample gutter space, flush door, flush snap latch and lock.
2. Trim: Surface or flush as required. Enclose panelboards located outdoors, or in other wet and corrosive areas in NEMA 4X weatherproof stainless steel enclosures. Enclose indoor panelboards in a NEMA 1 enclosure with manufacturer's standard gray enamel finish.
3. Directory: Typed card, with glass cover in frame on back of door giving the circuit numbers and the area or equipment served.

F. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

2.3 PANELBOARD MODIFICATIONS

A. Circuit breakers shall be designed, built, and tested in accordance with the Underwriter Laboratories, Inc. UL489 and shall be so labeled. Installation shall comply with NEMA Standard for Panelboards and the National Electrical Code.

B. Where possible, circuit breakers shall be the product of the manufacturer of the original panelboard on which they are installed.

C. Circuit breaker short circuit ratings shall be not be less than minimum rated device in the panel. The overall short circuit rating of the existing panel shall be maintained. Circuit breakers shall be rated for the required utilization voltage.

D. Circuit breakers shall be a product of the manufacturer of the original circuit breakers in the panelboard or shall be a UL listed replacement product.

E. Circuit breakers shall be molded case, bolt-in or plug-on type as required. Contractor shall verify the proper type.

F. GFCI (ground fault circuit interrupter) shall be provided for circuits where shown on the Drawings. GFCI units shall be 1 pole, 120 volt, molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed, Class A, Group I device (5 milliamp sensitivity, 25 millisecond time) and a minimum interrupting capacity of 10,000 Amperes RMS. Contractor shall verify the required short circuit interrupting rating and supply the correct breaker for the application.

G. GFCI for ground fault protection on heat trace equipment shall be provided for branch circuits where shown on the Drawings. GFCI units shall be rated properly for the intended voltage and trip setting indicated on the drawings and shall be molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed Class A Group I device (30 milliamp sensitivity, 25 millisecond trip time) and an interrupting capacity of 10,000 Amperes, RMS. Contractor shall verify the required short circuit interrupting rating and supply the correct breaker for the application.

H. Circuit breaker serving fire alarm system shall have red handle and a lockable mechanism in the breaker closed ("Energized") position.

I. Install new circuit directory cards in each panelboard. New directories shall be heavy card stock with machine printed text. Verify all existing circuits and update circuit directories giving location and description of every load served by the panel.

PART 3 – EXECUTION

3.1 PREPARATION

A. Review Drawings to verify that panelboards are correct for the application.

3.2 INSTALLATION

A. Install the panelboard in accordance with NEMA PB 1.1 and NEC Article 408.

B. Mount panelboards 6'-0" (to top of cabinet) above finished floor or grade.

C. In wet and corrosive areas, including outdoor locations, install panel enclosures on spacers to provide approximately 1/4-inch between back of cabinet and mounting surface.

D. In wet and corrosive areas, including outdoor locations, connect conduit to the bottom of enclosure and to the lower 30 percent of the sides using watertight connectors.

END OF SECTION

SECTION 16460
LOW VOLTAGE DRY-TYPE DISTRIBUTION TRANSFORMERS

PART 1 – GENERAL

1.1 SCOPE

A. The Contractor shall furnish and install single-phase and three-phase general purpose individually mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the contract drawings.

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 REFERENCES

A. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

B. NEMA ST-20 Dry-Type Transformer for General Applications.

C. UL 1561, CSA C9-02 and C22.2 No.47

D. IEEE C57.110 Recommended Practice for establishing transformer capability when feeding nonsinusoidal load currents

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:
   1. Outline dimensions and weights
   2. Transformer ratings including:
      a. kVA
      b. Primary and secondary voltage
      c. Taps
      d. Basic impulse level (BIL) for equipment over 600 volts
      e. Design impedance
      f. Insulation class and temperature rise
      g. Sound level.
   3. Product data sheets
   4. Equipment anchorage details

1.5 DELIVERY, STORAGE AND HANDLING

A. Store and handle in strict compliance with manufacturer’s instructions and recommendations. Protect from potential damage from weather and construction operations. Store so condensation will not form on or in the transformer housing and if necessary, apply temporary heat where required to obtain suitable service conditions.

B. Handle transformer using proper equipment for lifting and handling, use when necessary lifting eye and/or brackets provided for that purpose.

1.6 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Eaton

B. Schneider Electric

C. Hammond Power Solutions

D. Siemens

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 RATINGS

A. The kVA and voltage ratings shall be as indicated on the drawings.

B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.

C. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

D. Transformers efficiency shall be measured according to federal law 10 CFR Part 431.

E. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

	Self-Cooled Ventilated		Self-Cooled Sealed
Equivalent Winding kVA Range	K-Factor=1 K-Factor=4 K-Factor=9	K-Factor=13 K-Factor=20	
3.00 and below	40	40	45
3.01 to 9.00	40	40	45
9.01 to 15.00	45	45	50
15.01 to 30.00	45	45	50
30.01 to 50.00	45	48	50
50.01 to 75.00	50	53	55
75.01 to 112.50	50	53	55
112.51 to 150.00	50	53	55
150.01 to 225.00	55	58	57
225.01 to 300.00	55	58	57
300.01 to 500.00	60	63	59
500.01 to 700.00	62	65	61
700.01 to 1000.00	64	67	63
Greater than 1000	Consult Factory	Consult Factory	Consult Factory

F. Where K-factor transformers are indicated on the drawings, the transformers shall be specifically designed to supply circuits with a harmonic profile equal to or less than a K-factor of 1 without exceeding 115 degrees C temperature rise.

2.3 GENERAL PURPOSE TRANSFORMERS

A. Insulation Systems
1. Transformer insulation system shall be as follows:
   a. 5-45 kVA minimum of 200 degrees C insulation system with 115 degree C rise.
   b. 50 kVA and above: minimum of 220 degrees C insulation system with 150 degree C rise, ventilated design.
2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient, and a 24-hour average ambient of 30 degrees C
3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635

B. Core and Coil Assemblies
1. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction
2. On single-phase units rated 25 kVA and below the core and coil assembly shall be completely encapsulated in a proportioned mixture of epoxy or resin and aggregate to provide a moisture proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level
3. On single-phase units rated 37.5 kVA and above the coils assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture; the core shall be coated with HAPs (Hazardous Air Pollutants) free water reducible electrical varnish to give good corrosion resistance. The assembly shall be installed on vibration-absorbing pads
4. Terminals shall be welded to the leads of the coils for better conductivity, less maintenance, and lower risk of hot spots. Terminals shall not be spot welded or bolted to the coil leads.

C. Taps
1. Three-phase transformers rated 15 through 225 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage. Three-phase transformers rated greater than 225 kVA shall be provided with manufacturer's standard taps for that rating.
2. All single-phase transformers, and three-phase transformers rated below 15 kVA and above 500 kVA, shall be provided with the manufacturer's standard tap configuration.

D. Electrostatic Shielding
1. Where shown on the drawings, provide shielded isolation transformers with an electrostatic shield consisting of a single turn of aluminum placed between the primary and secondary winding and grounded to the housing of the transformer.
   a. Electrostatic shield shall provide primary to secondary winding capacitance between 24 and 18 picofarads over the range of 100 Hz to 20 kHz.
   b. Electrostatic shielding shall provide the following minimum attenuation when tested per MIL-Std-220A, Method of Insertion Loss Measurement, with matched impedance no load technique:
2. Common mode noise attenuation: Minus 80 dBA minimum at 0.1 kHz to 1.5 kHz; minus 55 dBA minimum at 1.51 kHz to 100 kHz.Normal mode (Transverse mode) noise attenuation: Minus 35dBA minimum at 1.5 kHz to 10 kHz.

2.4 WIRING/TERMINATIONS

A. Recommended external cable shall be rated 90 degrees C (sized at 75 degrees C ampacity) for encapsulated and 75 degrees C for ventilated designs. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.

2.5 ENCLOSURE

A. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees C per UL requirement. The core of the transformer shall be grounded to the enclosure.

B. On single-phase units rated 25 kVA and below the enclosure construction shall be encapsulated, totally enclosed, non-ventilated, NEMA 2, with lifting provisions.

C. On single-phase units rated 37.5 kVA and above the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting provisions. All ventilation openings shall be protected against falling dirt. On outdoor units, provide weathershields over ventilated openings.

D. Ventilated type transformers that meet 10 CFR Part 431 efficiency requirements, with a core size of 150 kVA or less, shall be suitable for installation with 2-inch clearance from a wall or other obstruction behind the transformer enclosure.

2.6 FINISH

A. Steel enclosures shall be finished with ANSI 61 color, weather-resistant enamel. Stainless steel enclosures shall not be painted.

PART 3 – EXECUTION

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
1. Ratio tests at the rated voltage connection and at all tap connections
2. Polarity and phase relation tests on the rated voltage connection
3. Applied potential tests
4. Induced potential test
5. No-load and excitation current at rated voltage on the rated voltage connection

3.2 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer’s recommendations and the contract drawings.

B. Make sure that the transformer is levelled.

C. Check for damage and loose connections.

D. Install seismic restraint where indicated on the drawing.

E. Prior to putting transformer into service, verify secondary voltages and if necessary, adjust primary taps.

F. Transformer shall be properly grounded per NEC.

G. Floor mounted transformer shall be installed on 4” housekeeping pad, unless indicated otherwise.

H. Install optional vibration isolation pads between transformer enclosure and the mounting surface as needed.

3.3 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION

SECTION 16466
SOLID STATE REDUCED VOLTAGE STARTER

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies Solid State Reduced Voltage (SSRV) motor starter furnishing and installation.

1.2 REFERENCE STANDARDS

The motor control panels must conform to requirements in the latest edition of the following publications:

A. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

B. Division 01 - General Requirements.

C. Section 16195 - Electrical Identification

1.3 MEASUREMENT AND PAYMENT

A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.4 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI).
   2. ETL Testing Laboratories (ETL).
   3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C62.41.1, Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
   4. National Electrical Manufacturer's Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   6. Nationally Recognized Testing Laboratory (NRTL).
   7. Occupational Safety and Health Administration (OSHA).
   8. Underwriter's Laboratory, Inc. (UL):
      a. 508, Standard for Safety Industrial Control Equipment.

B. Qualifications:
   1. Provide drives that are listed and labeled by UL, ETL, or other NRTL as defined by OSHA regulations, or that have been inspected and subsequent field-labeled by such NRTL.
      a. Where listed drives and other components are installed in a common enclosure, that assembly shall be listed and labeled per UL 508 or equivalent NTRL standard.
   2. SSRV Supplier shall maintain an authorized service organization within 300 miles of the project site.

C. Coordination:
1. SSRV manufacturer shall verify the SSRV is compatible with the equipment motor over its required operating range and do so without exceeding the motor or SSRV safety factors.
2. SSRV shall be supplied complete with all required control components.
a. SSRV manufacturer shall review the application and provide, at no additional cost to the Buyer, the hardware and software necessary to allow the SSRV to control the driven equipment motor over its required operating range.
i. These may include, but are limited to, analog and digital interface modules, communication interface modules, switches, lights and other devices.
3. Coordinated control devices with devices furnished with driven equipment such as vibration switches, thermal sensors, leaks detectors, etc.

1.5 SUBMITTALS

A. Shop Drawings:
1. See Specification 01300 for requirements for the mechanics and administration of the submittal process.
2. Schedules of SSRV's for the project listing for each SSRV:
a. SSRV Complete Catalog Number.
b. SSRV Frame Size.
c. Rated Input Current.
d. Rated Continuous Output Current.
e. Rated Short Circuit Current.
f. Motor Manufacturer.
g. Motor Frame Size.
h. Motor Full Load Amps.
i. Motor Service Factor.
3. Product technical data:
a. Complete electrical ratings and performance specifications confirming compliance with specified ratings and performance.
b. Manufacturer's installation instructions.
c. Manufacturer's programming and operating instructions.
4. Fabrication and/or layout drawings:
a. Top, front and side exterior views, with details showing maximum overall dimensions of enclosure, mounting provisions and conduit/cable entry provisions.
b. Identify minimum clearances from other SSRV's or electrical equipment required for proper cooling at top, bottom, sides and back of enclosure.
c. Three (3) line diagrams showing AC schematic of SSRV, input, output and bypass devices including device ratings.
d. Interior layout drawing location of all components within enclosure, field wiring terminal boards and power and grounding connections.
e. Field wiring diagrams showing locations and sizes of all electrical connections, ground terminations, and requirements for shielded wire usage or any other special installation considerations.
5. Certifications:
a. Submit after installation:
i. Certified field service reports showing:
A) Each SSRV is operational.
B) Each SSRV and its driven equipment motor is compatible.
C) Each SSRV responds correctly to the input control signals.

B. Operations and Maintenance Manuals:
   1. See Specifications Section 01300 and Specification Section 01340 for requirements for:
      a. The mechanic and administration of the submittal process.
      b. The content of Operation and Maintenance Manuals.
   2. Approved copy of SSRV schedule per Submittal Article.
   3. Manufacturers instruction manuals.
   4. Troubleshooting procedures with a cross-reference between symptoms and corrective recommendations.
   5. Connection data to permit removal and installation of recommended smallest field-replaceable parts.
   6. Recommended spare parts list.
   7. Commissioning sheets showing “as-left” values of all user-programmable or adjustable drive parameters.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Solid state reduced voltage starter:
      a. Eaton
      b. ABB
      c. Siemens
      d. Schneider Electric

B. Submit request for substitution in accordance with Specification Section 01300.

2.2 GENERAL

A. The SSRV shall consist of a six (6) SCR power section with two (2) SCRs per phase connected inverse parallel for variable AC output voltage with minimal motor and starter hearing.

B. The SSRV power section shall be capable of providing maximum torque per amp throughout the motor’s speed-torque curve.

C. The logic control shall consist of a power section for gating the drive SCRs and a control section for performing all the necessary starter functions.

D. A snubber circuit shall be used to prevent false firing of SCRs due to dV/dt effects.

E. The SSRV shall be provided with a by-pass contactor that will effectively “short” the SCR power section to the incoming line to the motor load without the SCR voltage drop.

F. SSRV’s whether installed in motor control center (MCC) construction or separately mounted, shall constitute complete combination motor controllers per NEC Article 430 and shall provide the following per the requirements of that article without the addition of any external components or devices.
   1. Motor control.
   2. Motor overload protection.
   3. Motor and motor branch circuit short circuit and ground fault protection.
   4. Motor and controller disconnecting means.

G. SSRV's shall be "engineered" or "configured" drive packages in which the SSRV chassis, all input, output and bypass power devices, SSRV accessories, switches, contactors, relays, and related control devices are selected, furnished, factory assembled and tested by the SSRV manufacturer in a single enclosure requiring only connection of the power supply circuit, motor branch circuit, and external control wiring in the field.

2.3 PERFORMANCE AND SESIGN REQUIREMENTS

A. Application:
1. SSRV's shall be designed to operate successfully under the following site conditions:
   a. Ambient:
      i. Temperature: 0-40 Deg C.
      ii. 95 percent non-condensing relative humidity.
   b. Elevation: 3300 FT above MSL.
   c. Power supply characteristics:
      i. 480V, 3 PH, 3-wire, (+/- 10 percent).
      ii. Effectively grounded.
   d. Available short circuit current:
      i. 65,000A RMS SYM.

B. Ratings and Performance Specifications:
1. Voltage rating:
   a. Nominal :460 or 480 Vac, 3PH, 60 Hz.
   b. Range for continuous full-load operation: 432-528 Vac.
   c. Voltage imbalance tolerance for full load operation: 3 percent minimum.
2. Current rating:
   a. Continuous: Equal to or greater than the motor nameplate full load current multiplied by the motor service factor.
   b. Short-term overload: 400 percent for 30 seconds.
   c. Short circuit:
      i. 65,000A RMS SYM, minimum.
3. Efficiency: 98 percent, minimum, at full speed and full load.

C. Operational Features:
1. Pump control functions
2. Insensitive to input phase sequence.
3. Continued operation with momentary voltage dips of 35 percent of rated voltage, or single-phase condition: 2 sec, minimum.
4. Controls power loss ride-through 500 msec, minimum.
5. Anti-windmilling: ability to safely start into turning motor, forward or reverse.

D. The SSRV shall be provided with the following minimum user-programmable parameters:
1. Selectable torque ramp start or current limit start.
2. Starts per hour.
3. Time between starts.
4. Initial current, maximum current and ramp time.
5. Kick current and time.
6. Torque ramp.
7. Motor deceleration time.
8. Relay outputs.

E. The SSRV shall be designed such that the power circuit components are fully protected from line side disturbances and load side faults:
   1. General:
      a. Shutdown conditions associated with supply circuit conditions which can be corrected externally to the SSRV motor system shall be provided with automatic reset, with shutdown cause logged in memory.
      b. Shutdown conditions which indicate overload or fault within the SSRV, the circuit, or the motor shall require local manual reset at the SSRV, requiring operator intervention.
         i. Short SCR.
         ii. Component failure.
         iii. Under/over current.
            A) Coordinate under current set points with the Owner's Representative.
         iv. Overload.
         v. Short circuit.
         vi. Ground fault.
         vii. Logic fault.
      c. When automatic shutdown occurs, SSRV shall restart immediately upon reset whether the drive is in automatic or manual mode.
      d. SSRV shall hold cause of trip data for a minimum of four shutdowns in memory.
         i. Data to be accessible through the keypad, local communication link and remotely.
      e. Common alarm contact.
   2. Input protection:
      a. Input circuit breaker or current-limiting fuses with externally operable disconnect:
         i. Fault current interrupting rating equal to or greater than the specified withstand rating of the SSRV.
         ii. Handle should be padlock able in the OFF position.
      b. Incoming line transient suppression:
         i. 6000 V peak per IEEE C62.41.1.
         ii. Phase-to-phase and phase-to-ground protection.
   3. Internal Protection:
      a. Surge suppression and power device snubbers.
      b. SCR peak inverse voltage (PIV): 2.5 times line voltage.
      c. Instantaneous overcurrent trip.
      d. Power device overtemperature trip.
      e. Control logic circuit malfunction trip.
   4. Output protection:
      a. Inverse-time overload trip:
         i. UL Class 10 characteristic.
      b. Overvoltage trip.
      c. Over frequency trip.
      d. Short circuit trip:
         i. Line to line and line to ground.
      e. Ground fault trip.

2.4 OPERATOR AND REMOTE CONTROL INTERFACE

A. Drive controls shall be microprocessor-based with on-board human machine interface and both local and remote digital communications capability.
   1. All monitoring and control functions, other than those shutdowns specified to be manual reset only, shall be available both locally and remotely.

B. Control circuits shall be 115 Vac or 24 VDC:
   1. 115 Vac supplied by CPT in the SSRV.
      a. CPT shall have minimum additional capacity of 60 VA greater than that required by control devices.
      b. CPT shall have two (2) fuses on the primary side and on fuse on the secondary side.
      c. CPT shall have surge protection on the primary side independent of any other surge protection in the SSRV.
   2. 24 VD supplied by Class 2 power supply in the SSRV.
      a. Power supply shall have minimum additional capacity of 33 percent greater than that required by control devices.
      b. Provide two (2) current-limiting fuses on the AC supply to the power supply.
      c. Power supply shall have surge protection on the primary side independent of any other surge protection in the SSRV.

C. Operator Interface:
   1. Door or device mounted sealed keypad, membrane type with LED or LCD display.
      a. Messages shall be in English and engineering units.
      b. Drive operating parameters shall be programmable.
      c. Menu driven.
      d. Password security.
      e. Display faults and diagnostic data.
      f. Operating parameters, fault and diagnostic data maintained in non-volatile memory with historic log of fault and diagnostic data.
      g. Fault description shall be in plain text.
      h. Fault codes are bit acceptable.
      i. Gold plated plug in contacts.
   2. HAND-OFF-REMOTE selector switch Elapsed Time Meter, and/or other control as required in drawing.
   3. Status indications:
      a. POWER ON.
      b. RUN STATUS.
      c. SSRV FAULT.
   4. Metering indications (minimum):
      a. Amperes.
      b. Voltage.
      c. Frequency.
   5. Diagnostic indicators located externally on the face of the drive shall show the type of fault responsible for drive warning, shutdown or failure.
      a. On occurrence of more than one condition each shall be recorded or indicated by the diagnostics.

D. Remote Control Interface:
   1. Contacts:
      a. Contacts shall be rated 2 A inductive at 120 Vac.
      b. All contacts shall be wired to field wiring terminal boards.

2.5 EQUIPMENT CONSTRUCTION

A. Fabrication and Assembly:
1. Each SSRV system shall be factory-assembled in an enclosure for remote mounting and shall utilize interchangeable plug-in printed circuit boards and power conversion components wherever possible.
   a. Factory assembly shall be performed by the SSRB manufacturer or authorized agent.
   b. Systems fabricated or assembled in whole or in part by parties other than the SSRV manufacturer or authorized agent will not be acceptable.
2. Cooling fans shall be provided, as required, to run when drive is running.
3. Enclosures for separately mounted SSRV's:
   a. NEMA Type 1 for installation in Electrical Rooms.
   b. NEMA Type 12 for installation in other unclassified indoor areas.
   c. NEMA Type 3r or 4X as show on drawings for installation in outdoor area.

B. Wiring:
1. The wiring in the SSRV shall be neatly installed in wire ways or with wire ties where wire ways are not practical.
   a. Where wire ties are used, the wire bundles are to be held at the back panel with a screw-mounted wire tie mounting base.
   b. Bases with a self-sticking back with not be allowed.
2. All plug-in contacts shall be gold-plated.
3. Provide terminal boards for all field wiring and inter-unit connections.
4. Terminal blocks shall be complete with marking strips, covers and pressure connectors.
   a. They shall be non-brittle, interlocking, track-mounted type.
   b. Screw terminals will not be allowed.
   c. A terminal shall be provided for each conductor of external circuits plus on ground for each shielded cable.
   d. For free-standing panels, 8 IN of clearance shall be provided between terminals and the panel base for conduit and wiring space.
   e. Not less than 25 percent spare terminal shall be provided.
   f. Terminals shall be labeled to agree with identification indicated on the supplier's submittal drawings.
   g. Each control loop or system shall be individually fused, and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
5. All grounding wire shall be attached to the enclosure sheet metal with a ring tongue terminal.
   a. The surface of the sheet metal shall be prepared to assure good conductivity and corrosion protection.
6. Wiring shall not be kinked or spliced and shall have markings on both ends and be color coded.
   a. Markings or color code shall march the manufacturer's drawings.
7. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, type MTW or SIS, insulated for not less than 600V, with a moisture-resistant and flame-retardant covering rated for not less than 90 Deg C.

C. Auxiliary Control Devices:
1. Selector switches, pushbuttons, indicating lights and control relays as specified in Specification 1330.

D. Nameplates:
1. SSRV enclosure shall be provided with a suitable nameplate as specified in Specification section 16195.

2. Push buttons, selector switches, and pilot lights shall have the device manufacturer's standard legend plate.

3. Relays, terminals and special devices inside the control enclosure shall have permanent marking to match identification used on manufacturer's wiring diagrams.

4. Use stainless steel screws to attach nameplates.

E. Factory Painting: Enclosure, after being phosphate washed shall be thoroughly cleaned and given at least one coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

2.6 SOURCE QUALITY CONTROL

A. Factory Test:
1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure conformance to Specifications requirements.
2. Prior to final assembly:
   a. Inspect incoming components.
   b. Test and inspect power devices.
   c. Circuit cards:
      i. Component and functional test:
      ii. Burn-in chamber or temperature cycling test.
   d. System test after burn-in, or temperature cycling.
3. After final assembly:
   a. Continuity and insulation test of 480 Vac circuits.
      i. Test voltage shall be 2500 Vdc.
   b. Continuity and insulation test of 120 Vac circuits.
      i. Test voltage shall be 500 Vdc.
   c. Drive test:
      i. Burn-in complete drive at full load for 24 HRS.
      ii. Verify all auxiliary circuits operation.
      iii. Monitor output variables.
   d. Systems test:
      i. Provide inputs to field connections and simulate on-site operation.
      ii. Test all auxiliary equipment.

2.7 MAINTENANCE MATERIALS

A. Provide manufacturers' recommended renewable spare parts (e.g., power and control fuses).

B. Spare parts utilized during pre-start-up and demonstration testing shall be immediately restocked, at no cost to the Owner.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installed products in accordance with manufacturer's instructions and as indicated on the Drawings.

B. Verify the installed motor nameplate electrical requirements do not exceed the SSRV capacity.

3.2 START-UP

A. Star-up and Demonstration Services:
   1. Provide services of manufacturer's representative to perform start-up services.
   2. Shall consist of physical and electrical installation check.
   3. Simulate operation of the SSRV and its associated control and instrumentation system in both manual and automatic modes.
      a. Ensure compatibility of RVSS with associated control and instrumentation signals.
   4. Simulate SSRV failures and demonstrate troubleshooting aids.

B. Instruct Owner's Designated Personnel:
   1. Minimum of 2 HRS at the jobsite.
   2. Include both field and classroom instruction.
   3. Instructions shall include proper operation and maintenance procedures including, but not limited to:
      a. Lubrication.
      b. Troubleshooting.
      c. Repair and replacement.
      d. Parts inventory.
      e. Maintenance records.

END OF SECTION

SECTION 16483
LOW VOLTAGE SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Specifications for an individually mounted, rear-accessible, low voltage switchboards.

1.2 REFERENCES

A. The low voltage switchboards and protection devices in this specification are designed and manufactured according to latest revision of the following standards (unless otherwise noted).
   1. ANSI C37.16, Low Voltage Power Circuit Breakers and AC Power Circuit Protectors, Preferred Ratings, Related Requirements and Application Recommendations
   2. ANSI C37.50, Switchgear -Low Voltage AC Power Circuit Breakers Used in Enclosures -Test Procedures
   3. ANSJ/IEEE C37.13, In Enclosures, Low -Voltage AC Power Circuit Breakers Used
   4. ANSJ/NEMA PB 2, Deadfront Distribution Switchboards
   5. ANSJ/NFPA 70, National Electrical Code
   6. NEMA AB I, Molded Case Circuit Breakers and Molded Case Switches
   7. UL 489, Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
   8. UL 891, Dead-Front Switchboards

1.3 SYSTEM DESCRIPTION

A. Switchboards shall be individually mounted with insulated case feeders and low voltage insulated case and power circuit breaker mains and ties. Switchboards shall be factory assembled and metal enclosed. They shall have functionally compartmentalized units for individually mounted protective devices.

B. Switchboards shall be furnished with NEMA 1 indoor, non-walk-in enclosures as specified on the plans.

1.4 SUBMITTALS

A. Manufacturer shall provide copies of following documents to owner for review and evaluation in accordance with general requirements of Division I and Division 16:
   1. Product Data on specified product
   2. Shop Drawings on specified product
   3. Switchboard Data, detailed component data on specified product, such as CT ratios, ratings
   4. Certified trip curves for each specified product
   5. Certified copies of all Production Test Reports

1.5 PROJECT RECORD DOCUMENTS

A. Maintain an up-to-date set of Contract documents. Note any and all revisions and deviations that are made during the course of the project.

B. Record drawings shall be furnished providing the following information:
   1. Complete rating;
   2. Short-circuit rating of bus and interrupting rating of lowest rated device;
   3. Overall outline dimensions including conduit space;
   4. Device schedule showing location in switchboard;
   5. Device description;
   6. Device trip or fuse clip ampere rating;
   7. Conductor rating;
   8. One-line diagram;
   9. Instrument panel and barrier layout;
   10. Schematic and wiring diagrams.

1.6 OPERATION AND MAINTENANCE DATA

A. Manufacturer shall provide copies of installation, operation and maintenance procedures to owner in accordance with general requirements of Division 1 and Division 16.

B. Submit operation and maintenance data based on factory and field testing, operation and maintenance of specified product.

1.7 QUALITY ASSURANCE (QUALIFICATIONS)

A. Manufacturer shall have specialized in the manufacture and assembly of low voltage switchboards for 20 years.

B. Low voltage switchboards shall be listed and/or classified by Underwriters Laboratories in accordance with standards listed in Article 1.03 of this specification.

C. Manufacturer's Certificate of ISO 9002 Compliance.

D. Installer has specialized in installing low voltage switchgear with minimum 10 years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products in accordance with recommended practices listed in manufacturer’s Installation and Maintenance Manuals.

B. Deliver low voltage switchboard in shipping sections on shipping splits for ease of handling. Each section shall be mounted on shipping skids.

C. Inspect and report concealed damage to carrier within specified time

D. Store in a clean, dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic.

E. Handle in accordance with NEMA and manufacturer's written instructions to avoid damaging equipment, installed devices, and finish. Lift only by installed lifting eyes.

F. Switchboard shall have adequate lifting means, and be able to be rolled or moved into installation position and bolted directly to floor without use of floor sills.

1.9 WARRANTY

A. A Manufacturer warrants equipment to be free from defects in materials and workmanship for 1year from date of startup or 18 months from date of shipment, whichever occurs first.

1.10 EXTRA MATERIALS

A. Furnish one set of three spare fuses for each type and rating fuse device for switchboards containing fused disconnects.

B. An integral rail mounted breaker lifting device shall be provided with NEMA I switchboards and a portable breaker lifting device shall be provided for NEMA 3R switchboards.

C. Furnish 2 half-pint unopened cans of manufacturer's touch-up paint.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. ABB

B. Schneider Electric

C. Eaton

D. Pre-approved Equal

2.2 MANUFACTURED ASSEMBLIES

A. Furnish Individually mounted rear-accessible low voltage switchboards as indicated in drawings.

2.3 COMPONENTS

A. Structure
   1. Indoor switchboard shall be completely self-supporting, forming a single metal enclosed structure. Sides, top, and rear covers shall be code gauge steel. Frame structure members shall be die-formed, 11 gauge steel bolted together and reinforced at corners. Switchboard frames are to be suitable for use as floor sills in indoor installations.
   2. Breaker compartment doors shall be secured with two captive hex head screws. Barriers shall isolate breaker compartment from bus bar system.
   3. Switchboards shall be rated as indicated in drawings.
   4. Provide shutters in drawout breaker compartments to cover breaker primary line and load disconnects when the breaker is removed from the compartment.
   5. Switchboard shall have a rear cable and terminal compartment. Cable bending space shall meet National Electrical Code requirements.
   6. All switchboard sections shall have open bottoms and removable top plate(s) to install conduit.

B. Bus Bars
   1. Bus bars shall be full-sized.
   2. A-B-C bus arrangement (left-to-right, top-to-bottom, front-to-rear) shall be used throughout to assure convenient and safe testing and maintenance. Where special circuitry precludes this arrangement, bus bars shall be labeled.
   3. Main and riser busses shall be fully isolated from breaker, instrument and auxiliary compartments. Bus bar material shall be tin plated copper. Bus shall be arranged to permit future additions.
   4. Copper bars shall not exceed 1000 amperes per square inch cross section. If a main circuit protection device is provided, continuous bus current rating shall be frame size of device.
   5. Vertical bus shall be held rigid in short-circuit support structure of molded glass reinforced polyester bases to inhibit the spread of arcing faults.
   6. Provide barrier system to fully insulate each phase of the main bus and isolate each phase of vertical bus bars from each other and cable area so that the only live connections accessible in rear of each section are breaker load side connections.
   7. Continuous current rating shall be based on requirements of UL 891.
   8. Breaker primary connections shall be copper-to-copper, silver-plated on drawout breakers, tin plated on stationary breakers.
   9. Main bus bars shall be braced to withstand short circuit mechanical forces as indicated in drawings. Other bus work shall be braced to withstand short circuit mechanical forces during short circuits equivalent to maximum interrupting capacity of associated circuit breakers, or maximum let-through current for load size of a fused circuit breaker.
   10. A copper ground bus shall be secured to each vertical section structure. Ground bus shall extend entire length of switchboard and shall be equipped with a 4/0 terminal for connection to purchaser's ground system. A lug strap shall be provided for each vertical feeder section.
   11. All feeder device line and load connection straps shall be rated to carry continuous current rating of device frame (not trip rating). Load connection straps shall be insulated and extended beyond the main bus.

C. Service Entrance shall comply with UL Service Entrance requirements: service entrance label, incoming line isolation barriers, neutral connection to switchgear ground for solidly grounded wye systems.

D. Incoming Line Section shall be rated as indicated in drawings. Main cable connections shall have the number and size lugs per phase as indicated on the plans.

E. Protective devices
   1. Switchboard shall include protective devices as shown on drawings.
   2. Main and tie protective devices shall be low voltage power insulated case circuit breakers. Low voltage power circuit breakers shall meet requirements of ANSI/IEEE C37.13, ANSI C37.16, and ANSI C37.50. All protective devices shall be UL Listed.
   3. All main and feeder protective devices shall be in individual compartments, and arranged for either draw out or stationary (not available on low voltage power circuit breakers) mounting. Compartment shall be formed with steel barriers on each side, and glass reinforced polyester barriers on top, bottom and rear surfaces. Ventilation openings shall be provided as required.
   4. Circuit breakers and fused high pressure contact switches shall have a stored-energy type mechanism to provide a quick-make, quick-break operation. Manual charging of stored-energy mechanism and operation of devices shall be accomplished with compartment door closed and latched.

5. Microprocessor Based Tripping Systems
   a. Circuit breakers shall be equipped with solid state self-powered devices which shall include protective trip units, flux-shift trip device, current sensors, and rating plugs.
      i. Protective trip units shall be a micro-electronic processor that is automatic, self - contained and requires no external relaying, power supply or accessories. Its printed circuit cards shall resist moisture absorption, fungus growth, and signal leakage, and shall have highly reliable programmable controls with repetitive accuracy and precise unit settings. All electronics shall be housed in metallic enclosure to protect against high-fault interruption arcs, magnetic interference, dust and other contaminants.
      ii. Programmer shall be RMS sensing for long and short time characteristics for accurate measurement of true RMS content of current wave. Sampling rate shall be 64 times per cycle and up to the 31rst harmonic.
      iii. Current sensors shall be mounted on breaker frame and shall be made of molded epoxy to protect against damage and moisture. For 4- wire ground fault, a fourth current sensor shall be mounted on neutral bar in cable compartment and shall be constructed similar to phase overcurrent sensors. Ground fault function shall contain a memory circuit that integrates arcing fault current with time, summing intermittent ground-current spikes.
      iv. Solid state microprocessors shall use a broad range of field installable rating plugs for future up-rating capability, minimum size cable selection, and an extra degree of coordination flexibility.
      v. The trip unit shall be able to display trip fault information. All information from the trip unit shall be able to be viewed at each breaker without opening the breaker cubicle door.
      vi. Manual breakers shall have front mounted handles for charging closing springs. Breakers shall be closed by pressing a mechanical close button mounted on breaker escutcheon or by operating the breaker handle. Breakers shall be manually opened by pressing a mechanical trip button mounted on breaker escutcheon.
      vii. Circuit breakers/ switches shall be of draw out construction for individual removal and ready replacement from front of switchboard. Drawout construction, when specified, shall permit breaker to be withdrawn from an engaged position, to test position, and to disengaged position. Drawout mechanism shall be Mechanically interlocked with circuit breaker's trip mechanism so that breaker must be OPEN before it can be moved into or out of the connected position. The breaker shall automatically trip open if it is withdrawn while in CLOSED position. A CLOSED breaker shall trip open before it is racked into the engaged position.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that low voltage switchboards are ready to install.

B. Verity field measurements are as shown on the drawings.

C. Verify that required utilities are available, in proper location and ready for use.

D. Beginning of installation means installer accepts conditions.

3.2 LOCATION

A. Switchboards shall have adequate clearance for required rear access.

3.3 INSTALLATION

A. Install per manufacturer's instructions.

B. Install required safety labels.

3.4 FIELD QUALITY CONTROL

A. Inspect installed low voltage switchboards for anchoring, alignment, grounding and physical damage.

B. Check tightness of all accessible mechanical and electrical connections with calibrated torque wrench. Minimum acceptable values are specified in manufacturer's instructions.

3.5 ADJUSTING

A. Adjust all circuit breakers, switches, access doors, and operating handles for free mechanical and electrical operation as described in manufacturer's instructions.

B. Adjust circuit breaker trip and time delay settings to values specified.

3.6 CLEANING

A. Clean interiors of switchboards to remove construction debris, dirt, and shipping materials.

B. Repaint scratch or marred exterior surfaces to match original finish.

END OF SECTION

SECTION 16491
LOW VOLTAGE SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This specification covers over-voltage transient and surge protection, formerly TVSS, of low-voltage AC power applications for service entrances and sub-distribution panels used to power a facility or equipment.

1.2 RELATED SPECIFICATIONS

A. Division 16 – Electrical

1.3 REFERENCE STANDARDS

A. National Electric Code (NEC) Article 242

B. IEEE C62.41 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

C. IEEE C62.41.1 – Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits

D. IEEE C62.41.2 – Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits

E. IEEE C62.45 – Recommended Practice on Surge Testing for Equipment Connect to Low-Voltage (1000V and Less) AC Power Circuits

F. UL 1283 – Electromagnetic Interference Filters

G. UL 1449 Fourth Edition– Standard for Surge Protective Devices

1.4 LISTING REQUIREMENTS

A. SPD shall bear the UL mark and shall be listed to the most recent editions of UL 1283 and UL 1449. “Manufactured in accordance with” is not equivalent to UL listing and does not meet the intent of this specification.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide devices from a manufacturer with at least ten (10) years’ experience in manufacturing transient voltage surge suppressors. Manufacturer shall be ISO 9001 or 9002 certified.

1.6 DELIVERY, STORAGE AND HANDLING

A. Handle and store equipment in accordance with manufacturer’s Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment. This does not include copies delegated to Specification 01300 – Submittals.

1.7 SUBMITTALS

A. Submittals shall include UL 1449 Listing documentation verifying the following:
1. Short Circuit Current Rating (SCCR)
2. Voltage Protection Rating (VPR) for all modes
3. Maximum Continuous Operating Voltage (MCOV) rating
4. I-nominal rating (I-n)
5. Type 1 Device UL listed and labeled

B. Submittals shall include shop drawings including manufacturer installation instruction manual and line drawings detailing dimensions and weight of enclosure, internal wiring diagram illustrating all modes of protection in each type of SPD required, and wiring diagram showing all field connections and manufacturer's recommended wire and breaker sizes.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Eaton

B. Siemens Industry, Inc. – TPS series

C. Advanced Protection Technologies – XAS series

D. General Electric

E. Square D

F. Phoenix-Contact

G. Current Technology/ABB

H. Approved Equal

2.2 EQUIPMENT

A. SPD shall be UL 1449 labeled with 200 kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 242.

B. SPD shall be UL 1449 labeled as Type 1 intended for use without the need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal over-temperature controls. SPDs relying upon external or supplementary install safety disconnectors do not meet the intent of this specification.

C. SPD shall be UL 1449 labeled with 20 kA I-nominal (I-n) for compliance to UL 96A Lighting Protection Master Label and NFPA 780.

D. Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.

E. SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L and N-G for Wye systems: L-L, L-G in Delta and impedance grounded Wye systems.

F. If a dedicated breaker for the SPD is not provided in the switchboard or MCC, the service entrance SPD shall include an integral UL Recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPDs.

G. SPD shall meet or exceed a minimum surge current capability of:
1. Service Entrance Applications: 200 kA per phase
2. 480/277 VAC Distribution Applications: 200 kA per phase
3. 240/120 VAC or 208/120 VAC Distribution Applications: 100 kA per phase
4. Motor Control Panels: 20 kA per phase

H. UL 1449 listed Voltage Protection Rating (VPR) shall not exceed:

Voltage	L-N	L-G	N-G	L-L
120/240V, 1ϕ	700V	700V	700V	1500V
120/240V, 3ϕ	700V	700V	700V	1800V
208Y/120V, 3ϕ	700V	700V	700V	1500V
240V, 3ϕ		1500V		1500V
480Y/277V, 3ϕ	1500V	1500V	1500V	2000V
480V, 3ϕ		1800V		1800V

I. UL 1449 listed Maximum Continuous Operating Voltage (MCOV):

Voltage	Allowable System Voltage Fluctuation (%)	MCOV
120/240V, 1ϕ	25	150
120/240V, 3ϕ	25	320
208Y/120V, 3ϕ	25	150
240V, 3ϕ	20	320
480Y/277V, 3ϕ	20	320
480V, 3ϕ	20	552

J. SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100 kHz.

K. SPD shall be equipped with the following diagnostics and features:
1. Visual LED including a minimum one (1) green LED indicator per phase and one red service LED.
2. Audible alarm with on/off silence function and diagnostic test function.
3. Minimum one (1) set of NO/NC Form C dry contacts.
4. Surge Counter
5. NEMA 4X Stainless Steel Enclosure for outdoor and wet area and NEMA 12 enclosure for indoor dry area.

PART 3 - EXECUTION

A. Installers of low-voltage lightning arresters shall be knowledgeable, and if required, certified, in all applicable electrical practices, standards, codes and wiring techniques as they pertain to installing surge suppressors.

B. Installers shall follow all applicable safety standards.

C. Installers shall follow manufacturer's installation instructions and recommendations.

D. Installer shall mount SPD devices as close to the equipment as possible to keep phase and ground conductor as short as possible and free of sharp bends in conductors. Phase conductors to be #2 minimum and of equal length. Ground to system ground or to a separately installed ground rod with well for service entrance equipment or to ground rod with well for sub-distribution protected equipment such as a well motor. Installer shall make corrections to installation as directed by Engineer.

E. SPD shall be installed on the load side of the main service disconnect in the service entrance rated switchboard as shown.

F. Before energizing, installer shall verify service and separately derived system Neutral to Ground bonding jumpers per NEC.

PART 4 - WARRANTY

A. The Contractor warrants to the Engineer and Owner that all material and equipment furnished under this contract will be new and of good quality. The Contractor also warrants that all work will be of good quality, free from faults and defects for one (1) year.

B. Manufacturer to provide a minimum ten (10) year product warranty.

END OF SECTION

SECTION 16495
LOW VOLTAGE FUSES

PART 1 - GENERAL

1.1 SCOPE

A. This section specified requirements for fuses to be used in fusible switches or fuse holders of systems rated 600 volts and below, 0-6000 amperes.

1.2 REFERENCE STANDARDS

A. Low voltage fuses must conform to standards of the following publications:

1. American National Standards Institute. ANSI. C97.1, Standard for Low Voltage Cartridge Fuses, 600 Volts or Less.
2. National Electrical Manufacturers Association. NEMA. FU 1, Low-Voltage Cartridge Fuses.
3. Underwriters Laboratories, Inc.
    a. UL 198.2, High Interrupting Capacity Current Limiting Fuses
    b. UL 198.3, High Interrupting Capacity Class K Fuses
    c. UL 198.4, High Interrupting Capacity Current Limiting Class R. Fuses

1.3 SUBMITTALS

A. Requirements. Make all submittals in accord with Division 1, General Requirements.

B. Information. Submit for review the following manufacturer's information for each different type of fuse being provided.
1. Manufacturer's type or trade name.
2. Catalog cut-sheets, clearly indicating units to be provided.

1.4 DELIVERY AND STORAGE

A. Delivery. Schedule fuse delivery so fuses may be installed promptly after arrival.

B. Storage. Store fuses in a suitable, moisture-free location until installation is required. Install fuses in the equipment immediately prior to energizing the circuit in which fuses are used. Fuses installed and shipped with equipment or otherwise exposed to moisture may require removal and replacement, as directed. Such fuses must be replaced at no change in the contract sum.

PART 2 – PRODUCTS

2.1 VOLTAGE

A. Supply fuses with a voltage rating suitable for the nominal voltage of the system in which they are to be applied.

2.2 TYPES

A. Time Delay Fuses. Fuses in the 0-600 ampere range require a minimum time delay of ten seconds at five (5) times rated continuous current. Provide fuses which are UL labeled at time delay, current limiting, 200,000 amperes rms interrupting capacity, Class R fuses. Bussmann Fusetron dual element fuses are acceptable.

2.3 SPARE FUSES

A. As spares, provide the greater amount of either three (3) fuses or 20 percent of each size and type installed. Deliver the spare fuses to the Owner at the time of final acceptance of the project. Neatly encase the spare fuses in suitable containers or cabinets, as approved, for location near points of use.

2.4 MANUFACTURER IDENTIFICATION

A. All low voltage fuses (600 volts or less) must be products of a single manufacturer.

B. Retain manufacturer's fuse identification labels, showing manufacturer, size and type installed. Place labels inside the cover of each compartment containing fuses.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Instructions. Follow the manufacturer's installation instructions in all respects.

B. Fuse Clips. Check fasteners on fuse clips for tightness before installing fuses.

C. Labels. Install all fuses so label is in an upright, totally readable position. Fuses without labels are not acceptable.

3.2 INSTALLATION STANDARDS

A. Install fuses in strict compliance with applicable provisions of the National Electrical Code.

END OF SECTION

SECTION 16500
LIGHTING

PART 1 – GENERAL

1.1 SUMMARY

A. Specification for:
   1. LED fixtures
   2. Emergency/Exit fixtures
   3. 24-Hour Programmable Time Switch

1.2 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
   1. No. 70 - National Electrical Code (NEC)
      a. Article 410 - Luminaires, Lampholders, and Lamps
      b. Article 500 - Hazardous (classified) locations
      c. Article 700 - Emergency Systems
   2. No. 101 - Life Safety Code

B. American National Standards Institute (ANSI)
   1. C78.379 - Electric Lamps - Incandescent and High Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
   2. C82.1 - Ballasts for Fluorescent Lamps - Specifications.
   3. C82.4 - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

C. American National Standards Institute/Illuminating Engineering Society (ANSI/IES): The IES Handbook shall be used as a basis for design and construction of lighting systems.

D. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc./Illuminating Engineering Society (ASHRAE/IES): ASHRAE/IES 90.1 - 1989 - Energy Efficient Design of new Buildings Except Low-Rise Residential Buildings.

E. American National Standards Institute/Underwriters Laboratories (ANSI/UL).
   1. UL1570 - Fluorescent Lighting Fixtures.
   2. UL1571 - Incandescent Lighting Fixtures.
   3. UL1572 - High Intensity Discharge Lighting Fixtures.
   4. UL844 - Fixtures for Hazardous Areas.

1.3 SUBMITTALS

A. Submit the following under the provisions of Section 01300 - Submittals:
   1. Outline dimensions, support points and unit weight.
   2. Operation and maintenance data.
   3. Complete test report with photometric curves.
   4. Zonal cavity method coefficient of utilization table
   5. Voltage, type, and manufacturer of ballast
   6. Storage, handling, and installation recommendation.

7. Connection diagrams.
8. Catalog data.

1.4 QUALITY ASSURANCE

A. Tests. Run manufacturer's tests on lighting fixtures in accordance with applicable Underwriters Laboratories (U.L.) Standards 1570, 1571 and 1572.

1.5 DELIVERY, STORAGE AND HANDLING

A. Have lighting fixtures individually packed to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 – PRODUCTS

2.1 REQUIREMENTS

A. Provide lighting fixtures in accordance with the construction drawings and this specification.

B. LED Fixtures. Provide LED type fixtures at a minimum or as indicated on the construction drawings.
   1. LED Stanchion Lighting
      a. 45 Watt rating with Lamp included.
      b. 120 VAC 60Hz
      c. 25 degrees stanchion mount housing
      d. 1 ½" NPT Entry. Contactor shall provide reducers, adapters, or fittings as necessary to fit fixture to existing mount.
      e. Housing shall include globe and protection guard
      f. Acceptable Manufacturers
         i. RAB Lighting
         ii. Hubbell Killark CertiLite V LED Series
         iii. Appleton
         iv. Crouse-Hinds
         v. Approved Equal
   2. LED Wallpack Lighting
      a. Rugged one-piece die-cast aluminum housed and hinged, removable die-cast aluminum door. One-piece silicone gasket to seal the optical chamber.
      b. UL 1598 Wet location listed and IP65 ingress protection rated.
      c. LED electronic driver integral to the fixture shall incorporate internal fusing designed to withstand a minimum 3kV surge test and is Class 2 rated for 120-277V between -30 deg and 60 deg Celsius.
      d. Door shall be polycarbonate refactor type.
      e. Minimum 1500 delivered lumens per fixture when provided with all specified options or accessories.
      f. Lamp shall be included.
      g. Acceptable Manufacturers:
         i. Lithonia
         ii. Lumark
         iii. Hubbell Killark

iv. Appleton
v. Approved Equal

3. LED Flood Lighting
   a. 250 Watt rating with Lamp included.
   b. Multivolt or 120 VAC, 60Hz at a minimum.
   c. Slip fitter mounting.
   d. Fixtures shall be enclosed and gasketed.
   e. Housing shall include globe and vandal protection guard.
   f. Acceptable Manufacturers
      i. Lithonia
      ii. Appleton
      iii. Cooper
      iv. Approved Equal

C. Emergency Fixtures / Exit Fixtures
   1. In working areas such as dry wells, or valve vaults with two or more levels, rooms which do not exit directly outside, or rooms with multiple means of egress, exit signs and lighting are required for safe evacuation of workers.
   2. Provide Lithonia or approved equal wall-mounted, sealed beam, battery powered packs with dual heads where emergency illumination and exist signs are required.

D. 24-Hour Programmable Time Switch: Provide time switch as indicated on the construction drawings.
   1. Time switches shall be of the programmable type capable of being programmed at any intervals over a 24-hour day. Program tabs shall be easily set by hand without tools to obtain or to change the desired programming schedule. The switching condition shall be maintained when adjacent tabs are set alike.
   2. NEMA 1 enclosure intended for general purpose indoor use.
   3. The unit shall be powered by a self-starting, enclosed, 120 Volt, synchronous motor capable of continuous accurate operation. A reserve power, precision wound spring and associated escapement device shall be integrally mounted to maintain time settings during power failures of up to 24 hours.
   4. The switch mechanism shall be a self-contained unit rated at not less than 20 Amps, 120 Volts, single pole, double throw and shall be readily replaceable in the field.
   5. An omitting device shall be furnished as an integral part of the time switching operation to be skipped for any pre-selected day or days of the week.
   6. Time switches shall be manufactured by TORK, Intermatic, or equal.

PART 3 – EXECUTION

3.1 PREPARATION

A. Check the types and quantity of fixtures to be mounted in the area to be illuminated and verify that materials are on hand.

B. Pick out the correct bulbs for the fixtures along with the necessary accessories and mounting hardware.

3.2 INSTALLATION

A. Install fixtures in accordance with manufacturer's instructions, NEC Articles 410, 500 and 700 as applicable, and the Drawings.

B. Wire up fixtures in accordance with the Drawings and ensure proper switching, circuiting and balanced loads.

C. Make sure proper grounding and bonding are provided for fixtures and raceways.

D. Install specified lamps in each fixture.

E. When applicable, aim and adjust fixtures in accordance with directions as indicated on the Drawings.

F. Energize and test fixtures for proper operation.

G. Check the illumination level with a light meter and ensure that sufficient light is reaching areas where tasks are performed and that egress paths are properly illuminated during emergency situations.

END OF SECTION

ATTACHMENT NO. 1

CLOTH MEDIA FILTER EQUIPMENT SCOPE OF WORK

WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2
WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD

QUIDDITY
Texas Board of Professional Engineers and Land Surveyors Reg. No. F-23290
912 S. Capital of Texas Hwy, Suite 300 • Austin, TX 78746 • 512.441.9493

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Protecting the World's Water.

Proposal#: 180744

TO: **Quiddity**
912 S Capital of Texas Hwy Suite 300
Austin
Texas 78746
USA

PROJECT: WILBARGER CREEK MUD 2 TX

ATN: **Zachary Cooper, PE**

PROPOSAL DATE: July 8, 2026

CC: **Hartwell Environmental Corp. / ph#: 512/347-7676**
Lance LeBrun

The following Notes apply to Aqua-Aerobic Systems' proposal:

- We are pleased to quote, for acceptance within 60 days of this date, prices and terms on goods listed below.
- Equipment will be furnished by Aqua-Aerobic Systems with unloading of goods, civil work, and installation by the Buyer.
- This Proposal is for the addition of two (2) disks to the two (2) Aqua Disk Model 54 x 12/4E - PC Disk Filters located at Wilbarger Creek MUD #2.

Cloth Media Filters

AquaDisk Misc/Spare Parts

2 AquaDisk Model # ADFSC-54x12/4E-PC Upgrade(s) consisting of:

- Pile cloth media and non-corrosive support frame assemblies.
- Disk segment 304 stainless steel support rods.
- Media sealing gaskets.
- 304 stainless steel backwash shoe weldments.
- UHMW polyethylene backwash shoe nozzle plates.
- 1 1/2" flexible hose.
- Stainless steel hose clamps.
- Stainless steel backwash shoe springs.
- 304 stainless steel backwash collection manifold(s).
- 304 stainless steel union(s).
- 3" full port, two piece, ASTM A351 Grade CF8M stainless steel body ball valve(s), flanged end connections with single phase electric actuator(s). Valve / actuator combination shall be manufactured by TCI / RCI (RCI, a division of Rotork).

AquaDisk Engineering

1 Set(s) Documentation for the AquaDisk will be provided as described:

- Operation & Maintenance Manuals (English language) in electronic format.

AquaDisk Supervision/Freight Domestic

1 Supervision Services and Freight Package(s) for the AquaDisk will be provided as follows:

- 4 Day(s) On Site for Mechanical & Electrical Inspection, Check Out, Start Up of Filter and Panel
- 2 Trip(s) for Mechanical & Electrical Inspection, Check Out, Start Up of Filter and Panel
- Freight to Jobsite

The Following Notes apply to Aqua-Aerobic Systems' Proposal:

- We expect record set drawings and equipment to be completed and in transit to you approximately 22-26* weeks

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after receipt of order with acceptable terms and conditions and guarantee of payment. *Schedules may be adjusted at time of order placement, depending upon existing order backlog. Weeks quoted are actual working weeks.
- Schedule changes due to supply chain disruption may impact the above quoted times. Aqua-Aerobic Systems will advise if/when any such disruption applies.

- F.O.B. JOBSITE; TITLE AND RISK OF LOSS: All prices and all shipments of goods are F.O.B. Manor, TX. It is the responsibility of the Buyer to unload shipments and utilizing the packing list and bill of lading provided with the shipment notate shortages/damages upon receipt of the shipments and notify Aqua-Aerobic Systems in writing within 7 days of the shortages/damages to facilitate filing of a freight claim. Delivery of the goods sold hereunder by the carrier shall be deemed delivered to Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.

- TAXES: State and/or local taxes are not included in the price but will be charged unless we receive a valid sales exemption certificate, direct pay permit, or other documentation required specifically by the taxing entity prior to shipment.

- PAYMENT TERMS: Subject to credit approval and guarantee of payment, payment Net 30 days from date of each shipment; no retainage allowed.
- Additional supervision services can be provided for an additional charge of $1750/day plus travel and living expenses.

- Only the components specifically called out in this proposal will be supplied. All existing parts will be reused. These parts include but are not limited to:
- Centertube
- Influent and Effluent Weirs
- Gear motor and drives
- Existing Backwash/Sludge waste valves and actuators
- Backwash Pumps
- Existing Filter Cloth Frames
- Control panels
- Pressure Transducer
- High Level Float

- Any modifications to the existing infrastructure, backwash piping system, are the responsibility of the General Contractor.

GOODS QUOTED ABOVE WILL BE SOLD SUBJECT ONLY TO THE TERMS AND CONDITIONS OF SALE SET FORTH HEREIN. ANY DIFFERENT OR ADDITIONAL TERMS ARE HEREBY OBJECTED TO.

Total Price:

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TERMS AND CONDITIONS OF AQUA-AEROBIC SYSTEMS, INC. (A Metawater Company)

This offer and all of the goods and sales of Aqua-Aerobic Systems, Inc. are subject only to the following terms and conditions. The acceptance of any order resulting from this proposal is based on the express condition that the Buyer agrees to all the terms and conditions herein contained. Any terms and conditions in any order, which are in addition to or inconsistent with the following, shall not be binding upon Aqua-Aerobic Systems, Inc. This proposal and any contract resulting therefrom, shall be governed by and construed in accordance with the laws of the State of Illinois, without regard to conflicts of laws principles. Resale of any products purchased from - Aqua-Aerobic Systems, Inc, is not permitted without prior written agreement with Aqua-Aerobic Systems, Inc expressly consenting to such resale. Any party who sells a product purchased from Aqua-Aerobic Systems, Inc, is subject to the terms and conditions included herein.

DURATION OF QUOTATION
This proposal of Aqua-Aerobic Systems, Inc. shall in no event be effective more than 30 days from date thereof, unless specifically stated otherwise, and is subject to change at any time prior to acceptance.

PROPRIETARY INFORMATION
This proposal, including all descriptive data, drawings, material, information and know-how disclosed by Aqua-Aerobic Systems, Inc. to Buyer in relation hereto is confidential information intended solely for the confidential use of Buyer, shall remain the property of Aqua-Aerobic Systems, Inc. and shall not be disclosed or otherwise used to the disadvantage or detriment of Aqua-Aerobic Systems, Inc. in any manner.

PAYMENT TERMS; ORDERS;
Unless specifically stated otherwise, quoted terms are Net 30 Days from invoice date. Past-due charges are 1.5% per month and will apply only on any past-due balance. Aqua-Aerobic Systems, Inc. does not allow retainage of any invoice amount, unless authorized in writing by an authorized representative of our Loves Park, Illinois office. Terms of payment are within Aqua-Aerobic Systems, Inc's sole discretion, and unless otherwise agreed to by Aqua-Aerobic Systems, Inc, payment terms must be accepted by Aqua-Aerobic Systems, Inc prior to Aqua-Aerobic Systems' acceptance of an order. Payment for the products must be made by approved credit card, check, wire transfer, or some other prearranged payment method unless credit terms have been agreed to by Aqua-Aerobic Systems, Inc. Invoices are due and payable within the time period noted on the invoice, measured from the date of the invoice. Orders are not binding until accepted by Aqua-Aerobic Systems, Inc.

SECURITY
If at any time the financial responsibility of the Buyer becomes unsatisfactory to Aqua-Aerobic Systems, Inc., or Aqua-Aerobic Systems, Inc. otherwise deems itself insecure as to receipt of full payment of the purchase price from Buyer hereunder, Aqua-Aerobic Systems, Inc. reserves the right to require payment in advance or security or guarantee satisfactory to Aqua-Aerobic Systems, Inc. of payment in full of the purchase price.

SHIPMENT
Shipping dates are not a guarantee of a particular day of shipment and are approximate, being based upon present production information, and are subject to change per the production schedules existing at time of receipt of purchase order. Aqua-Aerobic Systems, Inc. shall not be responsible for any delay in shipment for causes beyond its control including, but not limited to, war, riots, strikes, labor trouble causing interruption of work, fires, other casualties, transportation delays, modification of order, any act of governmental authorities or acts of God. Quoted shipment dates in this proposal are approximate dates goods will be shipped and, unless agreed to in writing by Aqua-Aerobic Systems, Inc., Buyer may not postpone or delay the dates of shipment of goods from our plant or from our supplier's plants beyond the dates set forth in this proposal. Buyer is required to notify Aqua- Aerobic Systems, Inc within 7-days of any discrepancies with shipment.

SHIPPING CHARGES; TAXES and OTHER RELATED FEES. Separate fees for shipping and handling will be charged on all purchases unless specifically stated otherwise. Prices quoted do not include any taxes, customs duties, or import fees. The Buyer is responsible for sales use and all other taxes and fees associated with the purchase. If aqua-Aerobic Systems, Inc. is required by any taxing authority to collect or to pay any such tax, duty or fee, the Buyer shall be separately billed at such time for the amounts Aqua-Aerobic Systems, Inc is required to pay

TITLE AND RISK OF LOSS
F.O.B. Destination - Delivery of goods to the destination shall be deemed delivery to the Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.

F.O.B. Aqua-Aerobic Systems, Inc's plant at Loves Park, Illinois - Delivery of the goods sold hereunder to the carrier shall be deemed delivery to the Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.

INSURANCE
Unless the goods are sold on a CIF basis, the Buyer shall provide marine insurance for all risks, including war and general coverage. Aqua-Aerobic Systems, Inc will provide evidence of coverage upon request. At no time will Aqua-Aerobic Systems, Inc issue a certificate of insurance listing Buyer as additional insured unless under fully executed contract and Aqua-Aerobic Systems, Inc is providing start-up services.

LIMITATION OF ACTION
No action shall be brought against Aqua-Aerobic Systems, Inc. for any breach of its contract of sale more than two years after the accrual of the cause of action thereof, and, in no event, unless the Buyer shall first have given written notice to Aqua-Aerobic Systems, Inc., of any claim of breach of contract within 30 days after the discovery thereof.

CANCELLATION CLAUSE
No acceptance of this proposal, by purchase order or otherwise, may be modified except by written consent of Aqua-Aerobic Systems, Inc. nor may it be canceled except by prior payment to Aqua-Aerobic Systems, Inc. the following sums as liquidated damages therefore: 1) If cancellation is prior to commencement of production and prior to the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to 15% of the total purchase price; 2) If cancellation is after the commencement of production or after the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to the total of the direct, out-of-pocket expenses incurred to the date of cancellation for labor, machine time, materials and any charges made to us by suppliers for cancellation, plus 30% of the total purchase price. All charges and expenses shall be as determined by Aqua-Aerobic Systems, Inc. In the event any items are used by Aqua-Aerobic Systems, Inc. to fill a subsequent order, then upon receipt of payment for such order, Aqua-Aerobic Systems, Inc. shall pay the Buyer a sum equal to the direct out-of-pocket expenses previously charged and received from Buyer.

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TERMS AND CONDITIONS OF AQUA-AEROBIC SYSTEMS, INC. (A Metawater Company)

QUALIFIED ACCEPTANCE AND INDEMNITY
In the event the acceptance of this proposal by Buyer either is contingent upon or subject to the approval by any third party such as, but not limited to, a consulting engineer, with respect to goods, parts, materials, descriptive data, drawings, calculations, or any other matter, then upon such approval by any third party, Aqua-Aerobic Systems, Inc. shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua- Aerobic Systems, Inc. conform to this proposal. In the event any such third party requires modifications in the proposal prior to the approval thereof, Aqua-Aerobic Systems, Inc. may at its sole option and without liability to any party elect to cancel this proposal or return the purchase order to Buyer. In the event Aqua-Aerobic Systems, Inc. elects to modify this proposal to conform to the requirements for approval by any third party, Aqua- Aerobic Systems, Inc. in such event shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua-Aerobic Systems, Inc. conform to this proposal as modified.

Buyer agrees to indemnify and save harmless Aqua-Aerobic Systems, Inc. from and against all costs and expenses and liability of any kind whatsoever arising out of or in connection with claims by third parties so long as the goods sold hereunder conform to the requirements of this proposal as approved by any third party.

WARRANTY; LIMITATION OF LIABILITY; AND DISCLAIMER
In return for purchase and full payment for Aqua-Aerobic Systems, Inc. goods, we warrant new goods provided by us to be free from defects in materials and workmanship under normal conditions and use for a period of one year from the date the goods are put into service, or eighteen months from date of shipment (whichever first occurs). If the goods include an "Endura Series" motor, the complete Endura Series unit shall be warranted by Aqua-Aerobic Systems, Inc to be free from defects in materials and workmanship under normal conditions and use for three years from the date the product is put into service or 42 months from the date of shipment (whichever occurs first).

OUR OBLIGATION UNDER THIS WARRANTY IS EXPRESSLY AND EXCLUSIVELY LIMITED to replacing or repairing (at our factory at Loves Park, Illinois) any part or parts returned to our factory with transportation charges prepaid, and which our examination shall show to have been defective. Prior to return of any goods or its parts to our factory, Buyer shall notify Aqua-Aerobic Systems, Inc. of claimed defect, and Aqua-Aerobic Systems, Inc. shall have the privilege of examining the goods at Buyer's place of business or where the goods have otherwise been placed in service. In the event this examination discloses no defect, Buyer shall have no authority to return the goods or parts to our factory for the further examination or repair. All goods or parts shall be returned to Buyer, F.O.B. Loves Park, Illinois. This warranty shall not apply to any goods or part which has been repaired or altered outside our factory, or applied, operated or installed contrary to our instruction, or subjected to misuse, chemical attack/degradation, negligence or accident. This warranty and any warranty and guaranty of process or performance shall no longer be applicable or valid if any product, including any software program, supplied by Aqua-Aerobic Systems, Inc., is modified or altered without the written approval of Aqua-Aerobic Systems, Inc. Our warranty on accessories and component parts not manufactured by us is expressly limited to that of the manufacturer thereof.

THE FOREGOING WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND OF ALL OTHER LIABILITIES AND OBLIGATIONS ON OUR PART, INCLUDING ANY LIABILITY FOR NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE; AND ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY DISCLAIMED; AND WE EXPRESSLY DENY THE RIGHT OF ANY OTHER PERSON TO INCUR OR ASSUME FOR US ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF ANY GOODS PROVIDED BY US. THERE ARE NO WARRANTIES OR GUARANTEES OF PERFORMANCE UNLESS SPECIFICALLY STATED OTHERWISE.

UNDER NO CIRCUMSTANCES, INCLUDING ANY CLAIM OF NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE, SHALL AQUA-AEROBIC SYSTEMS, INC. BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, COSTS OF CONNECTING, DISCONNECTING, OR ANY LOSS OR DAMAGE RESULTING FROM A DEFECT IN THE GOODS. LIMIT OF LIABILITY: AQUA-AEROBIC SYSTEMS, INC.'S TOTAL LIABILITY UNDER THE ABOVE WARRANTY IS LIMITED TO THE REPAIR OR REPLACEMENT OF ANY DEFECTIVE PART. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE, AND OUR LIABILITY WITH RESPECT TO ANY CONTRACT OR SALE, OR ANYTHING DONE IN CONNECTION THEREWITH, WHETHER IN CONTRACT, IN TORT, UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT, IN ANY CASE, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

Final acceptance of this proposal must be given to Aqua-Aerobic Systems, Inc. at their office in Loves Park, Illinois. Please acknowledge acceptance by signing the proposal and returning it to Aqua-Aerobic Systems, Inc.

Accepted by:

Company: _____

By: _____ **Date:** _____

Offer Respectfully Submitted,

Thomas Mangione, AMS Senior Sales Engineer
Aqua-Aerobic Systems, Inc.

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ATTACHMENT NO. 2

ELEVATED HEADWORKS EQUIPMENT SCOPE OF WORK

WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2
WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD

QUIDDITY
Texas Board of Professional Engineers and Land Surveyors Reg. No. F-23290
912 S. Capital of Texas Hwy, Suite 300 • Austin, TX 78746 • 512.441.9493

Scope of Supply

Project:
Wilbarger MUD No. 2 WWTP Expansion
Manor, TX

Specification:
11221 – PERFORATED PLATE SCREEN
11700 – SCREENINGS WASHER COMPACTOR

Equipment:
FSM Perforated Filter Screen Model FRSIII 700 x 75/6
SPECO WASTECOM™ Shaftless Spiral Conveyor/Compactor Model CPS200

Represented By:
Hartwell Environmental Corporation
Lance LeBrun
Phone: 512-423-0643
Email: llebrun@hartwellenv.com

Regional Sales Manager:
SAVÉCO North America, Inc.
James Willson
Phone: 706-550-3431
Email: james.willson@savecowaterna.com

Project No.: WEC225201
July 8, 2026

ITEM: "A" - One (1) FSM Perforated Filter Screen
Model FRSIII 700 x 75/6



BASIS OF DESIGN (EACH)

Application:	Municipal Wastewater
Peak Flow:	2.0 MGD
Screen Perforated Opening:	6 mm
Angle of Screen:	75 degrees from horizontal
Channel Width:	48 inches
Channel Depth:	5.5 feet
Downstream Water Level:	1.88 feet @ Peak flow
Headloss:	2.08 inches @ Peak flow with 0% blinding
	3.58 inches @ Peak flow with 30% blinding
Discharge Height:	4.1 feet (above top of channel)
Wash Water:	26 gpm at 40 – 60 psi
SCR (Screenings Capture Ratio):	85%

PERFORATED PANEL TRAVELING BELT SCREEN (EACH)

- Fully automatic self-cleaning FSM screen complete with all appurtenances – 316 stainless steel.
- Main frame constructed from type 316 stainless steel.
- Pivoting flanged baseplate for mounting screen assembly to top of channel and to allow screen to pivot out of channel, from type 316 stainless steel.
- Screen support rails from UHMW-PE provided front and back on each side of frame.
- Replaceable UHMW-PE seals mounted to each side of frame.
- Replaceable bottom seals – Buna-N rubber and triple layer polyester brush with 316 stainless steel adjustable holder.
- Perforated filter screen elements with 6 mm perforations from 3 mm thick (12 gauge) type 316 stainless steel, bolted to drive chain with 316 stainless steel bolt ny-lock nuts and washers.

- Screen drive roller chain from 316 stainless steel with specially hardened bushings, and pins from Duplex stainless steel and rollers from PA6.
- Stainless steel chain and screen elements driven by two (2) drive shaft mounted stainless steel sprockets with minimum thickness of 0.75 inches.
- Lower static guides from type 316 stainless steel.
- Drive tensioners – 316 stainless steel.
- Drive system to include 1.0 HP 1760 rpm TEFC (Class I, Division 2) geardrive motor suitable for 460/3/60 electrical supply.
- Nylon screen cleaning brush, automatic self-adjusting, with stainless steel drive shaft and 2.0 HP 1760 rpm TEFC (Class I, Division 2) geared motor suitable for 460/3/60 electrical.
- Rotary Deflector from type 316 stainless steel on back side of screen auxiliary driven by screen drive.
- Internal spray system to clean internal surfaces of screen panel from stainless steel with PVDF nozzles, complete with manual ball valve and solenoid valve.
- Removable 316 stainless steel odor control enclosures/covers.
- Screenings discharge chute with hinged hood – 316 stainless steel.
- Anchor bolts – 316 stainless steel.
- Fasteners – 316 stainless steel.
- Shop surface preparation, stainless steel full dip passivation.

CONTROL PANEL AND INSTRUMENTATION (EACH)

- One (1) NEMA 4X type 316 stainless steel wall mount main control panel suitable for 480/3/60 electrical supply. Control panel shall contain the following control devices for operation of the filter screen.
    1. Enclosure, Painted White
    2. Enclosure, Stand Kit
    3. Enclosure, Swing Out Panel Kit
    4. Enclosure, Voltage Divider, Lexan Type
    5. Enclosure, Data Pocket
    6. Main Disconnect, Circuit Breaker Type, Flanged Type
    7. Motor Branch Circuit Protection
    8. Motor Starter, NEMA Size 1, Non-Reversing, with Overload [Screen, Brush] (x2)
    9. Load Monitor [Screen]
    10. Phase Failure Relay
    11. Surge Protection, 480VAC
    12. Surge Protection, 120VAC
    13. Surge Protection, Analog
    14. Surge Protection, Ethernet
    15. Control Power Transformer, 480-120VAC w/ branch circuit protection
    16. LED Panel Light, w/Door Switch
    17. GFCI Convenience Receptacle

18. PLC, Schneider Modicon M340 PLC
19. Power Supply, 24VDC - Redundant Type
20. 12" Schneider Harmony OIU – 5-Port, Unmanaged Phoenix Ethernet Switch
21. UPS Battery Backup
22. Elapsed Time Meters (x2)
23. Heater w/ Thermostat
24. Circuit breakers, 120VAC
25. Pilot Lights, LED type
26. Push Buttons
27. Selector Switches
28. Control Relays
29. Terminal Blocks
30. Dry Output Contacts
31. Intrinsically Safe Barrier: [Float Switch by others]
32. UL Certification
33. Sunshield
34. Air Conditioner (Non-hazardous)

- One (1) NEMA 7 Cast Aluminum Emergency Stop pushbutton station.
- One (1) NEMA 7 5-hole Local Control Station to control the following functions:
    1. Two (2) Screen/Brush Hand-Off-Auto selector switches.
    2. One (1) Press Hand-Off-Auto selector switch.
    3. One (1) Press Forward-Off-Reverse selector switch.
    4. Emergency stop pushbutton.

- One (1) motor cut-out switch: Interlock switch suitable for the area classification, mounted to the hinged hood.
- One (1) NEMA 7 120 VAC, brass body wash water solenoid valve.
- Differential Level Controller: One (1) LT500 HMI, Non-hazardous rated; level controller mounted next to control panel
    1. One (1) Hoffman, NEMA 4X Fiberglass enclosure with window
    2. Two (2) ultrasonic transducers, Siemens XPS-15F with 10m cable, rated for a Class I, Division 1 area.
- One (1) NEMA 7 pull-cord.
- One (1) limit switch, suitable for a NEMA 7 hazardous area, for detecting screen drive high torque.

SPARE PARTS (TOTAL)

- One (1) set of replacement cleaner brush elements.
- Two (2) spare screen elements.
- Spare Parts per 11320-2.8.B.

FIELD SERVICE (TOTAL)

- Site service of three (3) trips for a total of three (3) days for installation inspection, startup and operator training.

CLARIFICATIONS/COMMENTS

- SECTION 11221 2.4.D – For clarification, NEMA 8 is an older classification which is no longer in production. The emergency stop push buttons, switches, and solenoid valves provided shall be rated for a NEMA 7 environment.
- SECTION 11221 2.13 – For clarification, pump controls are to be done by others, not SAVECO.
- SECTION 11221 2.13 – For clarification, a float switch is not outlined as part of the controls, and Section 13340 notes that the float switch is provided by the contractor.
- SECTION 11221 2.13 – For clarification, the control panel is located outside of the hazardous area. Local controls shall be rated for a NEMA 7 environment.
- SECTION 11221 2.13 – For clarification, Drawing 3-E-1 shows the control panel in a non-hazardous area. If a Class I, Division 2 control panel is required, a pressure purge system will be required. The pressure purge system will require plant supplied clean dry, instrument grade compressed air.
- SECTION 11221 2.13.7 – For clarification, the PLC requirements listed in Section 13311 are listed for the current panel CP-12-101, but do not list requirements for the new screen control panel. The provided PLC is from Schneider Electric Modicon, per the acceptable manufacturers.
- SECTION 11221 2.13.8: For clarification, a manufacturer standard sun shield has been provided. If a custom sun shield is required as outlined in 13330-2.5.F, it will be done by others, not SAVECO.

OPTIONAL ITEMS

- None.

NOTE: ANY ITEM NOT LISTED ABOVE TO BE FURNISHED BY OTHERS

EXCLUSIONS

Taxes, electrical wiring, conduit or electrical equipment, piping, valves, or fittings, shimming material, lubricating oil or grease, shop or field painting, field welding, erection, hoist or lifting apparatus, detail shop fabrication drawings, performance testing, unloading, storage, concrete work, civil design, grating, platforms, stairs, hand railing, dumpster (except as specifically noted).

This proposal section has been reviewed for accuracy and is approved for issue:
By: Alexander Renken Date: July 8, 2026

ITEM: "B" - One (1) SPECO WASTECOM Shaftless Spiral Conveyor Compactor Model CPS200



BASIS OF DESIGN (EACH)

Application	Compact and Convey Screenings
Throughput Rate:	70 ft3/hr
Screw Diameter:	7 inches
Overall Length:	20.2 feet
Installation Angle:	7 degrees
Discharge Height:	1.6 feet
Wash Water Requirement:	8 GPM at 40-60 psi

SCREENINGS COMPACTOR (EACH)

- Inclined orientation.
- Push configuration.
- Three (3) vertical inlets.
- One (1) outlet to customer supplied dumpster.
- Shaftless spiral screw constructed from 316 stainless steel.
- Trough drainage module area located at lowest end from SINT® engineered polymer, 8 mm perforations, self-cleaning design with continuous contact with the shaftless spiral.
- U-trough construction from type 316 stainless steel.
- Except for the inlet portion, the conveyor is provided with bolted 1 mm thick type 316 stainless steel cover sections.
- Wear Bars will support the spiral throughout the trough length and be constructed from type 316 stainless steel. Wear bars shall be bolted to the inside along the longitudinal axis. Bolts and sealing washers shall be located on the outside of the transport tube.
- Compaction zone with cylindrical screen with 0.04-inch (1 mm) slotted openings combined with solid cylinder and covers from type 316 stainless steel.
- Compaction zone spray wash system with 0.5" connection to wash down the cylindrical screen and to flush solids down the drainpipe back to the channel.
- Compaction zone assembly cover shall be bolted and fabricated from type 316 stainless steel. A back-pressure iris plate from SINT® engineered polymer shall control the screenings dewatering and formed plug at the discharge end.
- Gear reducer drive unit with 2.0 HP TEFC (Class I, Division 2) motor suitable for 460/3/60 electrical supply.

CONVEYOR SUPPORTS (EACH)

- Support legs from type 316 stainless steel are supplied to support the screw compactor unit as required.

INLET HOPPER (EACH)

- Three (3) inlet hoppers constructed from type 316 stainless steel to receive material from screen discharge.

CONTROL PANEL AND INSTRUMENTATION (TOTAL)

- Controls for the shaftless spiral conveyor compactor to be included with the screen control panel.

- One (1) NEMA 7 120V brass body solenoid valve to control water spray functions.
- One (1) NEMA 7 Cast Aluminum emergency stop pushbutton.
- One (1) NEMA 7 pull-cord.

SPARE PARTS (TOTAL)

- None.

FIELD SERVICE (TOTAL)

- Provided with screen start-up services.

CLARIFICATIONS/COMMENTS

- SECTION 11700 - For clarification, all wetted and structural components, anchor bolts, and fasteners shall be constructed of type 316 stainless steel.
- SECTION 11700 2.3.C.2 - For clarification, motors shall be rated for operation in a Class I, Division 2 environment.
- SECTION 11700 3.4.B - For clarification, installation supervision, start-up and test services for the SAVECO CPS shall be combined with the screen start-up services.

OPTIONAL ITEMS

- None.

NOTE: ANY ITEM NOT LISTED ABOVE TO BE FURNISHED BY OTHERS.

EXCLUSIONS

Taxes, electrical wiring, conduit or electrical equipment, piping, valves, or fittings, shimming material, lubricating oil or grease, shop or field painting, field welding, erection, hoist or lifting apparatus, detail shop fabrication drawings, performance testing, unloading, storage, concrete work, civil design, grating, platforms, stairs, hand railing, dumpster (except as specifically noted).

This proposal section has been reviewed for accuracy and is approved for issue:
By: Alexander Renken Date: July 8, 2026

SAVÉCO
Member of WAMGROUP

PROPOSAL

Item	Equipment	Price
A	One (1) FSM Perforated Filter Screen Model FRSIII 700 x 75/6	$
B	One (1) SPECO WASTECOM Shaftless Spiral Conveyor Compactor Model CPS200	$

Validity:
Prices are valid for a period of 30 days from the date of this proposal.

Warranty Statement and Term:
SAVÉCO North America, Inc. warrants the supplied equipment to the original end user against defects in workmanship or material under normal use and service in compliance with the original design specifications and the maintenance requirements and instructions as found in the Operations & Maintenance Manual. All SAVÉCO North America supplied equipment is warranted for 12 months from date of start-up or 18 months from date of shipment, whichever occurs first.

Warranty Exclusions:
This warranty does not cover costs for standard and/or scheduled maintenance performed, nor does it cover consumables and SAVÉCO North America parts that, by virtue of their operation, require replacement through normal wear (aka: Wear Parts), unless a defect in material or workmanship can be determined by SAVÉCO North America. Wear parts are defined as brushes, rollers, spray nozzles, drum seals and other items specifically identified in the Operations & Maintenance Manual.

Warranty Coverage:
SAVÉCO North America's liability is limited to the supply or repair of defective parts returned, freight prepaid by buyer to a location specified by SAVÉCO North America. Repaired or replacement parts will be shipped to buyer prepaid via standard ground freight. Express or expedited shipments will be at the expense of the buyer.

Exclusions and Exceptions:
This Warranty excludes damage or wear to equipment caused by misapplication of product, improper maintenance, accident, abuse, unauthorized alteration or repair, Acts of God, or installation or operation that is non-compliant with SAVÉCO North America installation and operations instructions.

Limited Liability:
SAVÉCO North America shall not under any circumstances be liable for any incidental or consequential damages arising from loss, damage to property, personal injury or other damage or losses owing to the failure of SAVÉCO North America's equipment. The liability of SAVÉCO North America, Inc. is limited as set forth above within the time period set forth above.

Terms: 15% with Submittal Approval
80% Net 30 Days after Shipment
5% Net 30 days after Startup. Startup not to exceed 180 days from equipment delivery.

Taxes: No sales or use taxes have been included in our pricing.

Freight: Prices quoted are F.O.B. shipping point with freight allowed to a readily accessible location nearest jobsite. Any claims for damage or loss in shipment to be initiated by purchaser.

Submittals: Full submittals will be supplied approximately 6 to 8 weeks after receipt and acceptance of purchase order at the SAVÉCO North America offices. We allow 2-3 weeks for submittal approval at which time we will commence fabrication of the equipment and controls.

Shipment: Shipment time is approximately 20 to 26 weeks after approved submittal is received at the SAVÉCO North America offices. Under no circumstances will verbal approval be accepted.

Additional Field Service: This service may be scheduled at $1,600.00 per day plus expenses or is available through a yearly service contract.

Material of Construction: SAVÉCO North America is providing the equipment from the type of material specified for this project. If from 304L stainless steel the concentration of chloride and hydrogen sulfide (H2S) in the equipment operating environment shall be kept below the following values:

- Chloride <200 mg/L
- Hydrogen Sulfide (H2S) <6ppm

If not already done so, SAVÉCO North America can provide the equipment from 316L stainless steel for a price adder for environments that exceed the values noted above.

Please issue Purchase Orders to:
SAVÉCO® North America, Inc.
1570 St Paul Avenue
Gurnee, IL 60031

Attn: Todd Campbell
Phone: 224-302-0301
Email: todd.campbell@savecowaterna.com

ATTACHMENT NO. 3

DEWATERING FACILITY EQUIPMENT SCOPE OF WORK

WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2
WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD

QUIDDITY
Texas Board of Professional Engineers and Land Surveyors Reg. No. F-23290
912 S. Capital of Texas Hwy, Suite 300 • Austin, TX 78746 • 512.441.9493

PWTech

SCOPE

TO:	**Bidding Contractors**
PROJECT / REF:	**Wilbarger Creek M.U.D No 2 WWTP Expansion**
PROPOSAL TYPE:	Scope of supply
SPEC. SECTIONS:	11152 – DOUBLE DISC PUMPS 11450 - VOLUTE PRESS 11540 - LIQUID POLYMER BLENDING UNIT 11733 – SCREW CONVEYOR PLC will comply with S13311 Flowmeter will comply with S 13340 §2.1
DATE:	15 June 2026
PWT #:	VDP-TX-25175
REV:	6
SIZING INFORMATION:	Sized to dewater up to 546,000 gallons per week from 0.75% municipal WAS in 35 hours of operation (260 GPM).
MANUFACTURERS REP:	Chris Cortez South Western Environmental Equipment Technicians (SWEET) Cell: (972) 489-2951 cjcortez@sbcglobal.net
NOTES:	
REVISION NOTES:	Rev 2 – Added 15HP VFD for sludge feed pump Rev 3 – Added feed pumps and second pump VFD Rev 4 – Added Clarifications for Bid Rev 5 – Added 1” Washwater Header and valves Rev 6 – Elevated polymer system by ~ 30”. Upsized washwater valves to 1”
PREPARED BY:	Alex Davey

PROPOSAL CONTENT

- Scope of supply summary
- Scope Details
- Exceptions and Exclusions
- Governing Conditions and Warranty Notes
- Price
- PWTech Terms and Conditions and Warranty

SCOPE OF SUPPLY

Line	Qty.	Item	Manufacturer / Model / Description
1	1	Volute* Dewatering Press	PWTech - ES-356 – Tag # VP-14D-101
2	2	Polymer Preparation System	VeloDyne - VeloBlend VM-10P-1200-X0D Tag #'s PBU-14C-101 and PBU-14C-201
3	1	Influent Sludge flowmeter	Rosemount™ Model 8750W with 6" ANSI Flanges
4	1	Conveyor System	JDV U420 Shaftless Screw Conveyors Tag #'s SCC-14-101 and SCC-14-102
5	2	Double Disc Pumps	Penn valley Double Disc – Model 6DDSX107CNU Tag #'s DDP-14A-101 and PBU-14A-201
6	1	Control System for Item 1-4	PWTech
7		Documentation	Submittals, O&M manuals, Startup Report
8		Field services	Installation inspection, Commissioning, Testing and operator training
9		Delivery to site	

*Volute is registered with the U.S. Patent and Trademark Office as a registered trademark of AMCON, Inc., Yokohama, Japan

SCOPE DETAILS

1. Volute Dewatering Press - PWTech Model ES-356

Design

- The unit to be supplied will be an ES-356 with a MAXIMUM capacity of ~ 330 GPM from 0.75% sludge
- This unit will have 1" wash water headers and valves mounted on the floc tank. Hose connection to the drum wash showers is ¾" ID and showers use 3/8" pipeworks.

Components

- The Dewatering Press consists of:
  - Flash mixing tank including mixer with gear motor, high Level Switch and VFD's which will be located in the Control Panel.
  - Two (2) Flocculation tank including mixers with gear motors, level Instruments (one per tank) and VFD's which will be located in the Control Panel.
  - Six (6) x 350 Series Dewatering Drums with a drive motors and VFD's which will be located in the Control Panel.
  - Six (6) 1" Washwater Solenoid Valves
  - Filtrate collection pan and support frame.
- Connections are:
  - Inlet: DN 6" ANSI B16.5 Class 150 Flange
  - Filtrate outlet: Two (2) x DN 8" ANSI B16.5 Class 150 Flange
  - Drain: DN 4" ANSI B16.5 Class 150 Flange
  - Washwater Water inlet: 1" FNPT
  - Polymer solution Inlet: 1" FNPT

Materials and Construction

- The unit is all stainless steel. No carbon steel is used in the manufacture of the press.
- Unit is manufactured and assembled in the USA. All components are sourced from the USA or Japan.
- Electrical components are manufactured and tested prior to shipment to site in the United States.
- Dewatering drum gear drives are SEW Eurodrive gear motors utilizing helical-bevel gear reduction.
- Flocculation tank gear drives are Brother/Nissei GTR gear motors utilizing heloid gear reduction, one piece construction and are sealed for life.

Supplied spare parts

- One (1) washwater solenoid.

2. Polymer Preparation unit – Velodyne Model VM-10P-1200-X0D

Design

- Polymer Flow Range: 1 to 10 GPH
- Dilution Water Flow: 120 to 1200 GPH

Components

- Polymer Mixing Chamber:
  - VeloBlend VM - Staged Hydro-Mechanical
  - ½ HP, 230/460 VAC, 1750 RPM, Inverter ready Mixer motor
  - Mechanical Mixer Shaft Seal with seal flushing assembly
  - VeloCheck™ Neat Polymer Check Valve with Quick Release Pin
  - Pressure Rating of 100 psi with Pressure Relief Valve

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- Neat Polymer Delivery Assembly
  - A 15 GPH stainless steel & Viton progressive cavity metering pump shall be provided
  - ½ HP, 1750 RPM, 230/460 VAC, Inverter ready with gear reducer
  - Thermal type loss of polymer flow sensor
  - Metering pump calibration assembly with isolation valves: (500 ml)
- Dilution Water Inlet and Solution Outlet Assembly
  - Primary 180-1800 GPH rotameter controlled dilution water flow
  - Low differential pressure alarm switch
  - 0-160 psi inlet water pressure gauge (stainless steel, liquid filled)
  - Swing type PVC and Viton check valve
- Electrical Junction Box
  - All electrical components are pre-wired to an FRP junction box
  - A marked terminal strip is provided for landing all wiring for connection to the Volute Press Panel

Materials and Construction

- Mixing Chamber is Stainless Steel body and impeller with clear polycarbonate cover.
- Plumbing is Schedule 80 PVC
- Frame and fasteners are 304 stainless steel. Frame is open design for access to all components and is designed for bolt-down installation.
- Frame elevates polymer system by 30” off the floor– PLEASE NOTE that polymer source must be elevated to maintain flooded suction conditions.

Supplied spare parts

- One (1) complete set of tools required for normal operation and maintenance.
- One (1) set of gaskets and o-rings for all gasketed covers and connections.
- One (1) polymer injection valve.
- One (1) pump rotor, stator, and mechanical seal.
- One (1) repair kit for wear parts not specified.

3. Magnetic flowmeter, 6” Rosemount™ Model 8750W

Design

- 6” Flowmeter is designed for accurate measurement of flows between 180-1800 GPM
- Suitable for direct burial and constant flooding (IP 68).
- Includes Compact mounting of transmitter on the flowmeter body
- Flowmeter out-puts analogue signal (4-20 mA) to Volute Press Control panel

Components

- 6 inch ANSI 150# flange connections.
- Includes grounding rings

Materials and Construction

- Coated Carbon Steel construction with a polyurethane, ceramic, neoprene, or Teflon liner as required by the application.
- All metallic wetted parts are stainless steel type 316

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4. Conveyor system – JDV U420

Design

- Loading = 560 cubic feet per hour
- Conveyor #1 is designed to receive solids from the Volute Press and move them to Conveyor #2
- Conveyor #2 is designed to elevated cake solids and drop into a dump bin
- Anchorage calculations with supports and details signed and sealed by a licensed Professional Engineer in the State of Texas

Construction

- **U-Trough:** minimum 3/16” - 304SS
- **Trough Lids:** minimum 1/8” - 304SS - 304SS (Bolted / 4ft max with neoprene gasketing)
- **Trough Liners:** UHMW-PE, maximum 4ft lengths, minimum 3/8” thickness
- **Spiral:** 16 inch nominal OD, standard pitch, single high tensile bar
- **Included Hardware:** Assembly bolts, lock-washers and hex nuts – 304/316SS

Electrical components:

- One (1) Emergency stop switch c/w cable, mounting hardware, 120VAC NEMA 4
- Two (2) Loss of rotation (LOR) sensor

Conveyor #1: Collection

- 17 foot approximate length
- Horizontal configuration
- Two (2) rectangular inlet(s)
- One (1) discharge outlet to conveyor #2
- 5 HP Drive
- Floor Supports included

Conveyor #2: Inclined Load-out

- 17 foot approximate length
- Inclined configuration (~20 degrees)
- One (1) open end inlet
- One (1) rectangular discharge outlet to dump bin
- 7.5 HP Drive
- Floor Supports included

5. Penn Valley Pump - 6” Model 6DDSX107CNU-MK1 Double Disc Pump™

Design

- Duty: 195-260 gpm at 8-10 ft TDH
- Maintain-in-place hinged housing design for ease of maintenance
- Per drawing PVD728 Piggy-back motor mount

Components

- 6” ASA/ANSI 150# flanged suction and discharge connections
- Suction and Discharge pulsation dampener

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- 15 HP, 1160RPM 230-460/3/60 TEFC Severe duty, inverter ready motor with space heater
- 180 RPM Max pump speed achieved with V-belt and pulley drive
- Two-piece swan neck design with full port rigid clack valve
- 304SS Welded base with OSHA approved guards and covers
- Pump and dampeners coated with industrial primer and topcoat
- Cast iron housing and neoprene elastomers

Spare Parts

- Two (2) discs,
- two (2) trunnions,
- one (1) clack valve,
- one (1) disc tool,
- one (1) set v-belts
- one (1) set of gaskets

6. Electrical and Control

The Volute* unit is supplied with a pre-wired control panel designed to control all aspects of the thickening/dewatering operation unless otherwise specified and noted.

- Control panel is:
  - Fed by a single 208, 240, or 480VAC, 3-phase, 60 Hz, power supply (client specified)
    - Built with a Panel Short Circuit Current Rating (SCCR) of 25 KAIC
  - NEMA 4X rated manufactured in Stainless Steel type 304
  - Manufactured in a UL accredited facility and is UL listed
- Panel includes HMI and PLC control modules.
  - PLC is a Modicon M340
  - HMI is Model DT551 (Harmony GTU 10-inch):
  - HMI is programmed utilizing Ignition software
- All manual switching operations are undertaken via the HMI
- Unit includes complete control system for unit and ancillary equipment including operation of the polymer preparation system, conveyor system, and two (2) **15 HP VFD for control of the feed pumps**.
- Control system utilizes a system flow meter and PID loop to allow operator to set the system flow.
- Control panel includes system running and system fault outputs to plant PLC/SCADA and the ability to connect via Ethernet to external controls via network switch.
- A NEMA 4X FRP junction box on each of the polymer preparation skids are pre-wired to the polymer preparation components and includes numbered terminal block with terminal block legend allowing for easy on-site connection to the main Volute* system control panel.

Supplied spare parts

- One (1) PLC.
- One (1) lot I/O cards of each type..
- One (1) PLC Power supply.

7. Documentation:

Scope includes:

- Submittals (electronic) and
- O&M Manuals (hard copy and electronic).
- Startup Report

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- PLC/HMI Program (electronic copy) – does not include programming software

8. Field Services:

Scope includes the following start-up services -

- On-site start-up and training services for:
  - Two (2) trip each consisting of up to four (4) consecutive days (8 hours per day, Monday-Friday) by a PWT field service engineer and/or qualified manufacturer's representative
- Services include:
  - Installation inspection for all components under this scope
  - Commissioning of Volute* unit and all components under this scope.
  - Start-up of Ancillary equipment included in this Scope
  - Functional testing and calibration of equipment
  - Training on all equipment
- Phone consultation regarding installation will also be provided.
- Should additional services be deemed necessary by the PURCHASER, the additional services can be procured from PWT on a per diem basis. The current rate is $1000 per day plus travel.

9. Delivery and Freight

- Submittals issued approximately ten (10) weeks from receipt of written Purchase Order
- Delivery is approx. eighteen (18) weeks from receipt of written acceptance of Submittal documents
- Deliver to site for all components **is INCLUDED in the price**.
- Spare parts as specified in this scope will be invoiced for on delivery of the major equipment, but will be stored by PWTech and delivered to site separately upon startup of equipment.

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EXCLUSIONS AND EXCEPTIONS:

The Following items are specifically excluded from this scope unless specifically noted otherwise:

- Taxes, Tariffs, permits, and bonding
- Any civil works including, but not limited to, any building works, construction of suitable foundations, and access structures.
- Installation including, but not limited to, mechanical, plumbing, and electrical hook-ups
- Unloading of delivered equipment on site and storage
- PLC/HMI Programming software unless specified elsewhere.
- Engineer stamped drawings or seismic calculations except as otherwise noted.
- Standard costing excludes controls as per S11540 §2.6.
- S11540 § 2.2A Polymer system sizing is incorrect – maximum flowrate needed for 0.25% solution is ~9 GPM
- S13311 § 1.7 A – PWTech notes that its preferred manufacturers are not included in this list and must be pre-approved.

GOVERNING TERMS AND CONDITIONS AND WARRANTY

This scope is subject to Process Wastewater Technologies, LLC. Standard Terms and Conditions and Standard Warranty as attached. The following items are specific to this project:

Payment Terms:

Payment terms for this scope are as per the table below:

Trigger	Amount		Terms			Condition
Submittals	**20**	%	due NET	30	days	On Approval of Submittals
Delivery	**70**	%	due NET	30	days	On shipping, or the offer to ship
O&M	**5**	%	due NET	30	days	On Delivery of final O&M Manuals
Startup	**5**	%	due NET	30	days	On Completion of startup and any other services provided under this scope.

Validity

Validity of this proposal is strictly **90** days. Written authorization from seller is required to extend this.

Warranty

Warranty is 12 months from Substantial completion as per the specifications.

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Process Wastewater Technologies, LLC. Standard Terms and Conditions (Muni.)

These below terms and conditions shall exclusively govern the sale of all goods and related services by Process Wastewater Technologies, LLC. ("PWT") to Buyer.

Item 1. ACCEPTANCE

Buyer may accept the preceding offer by noting acceptance in the space provided on the preceding offer sheet, if such space is provided, or by written purchase order. No oral acceptance shall be effective. This writing is intended by the parties as a final expression of their agreement and, in conjunction with the accompanying signed offer or purchase order and the PWT Standard Limited Warranty ("PWT Standard Limited Warranty"), is intended as a complete and exclusive statement of the terms of their agreement. Acceptance or acquiescence in a course of performance rendered under this agreement shall not be relevant to determine the meaning of this agreement even though the accepting or acquiescing party has knowledge of the nature of the performance and opportunity for objection. No agent, employee or representative of PWT has any authority to bind the Seller to any affirmation, representation or warranty concerning the equipment, components or related services sold under this agreement, and unless an affirmation, representation or warranty made by an agent, employee or representative is specifically included within this written agreement, it has not formed a part of the basis of this agreement and shall not in any way be enforceable.

Item 2. CANCELLATION

Upon acceptance of the preceding offer, Buyer shall have no right to cancel this agreement or any part thereof, except under the conditions specified in this provision or otherwise agreed to in writing by both parties. Any cancellation by Buyer of this agreement must be in writing and shall be deemed effective upon receipt by PWT. In the event of cancellation by Buyer prior to the commencement of production of the goods specified under this agreement, Buyer shall pay PWT a cancellation charge equal to all of the costs incurred by PWT under this agreement up to the time of cancellation, plus fifteen percent (15%) of the full order amount. In the event that production of the goods under this agreement has commenced prior to cancellation, Buyer shall pay a cancellation charge equal to all of the costs incurred by PWT under this agreement up to the time of cancellation, plus an amount equal to the greater of: the value of the goods already completed under the agreement; or fifteen percent (15%) of the full order amount.

Item 3. PRICES

Unless otherwise stated in this offering, prices are F.O.B. the PWT manufacturing facility in Cincinnati, Ohio Charges for on-site technical assistance performed by a factory technical representative are not included unless indicated.

Item 4. VALIDITY

Unless otherwise specified, the preceding offer is valid for acceptance for (30) thirty days and is subject to review thereafter. Prices may be extended beyond thirty (30) days only if confirmed in writing by PWT.

Item 5. PAYMENT TERMS

Twenty percent (20%) of the purchase price under this agreement shall be invoiced net thirty (30) days upon approval of submittals and/or shop drawings; Seventy percent (70%) of the purchase price under this agreement shall be invoiced net thirty (30) days upon shipping, or upon PWT's offer to ship. Five percent (5%) of the purchase price under this agreement to be invoiced net thirty (30) days upon delivery of O&M Manuals and the remaining five percent (5%) will be invoiced net thirty (30) days upon completion and/or performance of all related services under this agreement. Interest will be charged on the unpaid invoiced balance at the rate of one and a half percent (1½%) per month for any amount received after thirty (30) days from the date of invoice. Any collection costs and/or attorney fees incurred by PWT in order to collect payment due will be invoiced to the Buyer, and Buyer agrees to pay said costs.

Item 6. FEES AND TAXES

Buyer shall pay directly or reimburse PWT for payment of any and all applicable customs, sales, use, excise or other fees and taxes associated with the production and delivery of goods under this agreement. Buyer is responsible for and bears the risk of establishing, if applicable, a valid exemption from any tax, and shall indemnify, defend and hold PWT harmless for any loss, cost or expense relating to any such exemption.

Item 7. DELAYED SHIPPING

If Buyer specifies a shipping date more than one (1) year from the date of acceptance of the preceding offer, the price stated in the preceding offer for the same goods shall be increased by a figure of six percent (6%).

Item 8. FINANCIAL RESPONSIBILITY OF BUYER

If at any time before shipment, Buyer's financial ability to pay becomes impaired or unsatisfactory, PWT shall have the right to require Buyer to make payment in full before shipment. In addition, if at any time before shipment, any proceeding is brought by or against Buyer under the bankruptcy or insolvency laws, PWT shall have the right to cancel this contract and Buyer shall pay PWT a cancellation charge equal to all of the costs incurred by PWT up to the time of termination, plus fifteen percent (15%) of the purchase order amount.

Item 9. SHIPPING

Unless otherwise specified, all equipment and components will be shipped in one lot by the lowest cost method at the discretion of PWT. Any additional shipping requests by Buyer may be subject to additional shipping and handling charges. All shipments shall be F.O.B. the PWT manufacturing facility in Cincinnati, Ohio. Delivery to the carrier shall constitute delivery to Buyer for purpose of transfer of risk of loss or damage in transit, and any delivery deadlines specified in this agreement. Buyer is responsible for obtaining any desired cargo insurance and shall pursue any loss or damage claims solely with the carrier.

Item 10. DELIVERY SCHEDULE

Unless otherwise specified, delivery dates under this agreement are approximate, and failure to meet an exact delivery date shall not constitute a breach of this agreement unless delivery is not effected within a reasonable time after the specified delivery date.

Item 11. INSPECTION

Inspection by Buyer or Buyer's representative of the goods specified under this agreement will be permitted prior to shipment at the PWT manufacturing facility in Cincinnati, Ohio, at a time mutually agreeable to both parties. Inspection will be allowed only inasmuch as such inspection does not unreasonably interfere with PWT's production work flow. Complete details of any requested inspection must be submitted to PWT in writing, at least two weeks in advance of the requested inspection date. Any inspection under this provision must be completed prior to shipment of any goods under this agreement.

Item 12. OFFER BASIS

This agreement is exclusively based upon drawings and specifications in the possession of PWT at the time of this agreement. PWT expressly reserves the right to modify the price and other terms of this agreement as reasonable, should additional drawings, documents, or other addenda be required to produce or deliver the goods and/or services provided under this agreement.

Item 13. LIMITED WARRANTY

PWT's warranty liability under this agreement is limited to the terms listed in the PWT Standard Limited Warranty that accompanies these Terms and Conditions, and is incorporated herein by reference. No other warranty, express of implied, is made with respect to the goods and/or services provided under this agreement.

Item 14. MEET AND CONFER

The parties shall amicably work together to negotiate and resolve any controversy or dispute arising out of, or in connection with this agreement or its interpretation, performance or nonperformance or breach thereof. In particular, in the event of a disagreement, the parties shall meet and confer and attempt in good faith to resolve their differences. At the request of the aggrieved party, a face-to-face meeting between decision-makers of the parties shall be arranged at the offices of the non-aggrieved party. Such a meeting shall occur with fourteen days of the delivery of the written request of the aggrieved party, unless otherwise agreed by the parties.

Item 15. ARBITRATION

If, after meeting and conferring as provided under this agreement, the parties are unable to resolve their differences, any disputes shall be settled by binding arbitration in accordance with the following procedures:

(a) The Arbitration shall be conducted in accordance with the Commercial Arbitration Rules of the American Arbitration Association ("AAA") in effect at the time of the arbitration, except as may be modified herein or by mutual agreement of the parties. The location of the arbitration shall be Baltimore, Maryland or Towson, Maryland.

(b) The arbitration shall be conducted by one arbitrator jointly selected by the parties. If the parties are unable to agree upon an arbitrator after thirty (30) days, the arbitrator shall be selected under AAA rules.

(c) The award shall be in writing and shall state the reasons for the award and shall be final and binding on the parties. The award may also include an award of costs, including reasonable attorneys' fees and disbursements. Judgment upon the award may be entered by any court having competent jurisdiction over the parties or their assets.

Item 16. GOVERNING LAW

All disputes and matters arising under, in connection with, or incidental to this contract shall be litigated, if at all, in and before the Circuit Court of Baltimore County, Maryland, USA to the exclusion of other courts of other states, the United States or other countries and to the exclusion of other venues. The parties expressly consent to the exclusive jurisdiction of this court and agree that this venue is convenient and not to seek a change of venue or to dismiss this action on the grounds of *forum non conveniens*, and not to remove any litigation from that court to a federal court. This Agreement shall be construed in accordance with and governed by the substantive laws of the State of Maryland, to the extent state law applies. An action for breach of this agreement must be commenced within two (2) years after the cause of action has accrued.

Item 17. WAIVER AND MODIFICATION

No waiver by either party of any breach, default or violation of any term, warranty, representation, agreement, covenant, condition or provision of this agreement shall constitute a waiver of any subsequent breach, default, or violation of the same or other term, warranty, representation, agreement, covenant, condition or provision. No modification, amendment, extension, renewal, rescission, termination or waiver of any of the provisions contained in this agreement, or any future representation, promise or condition in connection with the subject matter of this agreement, shall be binding upon either party unless in writing and signed by both parties.

Item 18. SEVERABILITY

Any provision of this agreement which is invalid, prohibited or unenforceable in any jurisdiction shall, as to such jurisdiction, be ineffective solely to the extent of such invalidity, prohibition or unenforceability without invalidating the remaining provisions hereof, and any such invalidity, prohibition or unenforceability in any such jurisdiction shall not invalidate or render unenforceable such provision in any other jurisdiction.

Item 19. ASSIGNMENT AND DELEGATION

Neither party to this agreement shall have the right to assign or delegate its interest in or obligations under this Agreement without the prior written consent of the other party, which shall not be unreasonably withheld. The merger, acquisition, reorganization or other restructuring of PWT shall not constitute an assignment under the terms of this agreement provided the surviving entity has assumed all of the obligations of PWT under this agreement. The transfer of any rights under this agreement from PWT to any entity controlled by or affiliated with PWT shall not constitute an assignment under the terms of this agreement provided PWT retains all of its obligations under this agreement. The rights and obligations of the parties to this Agreement shall be binding upon, and enforceable by their respective heirs, successors and permitted assigns.

PWT LLC Standard Limited Warranty

Item 1. LIMITATION OF LIABILITY

The only warranty which PWT LLC ("PWT") makes is that warranty which is set forth in the preceding agreement and which is further detailed below:

THE GOODS SPECIFIED UNDER AGREEMENT WITH PWT ARE PROVIDED "AS IS" AND PWT DOES NOT MAKE ANY OTHER EXPRESS WARRANTIES OR ANY IMPLIED WARRANTIES WITH RESPECT TO THESE GOODS AND/OR RELATED SERVICES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR USE.

In addition, PWT does not assume and expressly disclaims any liability for (i) any SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES which anyone may suffer as a result of the sale, delivery, service, use, or loss of use, of any goods and/or services provided by PWT, or (ii) any charges or expenses of any nature which are incurred without the express written consent of PWT. In particular, PWT does not warrant that any goods provided are free from any claim of any third person by way of infringement or the like, and PWT expressly disclaims any liability for any claim of infringement or the like that may result from the sale, delivery, service, use, or loss of use of any goods and/or services provided by PWT.

PWT's obligation under this warranty is expressly limited to the repair or replacement of any part or parts that are proved to the satisfaction of PWT to have failed prematurely or because of a fault in workmanship or materials.

PWT's total liability under this warranty or in connection with any claim involving any goods or services is expressly limited to the purchase price of the goods and/or services in respect of which damages are claimed.

Item 2. DEFECTS WARRANTY

PWT warrants that the goods manufactured by PWT shall be free from defects in material and workmanship for the shorter period of: (i) twelve (12) months from the date of start-up; or (ii) eighteen (18) months from the delivery of the specified goods.

PWT's liability under this warranty or in connection with any other claim relating to goods manufactured and delivered by PWT is limited to the repair, or at our option, the replacement or refund of the purchase price, of any products or parts or components which are returned to PWT freight prepaid, and which PWT determines, in its discretion, are defective in material and workmanship. Products or parts or components thereof which are repaired or replaced by PWT will be returned to the buyer freight collect.

Item 3. PRODUCTS OF OTHER MANUFACTURERS

PWT makes no warranty with regard to any products not manufactured by PWT, including but not limited to electrical components or equipment and other prime movers.

Item 4. TYPES OF DAMAGES AND CLAIMS FOR WHICH PWT LLC IS NOT RESPONSIBLE

The following non-exclusive list of items are specifically not covered by the PWT Standard Limited Warranty and, in the event of their occurrence, will render the PWT Defects Warranty null and void:

- defects which are caused by improper installation, improper or abnormal use or operation, or improper storage or handling;
- defects caused by the failure of the buyer or user to perform and log normal preventative maintenance;
- defects caused by the use of replacement parts not approved in writing by PWT;
- defects caused by repairs by persons not authorized in writing by PWT;
- defects caused by modifications or alterations made by the buyer or user;
- any damage to our any product occurring while it is in the possession of the buyer or user.

Item 5. EQUIPMENT SAFETY PARAMETERS:

With respect to operation of the equipment, it is the responsibility of the buyer to define and provide any safety device(s) or associated safety device(s) (other than that which is ordinarily furnished by PWT) which may be necessary and/or required, and to establish safety procedures and operational instructions to safeguard the operator(s) during maintenance, cleaning, or any use of the equipment whatsoever, and to subsequently ensure that the equipment is operated in conformance with all applicable safety procedures, laws, regulations and instructions.

It is also the responsibility of the buyer to enforce all safety regulations and operational instructions and to maintain the equipment in a safe condition (*e.g.*, guards in place; warning, caution and/or important labels affixed; electrical boxes secure; interlocks operational; etc.). In particular, all warning, caution and/or important labels must be maintained in a readable condition, and if necessary, replaced with new labels.

Additionally, as the nature of the equipment does not always make it possible to fully prevent operator access from rotating components, maintenance or cleaning of any nature must not be performed on the equipment without first disconnecting all power.

Item 6. OPERATOR SAFETY COMPLIANCE:

Buyer warrants and agrees that because it has sole control over the equipment, it shall be solely responsible for safety compliance. Operator access and use of equipment, and full compliance with all provisions of the Operator Safety section of PWT Instruction Manuals are essential and the user's responsibility; the provisions of that section being expressly incorporated herein.

ATTACHMENT NO. 4

PEAK SHAVING PUMP EQUIPMENT SCOPE OF WORK

WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2
WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD

QUIDDITY
Texas Board of Professional Engineers and Land Surveyors Reg. No. F-23290
912 S. Capital of Texas Hwy, Suite 300 • Austin, TX 78746 • 512.441.9493

QUOTATION

MANSFIELD PUMP COMPANY

301 Main Plaza, Unit 311
New Braunfels, TX 78130
Office: (210) 964-5999

Date: 7/13/26
Proposal #: 26-667**r3**
Customer ID: TBD
Project Name: Wilbarger Creek Municipal Utility District No. 2 Wastewater Treatment Plant Expansion to 1.5 MGD

Quotation for:
Quiddity Engineering

Salesperson	Phase Code	Ship Date / Current Lead Time	Ship Via	Terms
James Mansfield	11-122	20-22 Weeks after Approved Submittals	Motor Freight	NET 30

Quantity	Part Number	Description	Unit Price	Amount
TAG: SPP-04-301				
1	6STX-F55K	**Cornell** 6STX-F55K 465gpm @ 29' TDH @ 965rpm -Ductile iron volute (centerline), suction cover, backplate. -Ductile iron RH 12.38" Impeller, dynamically balanced -Mild steel wear plate -303 SS shaft sleeve. -6" suction, 6" discharge, ANSI Flanged 125# connection. -Type-2, 2.00" Silicon Carbide vs Silicon Carbide, viton elastomers, stainless steel hardware. Motor – G.E. To match existing -15hp, 3ph, 60Hz, 460v -1200rpm -TEFC, 284 T Frame -Class "H" insulation -No motor test Mounting -Fabricated steel base -Grout holes -Reverse overhead motor mount -Belt driven Treatment -Sandblast SSPC-SP10 pump & base exterior -Tnemec 394 primer -Tnemec 66 intermediate -Finish coat to be applied in the field -MFG factory enamel finish on motor Weight: 1,420 lbs.	$ 41,100.00	$ 41,100.00
1		HI Level 1B performance, with Engineer Approval	$ 3,670.00	$ 3,670.00
1		Lot of Delivery, Start Up, and Freight	$ 2,225.00	$ 2,225.00
			Subtotal	$ 46,995.00
			Tax Rate	0.00%
			Sales Tax	$ -
			Other	$ -
			Total	**$ 46,995.00**

If you have any questions concerning this quotation contact James:
(512) 745-7647 or james@mansfieldpump.com

Exceptions: Controls, Control Panel Upgrades, Gaskets, Hardware, Anchor Bolts, Grouting, Lifting Chain, Crane Service, Installation, Labor, etc. are NOT Included.

(1) The price quoted is F.O.B. Factory. See Freight Adder.
(2) Federal taxes, state taxes, or local taxes are NOT included.
(3) 100% NET 30 Days from date of invoice.
(4) Installation and offloading is by OTHERS.
(5) This Quote is Valid Until September 30, 2026.

Thank you!

ATTACHMENT NO. 5

LIFT STATION PUMPS EQUIPMENT SCOPE OF WORK

WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2
WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD

QUIDDITY
Texas Board of Professional Engineers and Land Surveyors Reg. No. F-23290
912 S. Capital of Texas Hwy, Suite 300 • Austin, TX 78746 • 512.441.9493

Xylem Water Solutions USA, Inc.
Flygt Products

4965 Eisenhauer Rd. #102
San Antonio, TX 78218
Tel 210/648-9101
Fax 210/648-9102

July 2, 2026

Quiddity
Attn:
912 S. Capital of Texas Highway, Suite 300
Austin TX 78746

Quote # 2026-SNT-0243
Project Name: City of Austin
Job Name: Wilbarger WWTP 1.5 MGD Expansion Lift Station

Xylem Water Solutions USA, Inc. is pleased to provide a quote for the following Flygt equipment.

Pumps & Accessories

Qty	Part Number	Description
4	3171.095-0693	Flygt Model NP-3171.095 6" volute Submersible pump equipped with a 460 Volt / 3 phase / 60 Hz 25 HP 1750 RPM motor, 436 impeller, 1 x 50 Ft. length of submersible cable, FLS leakage detector, volute is prepared for Flush Valve
4	14-69 94 79	TEST FAL 2.2 3171-3301 7POINT+ PLOTTED FAL 15-900006
2	14-69 00 11	START UP CHARGE FLYGT 3-TP MODELS: 3000,7000,8000
4	602 33 06	CONNECTION,DISCH 5½X6" CI
4	613 68 04	BRACKET,GUIDE BAR UPPER 2" 316
4	83 57 25	GRIP,CABLE SS 25-36MM
4	442 18 16	SLING,CHAIN UNIT SS WIRE 10M
1	620 09 00	GRIP EYE UNIT
4	14-40 71 29	MINI-CASII/FUS 120/24VAC,24VDC
4	14-40 70 97	SOCKET,11 PIN OCTAL DIN MOUNT
4	14-58 95 35	HARDWARE,DISC CONN ASSY 304SS
2	Hatch	5'3" x 3'6" Clear Opening w/ Safety Grates
1	14-69 98 30N	SHIPPING AND HANDLING-NO TAX

Total Price $ 167,238.10

Terms & Conditions

This order is subject to the Standard Terms and Conditions of Sale – Xylem Americas effective on the date the order is accepted which terms are available at http://www.xyleminc.com/en-us/Pages/terms-conditions-of-sale.aspx and incorporated herein by reference and made a part of the agreement between the parties.

As of October 14th, 2024, all orders must meet a minimum dollar value of $1,200. Xylem reserves the right to refuse to process any order that does not meet the minimum order value requirement. Xylem will support order adjustments to meet the minimum order value threshold.

FLYGT
a xylem brand

Purchase Orders: Please make purchase orders out to: Xylem Water Solutions USA, Inc.
Freight Terms: 3 DAP - Delivered At Place 08 - Jobsite (per IncoTerms 2020)
See Freight Payment (Delivery Terms) below.
Taxes: State, local and other applicable taxes are not included in this quotation.
Back Charges: Buyer shall not make purchases nor shall Buyer incur any labor that would result in a back charge to Seller without prior written consent of an authorized employee of Seller.
Tariff Changes: The prices quoted herein are based on the current tariff rates, duties, government charges, and trade regulations as of the date of this quote. If any new tariffs, duties, taxes, or similar charges are imposed, or any existing tariffs, duties, or charges are increased or modified by any government or regulatory authority (collectively, "Tariff Changes"), and such Tariff Changes result in an increase in the cost of goods, Xylem reserves the right to adjust the pricing of the affected goods to reflect the increased costs.
Shortages: Xylem will not be responsible for apparent shipment shortages or damages incurred in shipment that are not reported within two weeks from delivery to the jobsite. Damages should be noted on the receiving slip and the truck driver advised of the damages. Please contact our office as soon as possible to report damages or shortages so that replacement items can be shipped and the appropriate claims made.
Terms of Delivery: PP/Add Order Position
Terms of Payment: TBD
Xylem's payment shall not be dependent upon Purchaser being paid by any third party unless Owner denies payment due to reasons solely attributable to items related to the equipment being provided by FLYGT.

Validity: This Quote is valid for thirty (30) days.
Please note that this pricing is valid for 30 days and contingent upon final approval of submittals and release to fabrication by (within 90 days of bid date).
This quotation is subject to change if any changes to the specifications or plans are made that alter the scope of supply.

Schedule: Please consult your local Flygt Branch Office to get fabrication and delivery lead times.

Time of Delivery: Approx. 16-18 working weeks after receipt of order acceptance and approved submittals. Allow 2-3 weeks for submittals to be generated after a PO is received.

Thank you for the opportunity to provide this quotation. Please contact us if there are any questions.

Sincerely,

Gage Frank
Direct Sales Representative

FLYGT
a xylem brand

Cell: 210-758-8071
gage.frank@xylem.com

Xylem Water Solutions USA, Inc.
Flygt Products

Customer Acceptance

This order is subject to the Standard Terms and Conditions of Sale – Xylem Americas effective on the date the order is accepted which terms are available at http://www.xyleminc.com/en-us/Pages/terms-conditions-of-sale.aspx and incorporated herein by reference and made a part of the agreement between the parties.

A signed copy of this Quote is acceptable as a binding contract.

Purchase Orders: Please make purchase orders out to: Xylem Water Solutions USA, Inc.

Quote #:	2026-SNT-0243
Customer Name:	Quiddity
Job Name:	Wilbarger WWTP 1.5 MGD Expansion Lift Station
Total Amount: (excluding freight)	$ 167,238.10

Signature: _____ Name:_____
(PLEASE PRINT)

Company/Utility:_____ PO:_____

Address:_____ Date:_____

_____ Phone:_____

_____ Email:_____

_____ Fax:_____

FLYGT
a xylem brand

xylem

Xylem Preventive Maintenance Agreement Service

Protect your investment. Maximize reliability. Reduce downtime.



Our comprehensive Preventive Maintenance verification ensures your lift station and pumping equipment operate safely, reliably, and efficiently. A qualified Xylem representative will complete the following checks:

1. Lift Station Inspection. A visual inspection is performed to assess the overall condition of the lift station, including valves and piping where accessible. All inspections are safely conducted from outside the wet well.

2. Lifting Equipment Assessment. Inspect lifting equipment, including lifting chains and guide rails, to ensure safe and reliable operation.
Safety Note: Xylem may decline to lift pumps if any concerns are identified during inspection.

3. Control Panel Inspection. Visually inspect the control panel and verify site voltage across all three phases. If required, pump leads will be removed from the terminals to perform an insulation resistance test.

4. Pump Removal and Inspection. Each pump is lifted from the wet well for a thorough inspection. Xylem will assess and provide recommendations on:

- Condition of pump cables and cable entries
- Impeller (re-adjusted if necessary), wear ring, or insert ring condition
- Oil or glycol level (top off as needed) and overall condition of the pump
- Flush valve operation (if installed)

5. Dry Run Testing. Each pump will be run dry to confirm proper operation, including:

- Correct rotation
- No excessive noise or vibration

6. Pump Reinstallation. Reinstall pumps and verify proper seating on the discharge connection to ensure reliable operation.

7. Level Controls Inspection. Inspect and clean level sensors and/or floats as required and where safely accessible.

8. Operational Testing. Confirm proper operation of the pumps and control panel in both manual and automatic modes. Record amperage readings for each pump. If necessary, the pump may be taken to the Xylem facility for repairs.

For Xylem Supplied Panel: Verify pump alternation, alarm outputs, and operating levels.

For Non-Xylem Control Panels: A qualified electrician shall be present on-site to perform testing procedures and assist the Xylem representative.

9. Detailed Reporting. Provide a written report outlining findings and observations.

10. Follow-Up. A Xylem representative will review the report with the customer and discuss recommendations for optimal performance.





Extended Warranty offered for new pumps on continual PMA cover.

Connected PMA - Reach out to your local Xylem representative to learn more about our remote monitoring service for lift stations.

Strengthen your operation with a fully customizable Preventative Maintenance Agreement— available as a single-year plan or a multi-year contract— designed to deliver proactive, expert support tailored to your needs and budget.

Trust Xylem to keep your systems running at peak performance.

Xylem Inc.
Insert local address
Insert local address

Tel 000000
xylem.com

All information presented herein is believed reliable and in accordance with accepted engineering practices. Xylem makes no warranties as to the completeness of this information. Users are responsible for evaluating individual product suitability for specific applications. Xylem assumes no liability whatsoever for any special, indirect or consequential damages arising from the sale, resale or misuse of its products. Subject to change without notice.

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XB0077

xylem

ATTACHMENT NO. 6

BLOWER EQUIPMENT SCOPE OF WORK

WILBARGER CREEK MUNICIPAL UTILITY DISTRICT NO. 2
WASTEWATER TREATMENT PLANT EXPANSION TO 1.5 MGD

QUIDDITY
Texas Board of Professional Engineers and Land Surveyors Reg. No. F-23290
912 S. Capital of Texas Hwy, Suite 300 • Austin, TX 78746 • 512.441.9493

BUILDING**TRUST** • DELIVERING**EXCELLENCE**

MC SERIES MULTISTAGE CENTRIFUGAL BLOWER PROPOSAL

QUOTE NO.:	020526JC-1	REVISION #:	1
CUSTOMER:	All Bidding Contractors	QUOTE DATE:	7/9/2026
OWNER/PROJECT:	Wilbarger Creek	REPRESENTATIVE:	EI2
EQUIPMENT:	Multistage Centrifugal	ENGINEER:	Quiddity
PROPOSED BY:	James Cook	SPECIFICATION:	11171
SUPPLIER:	Lone Star Turbo		

QUANTITY	One (1)
APPLICATION	AERATION
MEDIA	Air
DESIGN FLOW	1200 SCFM
DESIGN PRESSURE	8 PSIG
DESIGN TEMPERATURE	110°F
DESIGN RH%	100%
ELEVATION	506 FT
PROPOSED BLOWER MODEL	MC81-8
BLOWER POWER RATING	75 HP

LONE STAR TURBO
8883 West Monroe Road
Houston, TX, 77061

TEL: 832-532-3112
FAX: 832-532-3115

PROPOSAL PRICING

Customer: All Bidding Contractors
Quotation No.: 020526JC-1

The following is a price summary for this quotation. Please click item specific for more Technical Offer details.

DESCRIPTION	UNIT PRICE	QTY	EXTENDED
MC81-8 Blower & Skid Package	Included	1	Included
Blower Accessory Package	Included	1	Included
Process Instrumentation Package	Included	1	Included
Blower Local Control Panel	Included	1	Included
Packaging & Freight	Included	LOT	Included
Field/Startup Services	Included	LOT	Included
Recommended Spare Parts	Included	LOT	Included
		Base Total	$128,610.00
		Grand Total	$128,610.00

SCOPE OF SUPPLY: Any work or equipment beyond the scope of this proposal will be performed or provided only after customer approval and acceptance by Lone Star Blower. No assumption should be made that anything not specifically defined is included.

VALIDITY: This quotation is valid for 90 Days.

PRICE: The price quoted is for all items purchased at one time. Partial orders may be subject to a price adjustment.

PAYMENT TERMS: 5%-Upon Receipt of Submittal; 15%-Upon Receipt of Submittal Approval; 30%-Upon Proof of Receipt of Major Material; 40%-Upon Delivery of Equipment; 10%-Upon Completion of Startup & Training. Terms subject to credit approval.

PACKAGING: Standard white wrap packaging for ground freight.

FREIGHT: Shipping Cost DAP Jobsite (INCOTERMS® 2010) are included.

APPROVAL DRAWINGS: 6-8 Weeks from Receipt of Approved PO

EQUPMENT LEAD TIME: 26-30 Weeks from Receipt of Approval Drawings

WARRANTY: A 12 month Blower Package warranty will begin upon successful completion of startup and certification for full-scale operation by Lone Star Blower, or 18 months from shipment, whichever occurs first. Under no circumstances will the warranty begin upon "beneficial use", completion of the project, or acceptance of the equipment as determined by the engineer or end user.

TERMS & CONDITIONS: Attached is a copy of our standard terms & conditions. Any and all warranty terms and conditions detailed in the proposal herein shall supersede and/or supplement the warranty language denoted in the Lone Star Turbo terms and conditions.

MC SERIES BLOWER MAJOR COMPONENTS

Lone Star Multistage Centrifugal Blower, accessories and controls for efficiency optimization and minimized power consumption. This proposal is offered in accordance with Lone Star Blower's standard design specifications.

(1) Lone Star MC Series Multistage / Model - MC81-8 / Air Service
Standard Blower Core Components:

- Cast Iron Body
- Carbon Steel Shaft
- Grease Lubricated
- Aluminum Impellers

(1) Lone Star Premium Structural Steel Skid/Base Components Included:

- Heavy Duty I-Bean Construction
- Powder Coated
- Motor Mounting Pads
- Motor Jack Bolts
- Lifting Eyes on Corners
- Premium Coupling
- OSHA Coupling Guard
- Vibration Isolation Pads

Main Drive Motor:
(1) 75HP, 460 VOLT, TEFC, Non-Hazardous, 3600 RPM, 1.15 SF, Motor

- 120V Space Heater
- 1.15 S.F for Constant Speed Operation
- Non-Hazardous Classification

Paint:

- Blower & Skid will include manufacturer's standard finish. 2-part epoxy paint, RAL5-5005 Dark Blue.

TECHNICAL OFFER - AIR BLOWER ACCESSORY PACKAGE

Lone Star Turbo offers all required accessories for a complete system.

Inlet Accessories (Shipped Loose; for each blower, for installation by Customer):

- 10" Inlet Filter/Silencer, Cartridge Type, Felt Element
- 10" Inlet Butterfly Valve, Lugged Style w/EPDM Seal, Manual

Discharge Accessories (Shipped Loose; for each blower, for installation by Customer):

- 10" Discharge Check Valve , Wafer Style w/EPDM Seat
- 8" Discharge Expansion Joint, EPDM Material
- 10" Discharge Butterfly Valve , Lugged Style, EPDM Seat, Manual

TECHNICAL OFFER - PROCESS INSTRUMENTATION PACKAGE

Lone Star Turbo offers Premium Instrumentation to protect your new equipment and allow for process monitoring and blower automation if desired. Equipment can be wired to plant system or combined with Blower Local Control Panel as applicable for further equipment capability and monitoring. Protect your investment and/or automate your packages with our Process Instrumentation Options.

Process Instrumentation Options (Shipped Loose for Customer mounting & Wiring):

Inlet Instrumentation (Shipped Loose; for each blower, for installation by Customer):

- Inlet Differential Pressure Gauge

Discharge Instrumentation (Shipped Loose; for each blower, for installation by Customer):

- Discharge Pressure Gauge

TECHNICAL OFFER - LOCAL CONTROL PANEL

Lone Star Turbo offers a complete line of local control panels (LCPs) to suit every application, process & environment. Lone Star Blower's Advanced sLOC-MC smart panels can handle a variety of blower setups to include: Analog Blower Protection, Inlet Valve Control, Vacuum Control & Variable Speed (VFD) applications. Having blower LCPs will greatly extend the life of the blower by monitoring, protection and shutting down the blower to protect itself from unsafe operating conditions while operating the equipment at peak efficiencies.

sLOC-MC-Monitoring Panel:
sLOC Monitoring Panel, Model - 2152 PLC Next® PLC and 7" HMI installed in a NEMA 4X 316SS Enclosure. 120V Powered. Monitors Amps and up to seven (7) other 4-20 mA analog instruments.

- Remote Mounted Local Control Panel (LCP)
- LCP Enclosure: NEMA 4X 316SS - 16" x 14" x 8"
- PLC / HMI: PLC Next®
- HMI Size: 7"
- HMI Window Kit
- Current Transmitter for Amp Monitoring

EQUIPMENT TESTING

Lone Star Turbo performs mechanical testing under full load for all new blowers. The standard mechanical test includes balance report & vibration analysis. In addition to mechanical testing, the following test is being proposed:

- No Additional Testing being Proposed

PACKAGING & FREIGHT

Lone Star Blower ships from our Houston, Texas, USA factory. Packaging is included with standard white shrink wrap with labels. Freight and Handling DAP Jobsite (INCOTERM® 2010) is included.

- Standard Packaging & Freight by Lone Star Blower

FIELD SERVICES

Lone Star Turbo has a fully trained & experienced service group which will perform field service, equipment commissioning & onsite repairs. This proposal includes:

- 3 trip(s) for a total of 6 days onsite for blower startup & operator training.
- *- Additional service is available per Lone Star's published labor rate sheet.*
- *- Advance notification of 15 working days is required for scheduling.*

SPARE PARTS

Lone Star Turbo stocks parts locally in Houston, TX but we offer spare parts, lubrication & accessory items which is recommended to be kept onsite to maximize operating time. This proposal includes:

- (3) Spare Inlet Filters
- (4) Spare Lubrication (Blower Bearing Grease)
- (4) Spare Lubrication (Bearing Grease)

PROPOSAL COMMENTS & CLARIFICATIONS

The following items directly related to this type of equipment are NOT INCLUDED unless specifically identified in Proposal:

- Fittings, Gaskets, Piping, Piping Hardware (Bolts, Nuts, Washers)
- Existing Equipment Removal & Disposal
- Equipment Installation
- Equipment Wiring, External Transformers or Electrical Equipment outside of our Proposed Package
- Performance Bonds
- Installing Contractor shall provide hardware and isolation ball valves for gauge mounting

LONE STAR TURBO

Lone Star Turbo

TERMS & CONDITIONS OF SALE
(EQUIPMENT AND/OR SERVICE)

1. GENERAL: As used herein, "Seller" means Lone Star Turbo "Purchaser" means the entity to which Seller's offer is made, or the entity purchasing Equipment and/or service from Seller. The term "Equipment" as used herein includes any and all products, equipment, parts, and accessories furnished by Seller to Purchaser. All offers and sales by Seller are expressly conditional upon these Terms and Conditions of Sale. Any terms or conditions in Purchaser's purchase order (or in any other Purchaser communication) which are different from or in addition to the terms and conditions contained in these Terms and Conditions of Sale are hereby objected to. All orders submitted to Seller are subject to approval by Seller's headquarters.

2. DELIVERY: The shipment/delivery period is an estimate only and commences after Seller's receipt of all necessary information, approvals, and signed submittals with release for manufacturing. In no event shall delivery be construed as falling within the meaning of "time is of the essence". Seller reserves the right to deliver in installments. Unless otherwise specified in Seller's quotation, delivery is F.O.B. Seller's manufacturing facility.

3. TITLE and RISK OF LOSS: Unless otherwise specified in Seller's written quotation, title and risk of loss or damage to the Equipment shall pass to Purchaser upon tender of delivery F.O.B. manufacturing facility. Notwithstanding the foregoing, a security interest in the Equipment or any replacement shall remain in Seller, regardless of mode of attachment to realty or other property, until full payment has been received by Seller. Purchaser agrees upon request to do all things and acts necessary to perfect and maintain said security interest and shall protect Seller's interest by adequately insuring the Equipment against loss or damage from any cause.

4. TAXES: Purchaser shall be responsible for applicable local, state and federal taxes which may be now or hereafter be applicable to, measured by, or imposed upon, or with respect to this transaction, the Equipment, its sale, its value or its use, or any services performed in connection therewith (except any taxes on Seller's income). If sales, use or other State or Municipal taxes in addition to any listed specifically as part of the stated purchase price, are imposed upon Seller, Purchaser agrees to pay the same or reimburse Seller upon demand. Seller will accept a valid exemption certificate from Purchaser, if applicable. If an exemption certificate pREV1iously accepted by Seller is not recognized by the governmental taxing authority involved, Purchaser agrees to promptly reimburse Seller for any taxes covered by such exemption certificate which Seller is required to pay.

5. PAYMENT: Unless specifically agreed otherwise in writing, payment is due in full within 30 days of the invoice date. Seller reserves the right to charge late fees on overdue amounts at a monthly rate of 1.5% (one and a half percent) or the rate permitted by law, whichever is lower. Purchaser shall have no right to set-off against any amounts which may become payable to Seller under this contract or otherwise, for amounts which Seller may allegedly or in fact owe Purchaser or any affiliate of Purchaser or assignee whether arising under this contract or otherwise. Any waiver by Seller of any lien or lien right shall be conditioned upon Purchaser's timely payment to Seller of all amounts due.

6. INSTALLATION: Unless Seller's written quotation specifies that Seller will perform installation of the Equipment, it is understood and agreed that Seller will not perform any installation of the Equipment.

7. START-UP, OTHER SERVICE: Any service (for example, Equipment start-up, if applicable) to be performed by Seller is specified in Seller's written quotation. Dates/time for the service is subject to scheduling and confirmation by Seller's service department. Seller's performance of service is subject to Seller's normal working hours (8:30 am to 5:00 pm, Monday through Friday excluding public holidays), unless expressly agreed otherwise. If any forklift, crane, and/or other lifting or rigging equipment or lighting equipment is necessary (as reasonably determined by Seller's service technician) for Seller to perform the service, Purchaser shall supply such equipment at its own expense together with sufficiently skilled and qualified labor in connection therewith, unless expressly agreed otherwise. If Purchaser requests Seller to comply with Purchaser's safety programs/procedures in connection with performing service at Purchaser's premises, Seller shall comply with such safety programs/procedures that have been provided in advance to Seller in writing with reasonable opportunity to REV1iew/implement, to the extent they are reasonable and applicable to the scope of Seller's activities at the premises.

8. INSURANCE: During the term of the Contract, Seller agrees to have the following insurance coverage:

a) Commercial General Liability insurance in an amount of $1,000,000 each occurrence for bodily injury and physical damage to tangible property, subject to an annual aggregate not to exceed $2,000,000;
b) Automobile Liability insurance in an amount of $1,000,000 combined single limit each occurrence;
c) Worker's Compensation insurance in accordance with applicable statutory law; and
d) Employer's Liability insurance in an amount of $1,000,000 for bodily injury each accident or disease.

If Seller will physically enter onto Purchaser's premises (or a third party's premises) in connection with the sale of the Equipment/ service, Seller agrees to, at Purchaser's reasonable request, provide an ACORD form of certificate confirming the above-stated insurance coverage. Seller shall have no other insurance-related requirement, unless specifically agreed to in writing by an authorized manager of Seller in connection with the order.

9. RETURN POLICY: Shipping and handling charges are not refundable. Purchaser is responsible for the return shipping fee. All returned items are subject to a 30% restocking fee. Returned items must be in brand new condition with all packaging enclosed in the exact condition in which you received them. Special order or non-stock items will not be accepted for return/refund.

10. CANCELLATION: Each party has the right to cancel the order/contract in whole or in part in writing with immediate effect if the other party becomes insolvent, makes a general assignment for the benefit of creditors, suffers or permits the appointment of a receiver for its business or assets, becomes subject to any proceeding under any bankruptcy or insolvency law, or has wound up or liquidated (voluntarily or otherwise). In addition, each party has the right to cancel the order/contract or any part thereof if the other party fails, within 30 days after receipt of written notice from the non-breaching party specifying the material breach and intent to terminate, to commence and diligently pursue cure of the breach. Unless an order is cancelled by Purchaser in accordance with this paragraph, Purchaser shall pay Seller's cancellation charges if Purchaser cancels the order (including if Purchaser cancels the order for Purchaser's convenience). The cancellation charges shall be reasonable and may include (among other things) all costs and expenses incurred, and commitments made by Seller and a reasonable profit thereon. Notwithstanding anything set forth to the contrary, Seller may suspend Seller's performance or cancel the order/contract (or any part thereof) immediately if Purchaser fails to provide payment security (if applicable) or if Purchaser fails to make any payments when due.

11. WARRANTY: Seller hereby warrants to Purchaser that the Equipment manufactured or distributed by it and delivered hereunder will be free from defects in material and workmanship under proper use and service; this warranty shall expire one (1) year from start-up or 18 months from the original shipment date from Seller's manufacturing facility whichever comes first. This warranty applies only to Equipment manufactured by Seller and does not cover motors, starters, electrical equipment or other components or accessories manufactured by others. Seller will repair or replace, F.O.B. its factory, any defective part or parts, at no charge, if promptly returned to it within the above-noted warranty period. This warranty extends only to the original purchaser of Equipment furnished hereunder and shall be void if the Equipment is repaired or tampered with in any manner other than by Seller's authorized service personnel. If Seller's inspection does not disclose a defect covered by the warranty, the Equipment will be returned to Purchaser at its expense or, if Purchaser elects, Seller will repair or replace the equipment and charge for such service at the regular rate. Seller hereby warrants to Purchaser that all other Equipment manufactured by Seller and delivered hereunder will be free from defects in material and workmanship under proper use and service; this warranty shall expire one year from the original shipment date from Seller's manufacturing facility. This warranty applies only to Equipment manufactured by Seller and does not cover components or accessories outside of standard packaged equipment offered. Seller will repair or replace, F.O.B. its factory, any defective part or parts, at no charge, if promptly returned to it within the warranty period. This warranty extends only to the original purchaser of Equipment furnished hereunder and shall be void if the product is repaired or tampered with in any manner other than by Seller's authorized service personnel. If Seller's inspection does not disclose a defect covered by the warranty, the Equipment will be returned to Purchaser at its expense or, if Purchaser elects, Seller will repair or replace the Equipment and charge for such service at the regular rate. Seller warrants to Purchaser that Equipment or parts thereof repaired or replaced pursuant to the above warranty under proper use and service against defects in workmanship and material; this warranty shall expire 60 days from date of start-up of such repaired or replaced. Equipment or parts thereof or on the expiration of the original Equipment warranty, whichever is later. If the nature of the defect is such that it is appropriate in the judgment of Seller to do so, repairs shall be made at the site of the Equipment. Seller warrants to Purchaser that any services performed by Seller in connection with startup or other servicing of Equipment shall be performed in a workmanlike manner; this warranty shall expire 60 days after the service date visit. If any nonconformity with this warranty appears, Seller shall re-perform the non-conforming portion of the services in a conforming manner. Any warranties granted beyond those stated above must be specifically identified as a warranty in Seller's specific quotation. Correction by Seller of nonconformities (i.e. repair or replacement of Equipment that is defective in material or workmanship, and re-performance of service which was not performed in a workmanlike manner) in the manner and warranty period provided above shall be Purchaser's exclusive remedy (and Seller's exclusive obligation) with respect to nonconforming Equipment and/or services. In the event Purchaser and Seller agree that Seller will sell any used Equipment to Purchaser, such used Equipment is sold AS-IS, WITH ALL FAULTS, AND WITHOUT WARRANTY OF ANY KIND.

THE ABOVE-STATED WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, IMPLIED, OR OTHERWISE. SELLER HEREBY EXPRESSLY DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR ANY PARTICULAR PURPOSE.

12. CONFIDENTIALITY: In connection with the order and/or performance under this contract, Seller and Buyer (as to information disclosed, the "Disclosing Party") may each disclose Confidential Information to the other party hereto (the "Receiving Party"). " Confidential Information" shall mean all information related to the business or products (including but not limited to the Equipment) or services of the Disclosing Party that is not generally known to the public, and all pricing and terms of this contract, provided that the obligations of this paragraph shall not apply as to any portion of the Confidential Information which: (i) is or becomes generally available to the public other than as a result of disclosure by the Receiving Party, its representatives or its affiliates, or (ii) has been or is subsequently independently developed by the Receiving Party, its representatives or affiliates, without reference to the Confidential Information, or (iii) is required to be disclosed by law or valid legal process provided that the Receiving Party who intends to make such disclosure shall promptly notify the Disclosing Party in advance of such disclosure and reasonably cooperate in attempts to maintain the confidentiality of the Confidential Information. The Receiving Party agrees, except as otherwise required by law: (i) to use the Confidential Information only as the Disclosing Party intended it to be used by the Receiving Party in connection with providing or receiving the Equipment/service under this contract, and (ii) to take reasonable measures to prevent disclosure of the Confidential Information, except disclosure to its employees to the extent necessary to facilitate providing or receiving Equipment/services as contemplated under this contract. Upon the Disclosing Party's request, the Receiving Party shall destroy or return to Disclosing Party all copies of Confidential Information. If either party or any of their respective affiliates or representatives is required or requested by subpoena, interrogatories, or similar legal process to disclose any Confidential Information, such party agrees to provide the Disclosing Party with prompt written notice of such request, so that the Disclosing Party may seek an appropriate protective order or waive compliance by the Receiving Party with the provisions herein. It is understood and agreed that this paragraph survives any expiration/termination of this contract.

13. INTELLECTUAL PROPERTY: No patents, copyrights, trademarks, trade secrets, or other intellectual property rights are being sold, granted, transferred, or assigned to Purchaser. Without limiting the generality of the foregoing, Seller retains all right, title and interest in and to all inventions, discoveries, ideas, works of authorship (including but not limited to all drawings), processes, methods, know-how, and techniques developed, discovered or conceived by Seller or its employees, including without limitation those developed and/or used in connection with the manufacture of Equipment or performing services hereunder. Such rights include, but are not limited to, patent rights, copyrights, trade secret rights, trademark rights, mask work rights and other proprietary rights throughout the world. Purchaser acknowledges and understands that no drawings, designs, specifications, or anything else provided by Seller shall be deemed to be "work made for hire."

14. PATENT INDEMNITY: Seller shall defend any suit or proceeding brought against Purchaser and shall pay any adverse judgment entered therein so far as such suit or proceeding is based upon a claim that the use of the Equipment or any part thereof manufactured by Seller, and furnished under this contract constitutes infringement of any patent of the United States of America, provided Seller is promptly notified in writing and given authority, information and assistance for defense of same, and Seller shall, at its option, procure for Purchaser the right to continue to use said Equipment, or modify it so that it becomes non-infringing, or replace the same with non-infringing equipment, or remove said Equipment and to refund the purchase price (less a reasonable amount for the time the Equipment was used). The foregoing shall not be construed to include any agreement by Seller to accept any liability whatsoever in respect to patents for inventions including more that the Equipment furnished hereunder, or in respect of patents for methods and processes to be carried out with the aid of said Equipment, except those which are inherent in the Equipment as furnished. The foregoing states the entire liability of Seller with regard to patent infringement. If any Equipment shall be sold by Seller to meet Purchaser's specifications or requirements and is not a part of Seller's standard line offered by it to the trade generally in the usual course of Seller's business, Purchaser agrees to defend, protect, and indemnify and save harmless Seller from any loss, damage, or injury arising out of a claim, suit or action at law or equity for actual or alleged infringement of any patent of the United States or foreign country because of the sale of such Equipment, and to defend any suits or actions which may be brought against Seller.

15. SOFTWARE: In the event any Equipment includes software in any form, such software is not sold to Purchaser but is only licensed on a limited, non-exclusive basis. Subject to Purchaser's compliance with these terms and conditions of sale, Seller grants to Purchaser for the useful life of such Equipment a royalty-free, non-exclusive, non-transferable license to use the software as intended by Seller solely for normal use of the Equipment. Purchaser shall not create derivative works based on the software, or REV1erse engineer, or disassemble or decompile the software, or transfer, copy, modify, or otherwise change the software.

16. EXPORT CONTROL: Equipment, technical data, technology, software, and services furnished by Seller to Purchaser shall at all times be subject to any and all applicable export control laws and regulations, including but not limited to applicable U.S. Export Administration Regulations, United Nations resolutions and European Union directives relating to trade embargoes and restrictions. Purchaser agrees and warrants that no Product, services, technical data, technology, software or other technical information or assistance or other item furnished by Seller, or any good or product resulting therefrom, shall be exported or re-exported by Purchaser or its authorized transferees, if any, directly or indirectly, in violation of any law or regulation.

Any export and/or re-export must be in strict accordance with applicable U.S. export laws and regulations, as well as United Nations resolutions and European Union directives relating to trade embargoes and restrictions. Violation of this paragraph constitutes a material and non-curable breach and entitles Seller to terminate the order immediately (even after shipment of the Equipment).

17. FORCE MAJEURE: If either party is delayed at any time by any Force Majeure, such party shall have such additional time within which to perform its obligations as may reasonably be necessary under the circumstances. "Force Majeure" means circumstances beyond the delayed party's reasonable control, including but not limited to, acts of God, acts of public enemies, wars, delays by Seller's suppliers, blockades, insurrections, riots, epidemics, quarantine restrictions, floods, lightning, fire, storms, earthquakes, and civil disturbances.

18. LIMITATION OF LIABILITY:
IN NO EVENT SHALL SELLER BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS OR REV1ENUE, LOSS OF TOTAL OR PARTIAL USE OF THE EQUIPMENT OR SERVICES, DOWNTIME COSTS, AND DELAY COST) HOWSOEVER ARISING, WHETHER ON ACCOUNT OF EQUIPMENT OR SERVICES FURNISHED HEREUNDER, DELAYS OR OTHERWISE (WHETHER A CLAIM IS BASED ON WARRANTY, STRICT LIABILITY, CONTRACT, TORT, NEGLIGENCE OR OTHERWISE).

SELLER'S TOTAL LIABILITY FOR ALL CLAIMS OF ANY KIND (WHETHER BASED ON WARRANTY, STRICT LIABILITY, CONTRACT, TORT, NEGLIGENCE OR OTHERWISE) FOR ANY LOSS OR DAMAGE ARISING OUT OF, CONNECTED WITH, OR RESULTING FROM THIS CONTRACT OR THE PERFORMANCE OR BREACH THEREOF, OR FROM THE DESIGN, MANUFACTURE, SALE, DELIVERY, RESALE, REPAIR, REPLACEMENT, INSTALLATION, TECHNICAL DIRECTION OF INSTALLATION, INSPECTION, SERVICING, OPERATION OR USE OF ANY EQUIPMENT COVERED BY OR FURNISHED UNDER THIS CONTRACT SHALL BE LIMITED TO 100% OF THE PURCHASE PRICE AMOUNT PAID BY PURCHASER TO SELLER UNDER THIS CONTRACT FOR THE SPECIFIC EQUIPMENT OR SERVICE WHICH GIVES RISE TO THE CLAIM. ALL CAUSES OF ACTION AGAINST SELLER ARISING OUT OF OR RELATING TO THIS CONTRACT OR THE PERFORMANCE HEREOF SHALL EXPIRE UNLESS BROUGHT WITHIN ON YEAR OF TIME OF ACCRUAL THEREOF.

19. MISCELLANEOUS:
19.1 If for any reason, Seller's quotation (or any other document or act by Seller) is deemed an acceptance of an offer from Purchaser, such acceptance is expressly conditional upon Purchaser's assent to any additional or different terms or conditions set forth in these Terms and Conditions of Sale.

19.2 No modification or additional term or condition shall be applicable to this contract by virtue of Seller's receipt, acknowledgment or acceptance of Purchaser's purchase order, shipping instruction forms, or other Purchaser documentation containing terms or conditions which are different from or in addition to those set forth in these Terms and Conditions of Sale. Any such modifications or additional terms or conditions are specifically rejected and deemed a material alteration hereof. Purchaser's issuance of a purchase order or Purchaser's acceptance of any drawings, Equipment, or services from Seller shall (without prejudice to any other manner in which acceptance of these Terms and Conditions of Sale may be evidenced) constitute full acceptance of these Terms and Conditions of Sale.

19.3. Neither party shall assign or transfer this contract without the prior written consent of the other party (which consent shall not be unreasonably withheld); any purported assignment in violation of this sentence shall be void. Irrespective of the foregoing, Seller may without consent assign this contract (or any of rights or obligations hereunder) to any of its affiliates and use sub-contractors.

19.4. If any part of this document is held by a court of competent jurisdiction to be invalid or unenforceable for any reason, such invalidity or enforceability does not affect any other provision, and this document shall be construed as if the invalid or unenforceable provision had never been set forth.

19.5. Neither party's failure to enforce, or its waiver of a breach of, any provision contained in this document shall constitute a waiver of any other breach or of such provision.

19.6. The validity, performance, and all other matters relating to the interpretation and effect of this contract shall be governed by the laws of the State of Texas, USA, without regard to its conflict of laws principles, and the exclusive forum shall be the State of Texas. The United Nations Convention on the International Sale of Goods shall not apply.

19.7 These Terms and Conditions of Sale cannot be superseded, amended, or modified except by a written document signed in handwriting by Seller's duly authorized officer and Buyer's duly authorized representative.

19.8. All headings, captions and numbering in these Terms and Conditions of Sale are for convenience of reference only and shall not be used to interpret any meaning of any terms or condition.

19.9. Seller and Purchaser are independent contractors; neither party shall act as the agent for the other. This contract is between Seller and Purchaser alone, and there are no intended rights or benefits provided hereunder to any third party.