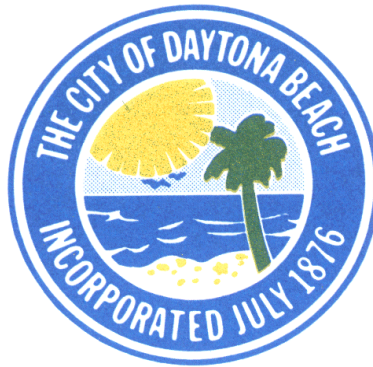


THE CITY OF DAYTONA BEACH
**BIOSOLIDS DEWATERING EQUIPMENT PURCHASE AT WESTSIDE REGIONAL
WASTEWATER TREATMENT PLANT**

INVITATION TO BID No. 19202
NIGP COMMODITY CODES:

54544
72012
72018
89005
89007
89013
83895



THE CITY OF DAYTONA BEACH
UTILITIES DEPARTMENT – WASTEWATER DIVISION
P.O. BOX 2451
DAYTONA BEACH, FL 32115

ISSUE DATE: January 7, 2019

The City implemented a new vendor registration system in April 2018. Bidders who wish to continue being notified of upcoming bid opportunities must ensure they have registered at: <https://vrapp.vendorregistry.com/Vendor/Register/Index/daytona-beach-city-of-fl-vendor-registration>
Register for the Commodity Codes listed above to receive updates for this solicitation.

INVITATION TO BID

THE CITY OF DAYTONA BEACH, FLORIDA will receive bids for **BIOSOLIDS DEWATERING EQUIPMENT PURCHASE, ITB No. 19202**, at the City of Daytona Beach Purchasing Division, City Hall Room 146, 301 S. Ridgewood Ave., Daytona Beach, Florida 32114, until **2:00 p.m., on February 12, 2019**, at which time bids will be opened publicly and read aloud. Bids received after said time will be returned unopened.

SEALED BIDS must be addressed to:

Joanne Flick, Purchasing Agent
The City of Daytona Beach Purchasing Division
301 S. Ridgewood Ave., Room 146
Daytona Beach, Fl., 32114

with "Sealed Bid for Biosolids Dewatering Equipment Purchase, ITB NO. 19202" plainly written on the outside of the envelope.

SCOPE OF WORK involves:

Purchase of Biosolids Dewatering Equipment purchase. The dewatering equipment consists of two (2) 3-belt belt filter presses (BFPs) and associated control, two (2) packaged skid-mounted liquid polymer blending units and associated control, one (1) horizontal shaft-less screw conveyor, one (1) inclined shaft-less screw conveyor, one (1) horizontal shaft-less screw truck unloading conveyor and associated controls. The BFP manufacturers are listed in Specification 11362, Polymer blending unit manufacturers are listed in Specification 11246 and Conveyor system manufacturers are listed in Specification 14555. Equipment will be bid on a lot-by-lot basis.

All of this equipment will be delivered FOB to the City's Westside Regional Wastewater Treatment Plant. Start-up and performance testing services for each piece of equipment is included and will be performed by the Awarded Bidders after the equipment is installed by the City under a separate contract.

AWARD OF CONTRACT is subject to Chapter 30, Code of the City of Daytona Beach

BID DOCUMENTS may be viewed or downloaded as pdf files on-line at <http://purchasing.codb.us> at no charge. Contract Documents, including Drawings and Technical Specifications are on file at the Daytona Beach Purchasing Division. All inquiries pertaining to this project should be emailed to purchasing@codb.us or mailed to Purchasing Agent, Post Office Box 2451, Daytona Beach, Florida 32115-2451.

A NON-MANDATORY PRE-BID MEETING will be conducted on January 22, 2019 at Wastewater Treatment Plant/Ralph Brennan Water Treatment Plant Administration Building Conference Room, 3651 LPGA Blvd, Daytona Beach, FL 32117 at 2:00 PM. Take Road 6 within the plant to the Administration Building. Interested Bidders are *urged* to attend.

THE CITY RESERVES THE RIGHT to accept or reject any or all bids or parts thereof, or to accept the Bid(s) or parts thereof, or to waive any informalities when considered to be in the best interest of the City.

BIDS MAY BE HELD by the City of Daytona Beach for a period not to exceed 60 days from the date of opening of bids for the purpose of reviewing the Bid and investigating the qualifications of Bidders prior to awarding the contract. Bidders submitting bids to the City must comply with Chapter 30, Purchasing Code, "Minority and Women Owned Business Enterprises.

THE CITY OF DAYTONA BEACH
VOLUSIA COUNTY, FLORIDA

By: Joanne Flick
Purchasing Agent
Issue Date: January 7, 2019

INSTRUCTIONS TO BIDDERS

THESE INSTRUCTIONS ARE STANDARD FOR ALL COMMODITY BID SOLICITATIONS ISSUED BY THE CITY OF DAYTONA BEACH. THE CITY MAY DELETE, SUPERSEDE, OR MODIFY ANY OF THESE STANDARD INSTRUCTIONS FOR A PARTICULAR SOLICITATION BY USE OF SPECIAL INSTRUCTION SHEETS.

1. BID DOCUMENTS. The Bid Documents consist of the Invitation to Bid; these Instructions; Special Instructions, if any; the Standard Terms and Conditions; Supplemental Terms and Conditions, if any; the Bid Proposal Form to be completed, signed, and submitted by the Bidder; and all additional information and forms provided by the City as part of this solicitation that are required to be completed and submitted by the Bidder as part of the Bid, regardless of whether these forms are described herein as exhibits or attachments to the Bid Proposal Form. Together, the Bid Proposal Form and the additional forms required to be submitted by the Bidder as part of the Bid, constitute the "Bid Package."

In making copies of Bid Documents available, the City does so only for the purpose of obtaining Bids and does not confer a license or grant to use the Bid Documents for any other purpose.

2. COMPLETING THE BID. In submitting the Bid, the Bidder must complete and include all Bid Package documents. In order for the Bid to be considered complete:

A. The Bidder must submit the information required, only on the forms provided by the City as part of the Bid Package, except where the Bid Documents specifically permit or require otherwise.

B. The City requests that the Bidder submit only the Bid Package. If the Bidder submits a Bid that includes any documents other than the Bid Package, except where the Bid Documents specifically permit or require otherwise, these extraneous documents will be discarded.

C. The Bid Proposal Form and the other documents included in the Bid Package all contain blank spaces that the Bidder must complete. The Bidder must fill in these blank spaces in ink or by typewriter, and must initial with ink, all corrections and erasures to the information provided by the Bidder in these blank spaces.

D. Unless this solicitation contains Special Instructions allowing for partial or lot-by-lot bids, the Bidder must quote all unit prices and extended unit prices (if any) set forth in the Bid Package. If this solicitation allows for partial or lot-by-lot bids, the Bidder must comply with the Special Instructions in completing filling out the unit prices and extended unit prices set forth in the Bid Package.

E. The Bid Price (including unit prices and extended prices if applicable), must be stated in numerals.

F. If this solicitation requires unit prices and there is a conflict between the unit prices and the extended totals, the unit price will take precedence. Likewise, discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

G. The Bidder must not submit alternative bids unless this solicitation specifically authorizes alternate bids. If this solicitation specifically allows the submission of alternate bids, the Bidder must submit the Base Bid and any/all Bid Alternate(s) in order to be considered responsive.

H. The Bid may not contain qualifications or exceptions of any kinds.

I. All other submittal requirements stated herein must be met.

3. SIGNING THE BID. The Bid Proposal Form, and all other Bid Package documents requiring the Bidder's signature, must contain an original signature of an individual who is authorized to bind the Bidder. The signature must be located in the space(s) marked for the Bidder's signature. Electronic signatures will not be accepted. In addition:

A. If the Bidder is a general partnership, its name and address must be stated, as well as the name and address of each member of the firm or partnership.

B. If the Bidder is a joint venture, the Bidder must provide on separate signed sheet(s) of paper along with the Bid Proposal documents provided by the City, the full legal names of all persons/firms comprising the joint venture.

C. The person signing the Bid Proposal Form on behalf of the Bidder must be the same person who signs all of the other Bid Package documents.

4. INVESTIGATIONS AND REQUESTS FOR INTERPRETATIONS. Before submitting a Bid, each Bidder will make all investigations and examinations necessary to ascertain all site conditions and requirements affecting the full performance of the contract and to verify any representations made by the City upon which the Bidder will rely. If the Bidder receives an award as a result of its Bid submission, failure to have made such investigations and examinations will in no way relieve the Bidder from its obligation to comply in every detail with all provisions and requirements of the Bid Documents, nor will a plea of ignorance of such conditions and requirements be accepted as a basis for any claim whatsoever by the Bidder for additional compensation.

If the Bidder is in doubt as to the meaning of any of the Bid Documents or any other Contract Documents included in this solicitation, the Bidder may submit a written request to the City for an interpretation, in care of the Purchasing Agent at the address set forth in the Invitation for delivery of the Bid. Such requests must be received prior to Bid Opening in order to be considered. The City is not obligated to respond to such requests. Any clarification or interpretation of the Bid Documents issued by the City in the form of a written addendum will be deemed to be a part of the Bid Documents.

Deadline for submitting questions will be 10 calendar days prior to bid due date.

No oral clarification or interpretation will be binding.

5. ADDENDA TO BID DOCUMENTS. Prior to Bid Opening, the City may, on the City's own initiative or in response to a request for clarification, furnish addenda for additions or alterations to these Instructions, the Bid Documents, and to any or all Drawings, Specifications, or other Contract Documents previously supplied by the City. In addition, the City may by addendum extend the date scheduled for Bid Opening.

The Purchasing Agent will make reasonable efforts to notify all potential Bidders of the issuance of an Addendum. The Purchasing Agent will also post Addenda on the City's official web site. The City's web site address is <http://purchasing.codb.us>.

However, the Bidder is solely responsible for ensuring that the Bid Package submitted reflects all such Addenda.

6. BID ENVELOPE. The Bid, including the Bid Proposal Form, and all required Bid Documents must be returned in an opaque, sealed envelope. The outer envelope must display the name and address of the Bidder, the Bid number and Bid title as set forth on the Invitation to Bid, and the date and time scheduled for Bid Opening. The envelope must be addressed to:

Purchasing Agent
City of Daytona Beach
Room 146
301 S. Ridgewood Avenue
Daytona Beach, FL 32114

7. SUBMISSION OF BID. The Bidder must submit the Bid by mail or hand delivery at or prior to the time fixed for Bid Opening in the Invitation for Bids. Bids submitted after the time fixed for Bid Opening will not be accepted. The Bid must be delivered to the Purchasing Agent at the address above. A Bid submitted to any other location will not be considered. Telephone, electronic, and faxed bids will not be considered.

8. AMENDMENT AND WITHDRAWAL OF BID. The Bidder may amend or withdraw the Bid at any time prior to Bid Opening, but only with prior written notice to the Purchasing Agent, submitted in the same manner as the Bid. The notice must be signed by a properly authorized agent of the Bidder.

Mere negligence on the part of the Bidder in preparing the Bid does not constitute a right to withdraw the Bid subsequent to Bid Opening.

Amendments may be made only through the submission of a complete Bid Package, along with a written statement, signed by the same person who signed the Bid Package documents, that the submission is intended to fully replace the Bidder's earlier submission. The City is not required to honor an amendment that fails to comply with this Paragraph 9.

9. DISQUALIFICATION OF BIDDERS.

A. **Only One Bid Permitted:** The Bidder may submit only one Bid. If the Bidder submits more than one bid for the work involved, all Bids submitted from the Bidder will be rejected.

B. **Collusion:** If the City determines that collusion exists among Bidders, the City will reject the Bids of all participants in the collusion.

C. **Scrutinized Companies List:** If the Bidder is found to have submitted a false certification as provided by F.S. Section 238.175(5), or been placed on the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List, the City will have the option to immediately terminate this Contract. The City Commission or the CRA Governing Board will have authority to act on behalf of the City.

10. BID OPENING. Bid Opening will be scheduled at the location and on the date and time specified by the Invitation for Bid, or by any applicable Bid Addendum that the City may issue. At Bid Opening, the City will open and record the Bid so long as it is proper and has been timely submitted. In recording the Bid the City will state the name of the Bidder and the Bid Price.

The Bidder is solely responsible to ensure that the Bid is time and date stamped by the Purchasing Agent prior to Bid Opening. Late Bids will be rejected and returned unopened.

The Bidder may be present at Bid Opening but is not required to be present.

11. UNIT PRICING AND QUANTITIES. If this solicitation requests submission of unit prices: (i) the successful Bidder will hold all unit prices bid firm and quantities stated are an estimate only and no guarantee is given or implied as to quantities that will actually be required during the Contract period.

12. THE BID IS AN OFFER. In submitting the Bid, the Bidder certifies that the Bidder is making a firm offer that will remain open for 60 days following Bid Opening unless properly and timely withdrawn by the Bidder prior to Bid Opening in conformance with these Instructions unless the City, in the City's sole discretion, rejects the Bid after Bid Opening. Extensions of time beyond the 60 day period will only be by agreement of the City and the Bidder.

13. FEDERAL TAXES. The Bid price will be exclusive of all federal taxes. If the Bidder believes that certain other taxes are properly payable by the City, the Bidder may list such taxes separately in each case directly below the respective item Bid price. Tax exemption certificates will be furnished upon request.

14. BID PRICE INCLUSIVE OF COSTS. The Bid Price is inclusive of all of the Bidder's direct and indirect costs of performing the Work, including the cost of packaging, shipping, and paying or royalties for copyright, patent, or trademarks, involved in the work.

15. BIDS AND PUBLIC RECORDS. Sealed Bids received by the City pursuant to the Invitation to Bid will be temporarily exempt from disclosure in accordance with Florida's Public Records Laws. Thereafter, all bids will be open for a personal inspection by any person pursuant to Public Records Law.

If the Bidder believes that the Bid or any portion thereof is permanently exempt from disclosure under the public records laws, the Bidder must state the grounds for this position in CAPITAL LETTERS on a cover sheet accompanying the sealed Bid. The Bidder will be contacted prior to the opening of the Bid and a determination will be made as to whether or not it is exempt prior to opening. If a determination is made that it is not exempt from disclosure, the Bidder may in writing request the return of the sealed Bid in accordance with Section 8 above.

16. BID OPENING RESULTS. The Bidder may secure information pertaining to Bid Opening results by visiting <http://purchasing.codb.us> and clicking the link titled, "Closed Solicitations", by visiting the Purchasing Division Office Monday through Friday between 8:00 am and 3:00 pm, by submitting a written request to the address supplied in the Invitation, or by emailing a request to purchasing@codb.us. Copies of Bid tabulation sheets will be furnished upon request and receipt of a valid email address or self-addressed stamped envelope.

17. BIDDER CAPABILITY/REFERENCES. Prior to contract award, the City may require Bidder to show that Bidder has the necessary facilities, equipment, ability, and financial resources to perform the work specified in a satisfactory manner and within the time specified.

In addition, the City may require Bidder to demonstrate that the Bidder has experience in work of the same or similar nature as the work required herein, and to provide references satisfactory to the City.

18. REVIEW; BASIS OF AWARD. Bids will be reviewed in accordance with the procedures set forth in these Instructions to Bidders and the applicable provisions of the Purchasing Code, Chapter 30, Code of the City of Daytona Beach available at [Municode Library](#). Any contract award pursuant to the Invitation to Bid will be made on the basis of the criteria for award of bids provided in the Purchasing Code.

19. LOCAL PREFERENCE. The Purchasing Code provides for a preference to local vendors whenever the application of such a preference is reasonable in light of the dollar-value of proposals received in relation to such expenditures.

As used in City Code, the term, "local vendor" means a person or business entity which has maintained a permanent place of business with full-time employees within the city limits of the City of Daytona Beach for a minimum of six months prior to the date bids or proposals were received for the purchase or contract at issue, which generally provides from such permanent place of business the kinds of goods or services solicited, and which at the time of the solicitation fully complies with state and local laws, including City zoning and licensing ordinances.

Pursuant to City Code, if the lowest responsive bid is submitted by a non-local vendor, and a bid submitted by a local vendor is within 10% of the lowest bid, then these two vendors will each have the opportunity to submit a best and final bid equal to or lower than the amount of the lowest bid within five working days after bid opening. The bid will be awarded to the bidder submitting the lowest responsive bid or final bid. In case of a tie between a local vendor and a non-local vendor, the bid will be awarded to the local vendor.

If the Bidder intends to qualify as a local vendor, the Bidder must complete and sign the Local Vendor affidavit and submit it as part of the Bid. A Bidder who fails to properly complete and sign this affidavit or submit it with the Bid, will not be considered for local preference.

If the Bidder submits a properly completed Local Vendor affidavit as part of its Bid, the City reserves the right to verify that the Bidder meets the definition of Local Vendor, including by requiring the Bidder to supply additional documentation. In all instances, the City will be the final arbiter as to whether the Bidder qualifies for local preference.

With certain exceptions, application of local preference is discretionary. For more information on how the Local Preference may apply, see the Purchasing Code.

20. MINORITY & WOMEN OWNED BUSINESS ENTERPRISES. The Vendor must comply with those provisions of the Purchasing Code, relating to Minority and Women- Owned Businesses.

A list of Minority Business Enterprise Vendors is available on-line at <http://purchasing.codb.us>.

21. IDENTICAL TIE BIDS. If there are two or more low responsive bids from responsible Bidders that are identical in price the tie will be awarded to the following in order of preference: a) the bidder qualifying for local preference under Code 30-86; b) the bidder in compliance with the drug free workplace certification requirements set forth in Florida Statutes 287.087; or c) the most responsible bidder as defined under the City Code 30-82 (9)(c).

22. RIGHT TO ACCEPT OR REJECT BIDS. The City will reject Bids which contain modifications, or which are incomplete, unbalanced, conditional, obscure, or which contain additions not requested, or irregularities of any kind, or which do not comply in every respect with these Instructions to Bidders and the Contract Documents, unless the City in its sole discretion determines that the non-compliance is minor.

The City does not bind itself to accept the minimum Bid stated herein, but reserves the right to accept any Bid, which in the judgment of the City will best serve the needs and interests of the City.

The City reserves the right to accept or reject any or all Bids in whole or in part, and to award by items, parts of items, or by any aggregate group of items specified. The City reserves also the right to waive technical defects when in its judgment the best interest of The City thereby will be served.

23. CRA MAY AWARD CONTRACT. If the funds to be used to pay for the materials solicited are from redevelopment trust funds, contract award may be made by the City of Daytona Beach Community Redevelopment Agency (CRA) instead of the City. In this instance, the CRA, instead of the City, may be party to any written contract required to be executed by the successful Bidder, and any references to the City in the Invitation to Bid, these Instructions, or the Bid Documents will be deemed to refer to the CRA as logic dictates.

24. CRA MAY ORDER GOODS PURSUANT TO CONTRACT. In the case of a continuing/term supply contract awarded pursuant to this solicitation, if the funds to be used to pay for a portion of the supply or service are from redevelopment trust funds, the CRA is authorized to order goods for a specific procurement under this Contract instead of the City.

25. PUBLIC ENTITY CRIMES. Any party submitting a Bid in response to this invitation must execute the Form AFFIDAVIT ON PUBLIC ENTITY CRIMES, which has been provided with this solicitation, and enclose it with the completed Bid Proposal Form. The Bidder's failure to properly complete, sign, and submit the AFFIDAVIT ON PUBLIC ENTITY CRIMES will be grounds for rejecting the Bid as non-responsive. If the City, having awarded the contract to the Bidder, later determines that the information provided in the AFFIDAVIT is false, the City may immediately terminate the contract for cause.

26. COMPLIANCE WITH LAWS. The Bidder will be responsible for complying with all applicable federal, state, and local laws, ordinances, rules, regulations, and all orders and decrees of bodies or tribunals having jurisdiction or authority which in any manner affect the work, or which in any way affect the conduct of the work.

At time of Bid submittal, the Bidder must hold the required licensure to be the prime contractor for all work to be performed under this solicitation. Any subcontractors or sub-consultants whom the Bidder proposes to use to perform work under this solicitation must also hold the required licensure at the time of Bid submittal.

27. MAINTENANCE OF LICENSES. The Bidder will maintain all required licenses in full force and effect during the contract term.

28. BIDDER RESPONSIBILITY FOR PREPARATION COSTS. Neither the City nor the City's officers or agents will be liable for the costs incurred by the Bidder in reviewing or responding to this solicitation.

29. SAMPLES. When required, samples must be furnished no later than the time specified for Bid Opening, free of expense to the City, marked plainly with name and address of Bidder, Bid number and opening date of Bid, and will include a memorandum indicating if Bidder requests return of samples. Failure to submit sample when required will result in the Bid being found non-responsive and ineligible from consideration. Samples provided by the successful Bidder will be retained by the City for comparison with deliveries. Samples submitted by other Bidders may be returned at Bidder's risk and expense, providing they have not been made useless through tests, when required, All samples submitted are subject to mutilation as a result of tests by the City.

30. SPECIFICATIONS/DESCRIPTION OF EQUIPMENT. If any proprietary, trade, brand or manufacturers' name or part number is used herein in describing the required equipment, it will be understood to indicate the minimum standard of composition and quality desired, and will not be construed to exclude equipment that equals or exceeds the functional capability and quality of the named equipment, unless otherwise indicated. If bids are based on such equivalent equipment, indicate the manufacturer's name and model number for the equipment and include any literature or other explanation of the equipment's quality or performance.

The equipment bid herein will be of standard manufacture, new, and of the current production model.

Detailed equipment's specifications for make and model offered will be provided with Bid.

In cases where it becomes necessary to determine whether or not a product bid is equal or equivalent to the product specified, the City of Daytona Beach, at its sole discretion, will make such determination.

31. FINALIZATION OF CONTRACT. Except as provided below, the successful bidder, if any, will be required to execute a Memorandum of Contract, furnished by the City, as a condition of the bid award. A sample Memorandum of Contract is included in this solicitation.

The City reserves the right to make minor changes in the Terms and Conditions of this Contract (including the Standard Terms and Conditions and Supplemental General Conditions), prior to award of the contract to correct errors, make minor formatting changes, comply with law, or for legal sufficiency. If the City exercises this right, then instead of the Memorandum of Contract, the Bidder will be required to exercise a form contract provided by the City, fully incorporating the ITB, the Bid Proposal, and the Terms and Conditions, and specifically identifying the changes to the Terms and Conditions made pursuant to this Section.

SPECIAL INSTRUCTIONS

SI 1. WORK DIVIDED INTO LOTS. Award of this Bid will be on a lot-by-lot basis to the lowest and best Bidder for each individual lot. Bidder will provide a price for each lot being bid. If the Bidder elects not to bid on a particular lot, Bidder must clearly mark "No Bid" on the lines provided for pricing for that lot.

SI 2. SUBSTITUTION REQUESTS. All requests for product substitution must be accompanied by the following documentation:

- A. Timeliness of Request:
 - 1. Submit a minimum 25 days before opening of the bids.
 - 2. City/Engineer will return initial opinion and request for additional information within 5 working days.
 - 3. City/Engineer will notify in writing of decision to accept or reject the substitution request within 20 working days of receiving required information.
- B. Formal substitution request contents:
 - 1. Manufacturer's literature including:
 - a. Manufacturer's name and address.
 - b. Product name.
 - c. Product description.
 - d. Reference standards.
 - e. Certified performance and test data of equipment offered for similar service at other full-scale installations.
 - f. Operation and maintenance data.
 - 2. Shop drawings, if available.
 - 3. Reference projects where the product has been successfully used:
 - a. Name and address of project.
 - b. Year of installation.
 - c. Year placed in operation.
 - d. Name of product installed.
 - e. Point of contact: Name and phone number.
 - 4. Itemized comparison of the proposed substitution with product specified including a list of significant variations:
 - a. Design features.
 - b. Design dimensions.
 - c. Installation requirements.
 - d. Operations and maintenance requirements.
- C. Minimum Qualifications. The manufacturer shall have at least 10 years of experience in the design and manufacture of the equipment. As part of the submittal package described below, the manufacturer shall submit evidence that equipment of similar capacity and service capability has been in successful operation for at least 5 years in at least 10 separate installations.
- D. Substitutions will not be considered for acceptance under the following conditions:
 - 1. No formal substitution request is made.
 - 2. Substitution requests are submitted after the deadline.
- E. City/Engineer's decision on a substitution requests will be final and binding.
 - 1. Approved substitutions will be considered at bid opening.

2. Requests for time extensions and additional costs based on submission of, approval of, or rejection of substitutions will not be allowed.

STANDARD TERMS AND CONDITIONS

1. Definitions. Certain terms used herein will have the following meanings:

(a) The City means the City of Daytona Beach, and unless the context dictates otherwise, includes the City's officers, employees, and agents.

(b) Commodities means the supplies, materials, goods, merchandise, food, equipment, or other personal property that the Vendor will be obligated to provide the City under this Contract. These commodities are generally set forth in the Bid Schedule.

(c) Contract means the Bid Documents, including Instructions, Special Instructions, Addenda, Standard Terms and Conditions, and Supplemental Conditions if any; the Bid Package submitted by the Vendor; the Resolution or Ordinance awarding the Bid; the form contract, if any, required by the City in order to integrate all terms and conditions herein, or in absence of such form contract, the signed short form memorandum of contract provided by the City for the Vendor's execution; any other documents specifically incorporated herein or by any of the documents referenced above; all purchase orders issued pursuant to the Bid Documents; and all amendments that may after the date of award be executed by the Vendor and the City.

(d) Vendor means the successful Bidder who was awarded this Contract by the City; and unless the context dictates otherwise, includes Vendor's officers, employees, and agents.

All other terms not defined above will have their ordinary meaning.

2. Indemnification. For value received, the Vendor will indemnify and hold harmless the City, including the City's officers, employees, and agents, from (i) all liabilities, damages, losses, and costs, including, but not limited to, reasonable attorneys' fees, to the extent caused by the negligence, recklessness, or intentionally wrongful conduct of Vendor, or of Vendor's officers, employees, and agents, including subcontractors and other persons employed or utilized by the Vendor in the performance of the Contract; and (ii) all liabilities, damages, injuries, losses, claims, suits, actions, judgments, charges, expenses, or costs of any nature and kind, including attorneys' fees and court costs, arising from or relating to actual or alleged violation of or infringement of any patent, trademark, copyright, service mark, trade secret or intellectual property right for or on account of the use of any product or services sold to the City or used in performance of the work.

3. Warranty. Except as provided in the Supplemental Terms and Conditions, if any, Vendor warrants that the commodities supplied pursuant to this Contract are new, of good quality, and conform to any specifications and requirements of this Contract; that such commodities are merchantable; and that they are fit for the ordinary purposes they are intended to serve.

4. MSD. Vendor will supply Material Safety Data (MSD) with each initial delivery of any materials defined by the State of Florida or the Federal Government as being toxic or harmful.

5. Packaging and Shipping. All invoices, packing lists and packages must bear the name of the Contract and the applicable City purchase order number as printed on the face of the purchase order.

6. Discontinued. Vendor will provide the City 30 days' advance written notice of a discontinued item, to allow the City to purchase additional quantities of such items. The City must give written approval of any replacements provided for discontinued items if they exceed the unit price for the discontinued item or fail to strictly meet quality, fit, form, or function of the discontinued item.

7. Payment. Payment will be made 45 days after Vendor has provided an accurate and undisputed invoice, except where the City accepts a prompt payment discount from the Vendor and the commodities are not defective. All invoices must have a unique invoice number, date, and pricing by line item and unit price that are consistent with this Contract and purchase order. Improper invoices will be returned to the Vendor. Any additional terms and conditions set forth on an invoice not in compliance with this Contract or the purchase order are null and void. Nothing in this Contract will be deemed to create an obligation on the City's part to pay a subcontractor or supplier of Vendor's for commodities provided under this Contract.

8. Sovereign Immunity. The City expressly retains all rights, benefits, and immunities of sovereign immunity under Florida law, including Section 768.28, Florida Statutes. Nothing in this Contract, or any purchase order, or notice provided under this Contract will be deemed to be a waiver of sovereign immunity or of the limitations on liability of the City beyond any statutory limited waiver of immunity or limits of liability which may have been or may be adopted by the Florida legislature, and the cap on the amount and liability of the City for damages regardless of the number or nature of claims in tort, equity, or contract will not exceed the dollar amount set by the legislature for tort. Nothing in this Contract, or any purchase order, or notice provided pursuant to this Contract will inure to the benefit of any third party for the purpose of allowing a claim against the City, which would otherwise be barred under the doctrine of sovereign immunity or by operation of law.

9. Books and Records. The Vendor will maintain books, records, and documents pertinent to performance under this Contract and any purchase order issued hereunder in accordance with generally accepted accounting principles. The City will have inspection and audit rights to such records during the term of this Contract and for three years following the termination of obligations hereunder. Records which relate to any litigation, appeals or settlements of claims arising from such performance will be made available until a final disposition has been made of such litigation, appeals or claims.

10. UCC. In addition to any rights or remedies contained in this Contract, each party will have the rights, duties, and remedies available through the Uniform Commercial Code.

11. Notices. All notices given by one party to the other under this Contract will be delivered to:

For the City:
Jo Ann Macrina, Deputy Utilities Director
Daytona Beach Utilities
125 Basin St., Suite 204
Daytona Beach, FL 32114

For the Vendor: **To the individual signing the Bid Proposal Form**

12. Amendments and Modifications. The City may unilaterally change, at no additional cost, the quantity and receiving point within the City for items not yet shipped. The City will not be required to pay for defective items, back-orders, late deliveries, deliveries of quantities of items

exceeding the quantities specified, or items shipped at a higher price than stated in this Contract or the purchase order. Except as otherwise provided herein, no change or modification of the Contract will be valid unless the same is in writing and signed by both Parties.

13. Assignments and Subcontracting. No assignment or subcontracting will be permitted without the City's written approval.

14. Compliance with Laws and Regulations. In providing goods pursuant to this Contract, Vendor will abide by all statutes, ordinances, rules, and regulations pertaining to, or regulating the provisions of, such services including those now in effect and hereafter adopted.

15. Principles in Construing Contract. The Contract will be governed by and construed in accordance with the laws of the State of Florida. Captions and paragraph headings used herein are for convenience only, are not a part of this Contract and will not be deemed to limit or alter any provisions hereof or to be relevant in construing this Contract. The use of any gender herein will be deemed to be or include the other genders, and the use of the singular herein will be deemed to be or include the plural (and vice versa), wherever appropriate.

16. Litigation/Venue. In case of litigation, the laws of the State of Florida will govern Florida; the exclusive venue will be Volusia County, Florida if in state court, or the U.S. District Court, Middle District of Florida if in federal court; and each party will bear all of its litigation costs, including attorney's fees.

17. Jury Trial Waived. THE PARTIES HEREBY WAIVE THEIR RESPECTIVE RIGHTS TO A JURY TRIAL OF ANY CLAIM OR CAUSE OF ACTION BASED UPON OR ARISING OUT OF THIS CONTRACT, OR ANY DEALINGS BETWEEN THE PARTIES. THE SCOPE OF THIS WAIVER IS INTENDED TO BE ALL ENCOMPASSING OF ANY DISPUTES BETWEEN THE PARTIES THAT MAY BE FILED IN ANY COURT AND THAT RELATE TO THE SUBJECT MATTER, INCLUDING WITHOUT LIMITATION, CONTRACT CLAIMS, TORT CLAIMS, BREACH OF DUTY CLAIMS AND ALL OTHER COMMON LAW AND STATUTORY CLAIMS.

18. Limitation on Waivers. Failure by the City to enforce any provision of this Contract will not be deemed a waiver of such provision or modification of this Contract. A waiver of any breach of a provision of this Contract will not be deemed a waiver of any subsequent breach and will not be construed to be a modification of the terms of the Contract.

19. Termination of Contract.

(a) The City may terminate this Contract, in whole or in part, at any time, for the City's convenience, non-appropriation of funds, or upon Vendor's material breach, by providing written notice as follows:

(1) Before terminating for convenience, the City must provide Vendor 30 days' notice. Termination will be automatic upon the expiration of the 30-day period.

(2) Before terminating for non-appropriation of funds, the City will provide Vendor such notice as is reasonably practical under the circumstances.

(3) Before terminating due to Vendor's material breach of its contractual obligations, City must provide Vendor written notice specifying the breach and demanding that Vendor remedy the breach within the Cure Period; except when the nature of the breach is that it is irrevocable and cannot be cured (an example of a breach that is irrevocable is the Vendor's submittal, as bidder, of an Affidavit on Public Entity Crimes which is false). The Cure Period will be 10 days; unless the nature of the material breach is such that it cannot be reasonably cured within this 10-day period despite Vendor's diligent efforts to do so, in which instance the Cure Period will be extended by one day for each day beyond the 10-day Cure Period that Vendor has continued to diligently attempt to complete the remedy. This Contract will terminate automatically and without need for additional notice if Vendor fails to remedy the material breach within the Cure Period.

In any of the above instances, upon termination, Vendor will immediately discontinue all services affected, unless the notice directs otherwise, and deliver to the City all data, drawings, specifications, reports, estimates, summaries, and any and all such other information and services of whatever type or nature as may have been accumulated by Vendor in performing this Contract, whether completed or in process.

(b) If the termination is for the City's convenience, Vendor will be paid compensation for goods delivered prior to the date of termination.

(c) If termination is for non-appropriation, Vendor will be paid for goods delivered prior to the fiscal year for which the non-appropriation event has occurred.

(d) If the termination is due to the Vendor's material breach, the City reserves all rights and remedies it may have under law due to such breach.

(e) If after notice of termination for the Vendor's material breach it is determined by the City or by a court of law that the Vendor had not materially breached this Contract, or that the City's notice for termination upon such breach was insufficient, the termination will be conclusively deemed to have been effected for the City's convenience. In such event, adjustment in payment to Vendor will be made as provided in Subsection (b) of this Section.

(f) The rights and remedies of City provided for in this Section are in addition and supplemental to any and all other rights and remedies provided by law or under this Contract.

20. Suspension of Services. If the notice of default issued by the City pursuant to the preceding Section so directs, Vendor will suspend services immediately upon receipt thereof, other than the work required to remedy the material breach.

21. Severability. If one or more of the provisions contained in this Contract will for any reason be held to be invalid, illegal or unenforceable in any respect, such invalidity, illegality or unenforceability will not affect any other provisions of this Contract, and this Contract will then be construed as if such invalid, illegal or unenforceable provision had never been contained herein or therein.

22. Public Records.

(a) To the extent applicable, Vendor will comply with the requirements of Florida Statutes Section 119.07, which include the following:

(1) Keeping and maintaining public records that the City requires for performance of the service provided herein.

(2) Upon the request of the City Clerk of the City, (i) providing the City Clerk with a copy of requested public records or (ii) allowing inspection or copying of the records, within a reasonable time after receipt of the City Clerk's request, at a cost that does not exceed the cost provided in Ch. 119, Florida Statutes, or as otherwise provided by law.

(3) Ensuring that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law until completion of this Contract, or, if this is a Contract for a specified Term, through the expiration of the Term; and following such completion or expiration, as applicable, if Vendor fails to transfer such records to the City.

(4) Upon completion of the work, or, if this is a Contract for a specified Term, upon expiration of the Term, keep and maintain public records required by the City to perform the service. Vendor will meet all applicable requirements for retaining public records. All records stored electronically must be provided to the City upon request from the City Clerk, in a format that is compatible with the City's information technology systems.

IF THE VENDOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE VENDOR'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS AGREEMENT, VENDOR MUST CONTACT THE CITY CLERK, WHOSE CONTACT INFORMATION IS AS FOLLOWS:

(Phone)	386 671-8023
(Email)	clerk@codb.us
(Address)	301 S. Ridgewood Avenue Daytona Beach, FL 32114

(b) Nothing herein will be deemed to waive Vendor's obligation to comply with Section 119.0701(3)(a), Florida Statutes, as amended by Chapter 2016-20, Laws of Florida (2016).

23. Title/Risk of Loss. Title and risk of loss will not be deemed to pass to the City unless and until the commodities ordered have been delivered; and, where inspection is required prior to City acceptance, until the City has inspected and accepted such commodities. In all instances shipment will be FOB destination.

24. Failure to Enforce. Failure by the City at any time to enforce the provisions of this contract will not be construed as a waiver of any such provisions. Such failure to enforce will not affect the validity of the contract or any part thereof or the right of the City to enforce any provision at any time in accordance with its terms.

25. Purchase Orders. All purchase orders issued pursuant to the Contract will be deemed to incorporate all terms and conditions of the Contract regardless of whether the Contract or Contract Documents are expressly referenced therein. In case of conflicts between a purchase order and any other with provisions of the Contract Documents, the other provisions of the Contract Documents will control.

26. Additional Quantities. For a period not exceeding 90 days from the date of award of the Contract by the City, the right is reserved to acquire additional quantities up to but not exceeding those shown on Bid at the prices Bid in this invitation.

27. Delivery. Delivery of all materials or products under this Bid will be quoted FOB Daytona Beach or other point of use as specified. No delivery charges will be added to invoices except when express delivery is substituted on order for less expensive method specified in Contract; in such cases, difference between freight or mail and express charges may be added to the invoice.

28. Delivery Failures. Failure of the Vendor to deliver within the time specified in the Contract, or within a reasonable time as interpreted by the Purchasing Agent, or failure to make replacements of rejected articles as directed by the Purchasing Agent, will permit the Purchasing Agent to purchase on the open market articles of comparable grade to take the place of those rejected or not delivered. On all such purchases the Vendor will reimburse The City within a reasonable time specified by the Purchasing Agent, for any expenses incurred in excess of the defaulted prices.

29. Governmental Restrictions. In the event any governmental restrictions are imposed which would necessitate alteration of the material, quality, workmanship or performance of the items awarded to the Vendor prior to delivery, it will be the responsibility of the Vendor to notify the City in writing at once, indicating the specific regulation which required an alteration. The City reserves the right to accept any such alteration, including any price adjustments occasioned thereby, or to cancel the Contract at no expense to the City.

30. Patent Infringement, Etc. By submission of this Bid, the Vendor certifies that the merchandise to be furnished will not infringe any valid patent, copyright, or trademark and the successful Vendor will, at his own expense, defend any and all sections or suites charging such infringement and hold The City harmless in case of any such infringements.

SUPPLEMENTAL TERMS AND CONDITIONS

In case of conflicts between these Supplemental Terms and Conditions and the Standard Terms and Conditions, these Supplemental Terms and Conditions will govern.

STC1 INSURANCE. Vendor will provide and maintain at Vendor's own expense, insurance of the kinds of coverage and in the amounts set forth in this Section.

(a) Coverage and Amounts.

(1) Workers Compensation Insurance as required by Florida Statutes, Chapter 440, Workers' Compensation Insurance, for all employees of Vendor, employed at the site of the service or in any way connected with the work, which is the subject of this service. The insurance required by this provision will comply fully with the Florida Workers' Compensation Law and include Employers' Liability Insurance with limits of not less than \$500,000 per occurrence. Any associated or subsidiary company involved in the service must be named in the Workers' Compensation coverage.

(2) Liability Insurance, including (i) Commercial General Liability coverage for operations, independent Vendors, products-completed operations, broad form property damage, and personal injury on an "occurrence" basis insuring Vendor and any other interests, including but not limited to any associated or subsidiary companies involved in the work; and (ii) Automobile Liability Insurance, which will insure claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle used by the Vendor in the performance of this Contract.

The limit of liability for each policy will be a combined single limit for bodily injury and property damage of no less than \$1,000,000 per occurrence. If insurance is provided with a general aggregate, then the aggregate will be in an amount of no less than \$2,000,000. The Risk Manager for the City may authorize lower liability limits for the automobile policy only, at the Risk Manager's sole discretion.

THE COMMERCIAL GENERAL LIABILITY INSURANCE POLICY SHALL NAME THE CITY OF DAYTONA BEACH AS ADDITIONAL INSURED. Contractor's Commercial General Liability insurance policy shall provide coverage to Contractor, and City when required to be named as an additional insured either by endorsement or pursuant to a blanket additional insured endorsement, for those sources of liability which would be covered by the latest edition of the standard Commercial General Liability Coverage Form (ISO Form CG 00 01) without the attachment of any endorsements excluding or limiting coverage for Products/Completed Operations, Independent Contractors, Property of City in Contractor's Care, Custody or Control or Property of City on which contracted operations are being performed, Explosion, Collapse or Underground hazards (XCU Coverage, Contractual Liability or Separation of Insureds. When City is added as additional insured by endorsement, ISO Endorsements CG 20 10 and CG 20 37 or their equivalent shall be used to provide such Additional Insured status.

Unless specifically waived hereafter in writing by the Risk Manager, Vendor agrees that the insurer will waive its rights of subrogation, if any, against the City on each of the foregoing types of required insurance coverage.

The City will be exempt from, and in no way liable for, any sums of money that may represent a deductible in any insurance policy. The payment of such deductible will be the sole responsibility of Vendor.

(b) Proof of Insurance. Vendor will furnish proof of insurance acceptable to the City prior to or at the time of execution of this Contract. Vendor will not commence work until all proof of such insurance has been filed with and approved by the City. Vendor will furnish evidence of all required insurance in the form of certificates of insurance which will clearly outline all hazards covered as itemized above, the amounts of insurance applicable to each hazard, and the expiration dates.

The Vendor must notify the City of cancellation as soon as the Vendor is knowledgeable of cancellation of any of the required coverages by the insurer, the Vendor, or any other named insured.

If requested by the City, the Vendor will furnish copies of the insurance contracts to support the certificates of insurance and the copies of said insurance must be acceptable to the City.

Anything to the contrary notwithstanding, the liabilities of the Vendor under this Contract will survive and not be terminated, reduced or otherwise limited by any expiration, limitation, exclusion or termination of insurance coverage. Neither approval nor failure to disapprove insurance furnished by the Vendor will relieve the Vendor or its sub-contractors from responsibility to provide insurance as required by this Contract.

(c) Subcontractor's Insurance. Each of Contractor's subcontractors will be required to provide insurance in substantially similar form to the insurance required of Contractor above based on services provided.

(d) Required Changes in Coverage and Amounts of Coverage. The City may at any time require Contractor to increase the amount of coverage, change the terms of coverage, and provide additional or different types of coverage, as the City may deem necessary; provided that the changes or increase in coverage are consistent with such requirements for similar operations and businesses then operating within the Central Florida area or are reasonable in light of prior claims made against Contractor's policies. Contractor must comply with such requirements within 30 days after the City's demand.

SUBMITTAL CHECKLIST

The following documents are to be submitted with the Bid. Make sure that each blank on the form is filled out. Use NA (not applicable) rather than leaving a line blank.

included	Item(s) Required
	Bid Proposal Form
	Bid Schedule
	Non-Collusion Affidavit
	Local Vendor Affidavit <i>only if filing for local preference</i>
	CERTIFICATION OF COMPLIANCE WITH AFFIRMATIVE ACTION PROGRAMS
	Drug Free Workplace / Tied Bids
	Florida Public Entity Crime Form
	Label the outer most package with the following: Bid Number Date of the Opening Contractor Name and Address

BID PROPOSAL FORM

ITB No.: 19202

TO THE MAYOR AND COMMISSIONERS
THE CITY OF DAYTONA BEACH, A FLORIDA MUNICIPAL CORPORATION

Dear Mayor and Commissioners:

This Bid is submitted by _____
(insert Vendor's full legal name; include D/B/A if applicable)

Business Address: _____
(include P.O. Box/street address, city, state and zip code)

Business Phone: _____ Business Fax: _____
(include area code) (include area code)

Business Email: _____
(leave blank if n/a)

The undersigned, as VENDOR or VENDOR's authorized representative, hereby declares and affirms each of the following:

1. That VENDOR is fully informed in regard to all conditions pertaining to the site(s).
2. That VENDOR has thoroughly examined all Contract Documents, including Specifications as applicable, relative to the commodities to be provided, and that VENDOR is sufficiently knowledgeable of the commodities to be provided.
3. That, pursuant to and in compliance with the Bid Package, including all other Contract Documents, the VENDOR hereby agrees to furnish all labor, materials, and equipment to provide the commodities in strict accordance with the Contract Documents and for the Unit and/or Lump Sum prices herein stated in the attached Bid Schedule.
4. Subject to the terms and conditions stated in the Contract Documents, that VENDOR will provide the commodities work in accordance with the schedule) specified in the Contract Documents.
5. That VENDOR agrees to indemnify and hold harmless the City any other interests as set forth in the Contract Documents.

BID PROPOSAL FORM, cont.

6. That insofar as the attached Bid Schedule includes extended unit prices, the use of extended unit quantities will not be construed to be a guarantee that the City will purchase such quantities if a contract is awarded; and that, subject to the terms and conditions of the Contract, the VENDOR will be entitled to payment based upon the units delivered and accepted.

7. That VENDOR has received the following Addenda (*leave blank if inapplicable*):

No. _____ Dated: _____ No. _____ Dated: _____

No. _____ Dated: _____ No. _____ Dated: _____

(list any additional Addenda by number and date): _____

8. That VENDOR has completed the required information required in this Bid Proposal Form and other documents comprising the Bid Package truthfully.

BID PROPOSAL FORM, cont.

9. That VENDOR is (mark the appropriate box and include the additional information, as applicable):

- ☐ An individual person/sole proprietor
- ☐ A Florida corporation/ limited liability company
- ☐ A foreign corporation/limited liability company authorized to do business in Florida*
_____ (specify state of incorporation /
formation)
- ☐ A Florida limited partnership
- ☐ A foreign limited partnership authorized to do business in Florida*
_____ (specify state of incorporation /
formation)
- ☐ A general partnership (provide partner names on separate, signed sheet of
paper)
- ☐ A joint venture**
- ☐ Other _____ (specify, including type of
entity)

* (If Vendor is a foreign corporation or foreign limited liability company, attach proof of registry from State of Florida)

** (provide on separate signed sheet(s) of paper the full legal names of all persons/firms comprising the joint venture.

In signing below, I certify that I am the above-named VENDOR or a person duly authorized by VENDOR to bind VENDOR to these terms and conditions.

By: _____
(Signature)

Printed Name: _____

Title: _____

Date signed: _____

BID SCHEDULE

ITB Number 19202

BIOSOLIDS DEWATERING EQUIPMENT PURCHASE AT \ WESTSIDE REGIONAL WASTEWATER TREATMENT PLANT

	Description	Total Amount
LOT 1	Purchase of two (2) 3-belt Belt Filter Presses and ancillary items and services per specifications	\$
LOT 2	Purchase of two (2) Liquid Pre-packaged Polymer Blending Units and ancillary items and services per specifications	\$
LOT 3	Purchase of Shaft-less Screw Conveyor System and ancillary items and services per specifications	\$

Note: WRITE "NO BID" FOR THOSE LINE ITEMS NOT BEING BID BY THE VENDOR

Date Signed: _____

By: _____
(Signature)

Name Typed: _____

Title: _____

Company Name: _____

NONCOLLUSION AFFIDAVIT OF PRIME BIDDER

STATE OF _____)
COUNTY OF _____)

_____, being first duly sworn deposes and says that:

- (1) He is _____ of _____, the Bidder that has submitted the attached Bid;
- (2) He is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;
- (3) Such Bid is genuine and is not a collusive or sham bid;
- (4) Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm or person to fix the price or prices or cost element of the Bid price or the Bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against the City of Daytona Beach, FL (Local Public Agency) or any person interested in the proposed Contract;
- (5) The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

By: _____
(Signature)

Name Typed: _____

Title: _____

Bidder: _____

Subscribed and sworn to before me

This _____ day of _____, 20____

(Signature of Notary Public) My commission expires: _____

LOCAL VENDOR AFFIDAVIT

Complete and submit this form ONLY if you qualify for local preference as provided in the City of Daytona Beach Purchasing Code.

A copy of the Bidder's Daytona Beach Business Tax Receipt must be submitted with this Affidavit.

NAME OF BIDDER: _____

LOCAL BUSINESS ADDRESS *(street address being used to claim Local Preference, including, zip code):*

The undersigned certifies under penalty of perjury each of the following:

The Local Business Address has continuously been used as a Permanent Place of Business with at least one full-time employee since _____.
(Insert date)

The Local Business Address has consistently offered or provided the goods or services being solicited by the City of Daytona Beach during the time referenced above.

The Local Business Address has not been established with the sole purpose of obtaining the advantages that may be granted pursuant to the Local Preference provisions of the City of Daytona Beach Purchasing Code.

Signature *(Must be same person as person signing the Bid Proposal)*

Print Name/Title

Subscribed and sworn to before me

This _____ day of _____, 20_____

(Signature of Notary Public)

My commission expires: _____

The City of Daytona Beach reserves authority to require a copy of the corporate charter, corporate income tax filing return, and any other documents(s) to evaluate the Bidder's Local Preference claim.

CERTIFICATION OF COMPLIANCE WITH AFFIRMATIVE ACTION PROGRAMS

The Vendor []has []has not developed and []has []has not on file at each establishment, Affirmative Action Programs pursuant to Executive Order 11246.

The Vendor []has []has not participated in a previous contract or subcontract subject to Executive Order 11246.

The Vendor []has []has not filed with the Joint Reporting Committee, the Director or the Equal Employment Opportunity Commission all reports due under the applicable filing requirements.

Date _____, 20 ____

Vendor: _____

By: _____

(Signature)

Name: _____

Title: _____

Address: _____

DRUG-FREE WORKPLACE CERTIFICATION

IDENTICAL TIE BIDS: - If there are two or more low responsive bids from responsible bidders that are identical in price and other evaluation criteria, the tie will be awarded to the following in order of preference: a) the bidder qualifying for local preference under Code 30-86; b) the bidder in compliance with the drug free workplace certification requirements set forth in Florida Statutes 287.087; or c) the most responsible bidder as defined under the City Code 30-82 (9)(c).

In order to have a drug-free workplace program, a business will:

- 1) Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.
- 2) Inform employees about the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violation.
- 3) Give each employee engaged in providing the commodities or contractual services that are under bid a copy of the statement specified in subsection 1).
- 4) In the statement specified in subsection 1), notify the employees that, as a condition of working on the commodities or contractual services that are underbid, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or *nolo contendere* to, any violation occurring in the workplace no later than five days after such conviction.
- 5) Impose sanction on, or require the satisfactory participation in a drug abuse assistance or rehabilitation program if such is available in the employee's community, by any employee who is so convicted.
- 6) Make a good faith effort to continue to maintain a drug-free workplace through implementation of this section.

(Signature)

AFFIDAVIT ON PUBLIC ENTITY CRIMES

(To be signed in the presence of a notary public or other officer authorized to administer oaths.)

Before me, the undersigned authority, personally appeared _____, who, being by me first duly sworn, made the following statements:

1. The business address of _____ (insert Bidder's name), hereinafter the "Bidder," is _____.

2. My relationship to Bidder is _____. (relationship such as "sole proprietor," "partner," "president," "vice president," etc.)

3. I understand that a "public entity crime" as defined in Section 287.133(1)(g), *Florida Statutes*, means a violation of any state or federal law by a person with respect to and directly related to the transaction of business with any public entity or with an agency or political subdivision of any other state or of the United States, including, but not limited to, any bid or contract for goods or services to be provided to any public entity or an agency or political subdivision of any other state or of the United States and involving antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy, or material misrepresentation.

4. I understand that "convicted" or "conviction" as defined in Section 287.133(1)(b), *Florida Statutes*, means a finding of guilt or a conviction of a public entity crime, with or without an adjudication of guilt, in any federal or state trial court of record relating to charges brought by indictment or information after July 1, 1989, as a result of a jury verdict, non-jury trial, or entry of a plea of guilty or nolo contendere.

5. I understand that an "affiliate" as defined in *Florida Statutes*, 287.133(1)(a), *Florida Statutes*, means:

- A. A predecessor or successor of a person convicted of a public entity crime; or
- B. An entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in the management of an affiliate. The ownership by one person of shares constituting a controlling interest in another person, or a pooling of equipment or income among persons when not for fair market value under an arm's length agreement, shall be a prima facie case that one person controls another person. A person who knowingly enters into a joint venture with a person who has been convicted of a public entity crime in Florida during the preceding 36 months shall be considered an affiliate.

6. I understand that a "person" as defined in Paragraph 287.133(1)(e), *Florida Statutes*, means any natural person or entity organized under the laws of any state or of the United States with the legal power to enter into a binding contract and which bids or applies to bid on contracts for the provision of goods or services let by a public entity, or which otherwise transacts or applies to transact business with a public entity. The term "person" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in management of an entity.

7. Based on information and belief: (check or initial A. or B. below)

- ___A. Neither the Bidder, nor any of the Bidder's officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the Bidder, nor any affiliate of Bidder, has been charged with and convicted of a public entity crime subsequent to July 1, 1989.
- ___B. The Bidder, or one or more of the Bidder's officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of Bidder

entity, or an affiliate of Bidder, has been charged with and convicted of a public entity crime subsequent to July 1, 1989. There has been a subsequent proceeding before a Hearing Officer of the State of Florida, Division of Administrative Hearings and the Final Order entered by the Hearing; and

(if Paragraph 7.B. applies, check or initial one of the following)

- _____ There has been a subsequent proceeding before a Hearing Officer of the State of Florida, Division of Administrative Hearings and the Final Order entered by the Hearing, and the Final Order **did not place** the Bidder or any affiliate of Bidder on the convicted vendor list. *(Attach a copy of the final order)*
- _____ There has been a subsequent proceeding before a Hearing Officer of the State of Florida, Division of Administrative Hearings and the Final Order entered by the Hearing. The Final Order **placed** the Bidder or any affiliate of Bidder on the convicted vendor list, but the date of the Final Order is **more than 36 months** prior to the date of submission of the Bidder's bid. *(Attach a copy of the final order)*
- _____ There has been a subsequent proceeding before a Hearing Officer of the State of Florida, Division of Administrative Hearings and the Final Order entered by the Hearing. The Final Order **placed** the Bidder or any affiliate of Bidder on the convicted vendor list, but the Bidder (or as applicable the affiliate of Bidder) has since been **removed from the convicted vendor list** in accordance with *Florida Statutes* Section 287.133(3)(f). *(Attach a copy of the final order, and a copy of the order/official agency document granting the petition to remove.)*

I UNDERSTAND THAT THE BIDDER IS REQUIRED TO INFORM THE CITY PRIOR TO ENTERING INTO A CONTRACT IN EXCESS OF THE THRESHOLD AMOUNT PROVIDED IN Section 287.017, *FLORIDA STATUTES*, OF ANY CHANGE IN THE INFORMATION CONTAINED IN THIS AFFIDAVIT.

Signed: _____

Date signed: _____

STATE OF _____
COUNTY OF _____

Sworn to and subscribed before me in the state and county referenced above on this ____ day of _____, 20__, by ____, who *(circle one)* took an oath/is personally known to me.

Notary Public

My commission expires

MEMORANDUM OF CONTRACT

This Memorandum of Contract is executed this _____ day of _____, 20____, by the undersigned, as representative of _____ ("Vendor"), hereby confirms that:

1. Vendor submitted a Bid Proposal, dated _____, in response to the Invitation to Bid ("ITB") No. 19202 issued by the City of Daytona Beach ("the City"); and
2. As expressly stated in the Bid Proposal, the Bid Proposal constituted an offer to enter into a contract, incorporating all of the terms and conditions of the ITB, the Bid Proposal, and all other documents contained or referenced therein (hereinafter, the "Contract Documents"); and
3. The Bid Proposal expressly provided that the City may accept the offer through the adoption of a Resolution by the Daytona Beach City Commission; and
4. The City has accepted Vendor's offer through issuance of the attached Resolution; and
5. As referenced in the Contract Documents, the Effective Date of the Contract is _____, being the date of bid award by the Daytona Beach City Commission.
6. The Bid Proposal was to provide Biosolids Dewatering Equipment purchase at the price set forth in the Bid Proposal; and

Signed this _____ day of _____, 20____.

By: _____

Printed Name: _____

Title: _____



THE CITY OF DAYTONA BEACH

**WESTSIDE REGIONAL WATER RECLAMATION FACILITY DEWATERING SYSTEM
IMPROVEMENTS**

BIOSOLIDS DEWATERING EQUIPMENT

INVITATION TO BID NO. 19202

**VOLUME 1 OF 1
(Specifications Divisions 1 to 17)**

ISSUED FOR BID

JANUARY 2019

**THE CITY OF DAYTONA BEACH UTILITIES DEPARTMENT
ENGINEERING DIVISION
P.O. BOX 2451
DAYTONA BEACH, FLA. 32115**



CITY OF DAYTONA BEACH
WESTSIDE REGIONAL WATER RECLAMATION FACILITY BIOSOLIDS DEWATERING
IMPROVEMENTS
DEWATERING EQUIPMENT PROCUREMENT
BID SET SUBMITTAL

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AND CONDITIONS OF THE CONTRACT**

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	SPECIAL INSTRUCTION SHEET
	SUBMITTAL CHECKLIST
	BID PROPOSAL LETTER
	BID SCHEDULE
	NONCOLLUSION AFFIDAVIT OF PRIME BIDDER
	DRUG-FREE WORKPLACE CERTIFICATION
	AFFIDAVIT ON PUBLIC ENTITY CRIMES
	LOCAL VENDOR AFFIDAVIT
	MINORITY AND WOMEN OWNED BUSINESS ENTERPRISE OFFICER CERTIFICATION FORM
	PROJECT-SPECIFIC CONSTRUCTION CONTRACT
	GENERAL CONDITIONS

DIVISION 01 – GENERAL REQUIREMENTS

SECTION NO.	TITLE
01010	SUMMARY OF WORK
01330	SUBMITTAL PROCEDURES
01410	REGULATORY REQUIREMENTS
01600	PRODUCT REQUIREMENTS
01610	PROJECT DESIGN CRITERIA
01756	TESTING, TRAINING, AND FACILITY START-UP
01770	CLOSEOUT PROCEDURES
01782	OPERATION AND MAINTENANCE DATA

CITY OF DAYTONA BEACH
WESTSIDE REGIONAL WATER RECLAMATION FACILITY BIOSOLIDS DEWATERING
IMPROVEMENTS

DEWATERING EQUIPMENT PROCUREMENT

BID SET SUBMITTAL

DIVISION 11 - EQUIPMENT

SECTION NO.	TITLE
11246	POLYMER BLENDING AND FEED EQUIPMENT-LIQUID
11362	BELT FILTER PRESS

DIVISION 14 – CONVEYING SYSTEMS

SECTION NO.	TITLE
14555	SHAFTLESS SCREW CONVEYORS

DIVISION 15 - MECHANICAL

SECTION NO.	TITLE
15050	COMMON WORK RESULTS FOR MECHANICAL EQUIPMENT
15075	EQUIPMENT IDENTIFICATION
15958	MECHANICAL EQUIPMENT TESTING

DIVISION 16 - ELECTRICAL

SECTION NO.	TITLE
16050	BASIC ELECTRICAL MATERIALS AND METHODS
16405	ELECTRIC MOTORS
16485	VARIABLE FREQUENCY DRIVES

DIVISION 17 - INSTRUMENTATION AND CONTROLS

SECTION NO.	TITLE
17000	INSTRUMENTATION AND CONTROLS

APPENDIX A	05120 – STRUCTURAL STEEL
	05140 – STRUCTURAL ALUMINUM
	05190 – MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY
	09910 – PAINTING
	09960 – HIGH PERFORMANCE COATINGS

SECTION 01010

SUMMARY OF WORK

PORTIONS PERTAINING TO THE INSTALLING CONTRACTOR IN THESE SPECIFICATIONS IS PROVIDED TO THE EQUIPMENT MANUFACTURERS FOR INFORMATIONAL PURPOSES ONLY.

EQUIPMENT MANUFACTURERS WILL SUBMIT BIDS FOR EQUIPMENT ONLY UNDER THIS SOLICITATION.

INSTALLING CONTRACTOR (CONSTRUCTION) WILL BE CONTRACTED UNDER A SEPARATE SOLICITATION.

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Identification and summary description of the Project, the Equipment, location and coordination.
- B. Project includes construction of new dewatering system at the existing dewatering building:
 - 1. Currently 3 belt filter presses (BFPs) and a conveyor system (horizontal, inclined and truck loading conveyors) are located on the second floor of the dewatering building. The sludge feed pumps and polymer system is located on the first floor. The sludge feed pumps are currently not used. Waste activated sludge (WAS) is directly pumped from the RAS/WAS pump station using dedicated WAS pumps to the BFPs on the second floor. Polymer solution is injected into the piping on the first floor as shown on the drawings.
 - 2. The new dewatering system improvements will include installing 2 new 3-belt BFPs and associated conveyor system (horizontal and inclined conveyors) on the first floor of the building. The two new BFPs will have a one set of horizontal and inclined conveyors. These conveyors will transfer dewatered cake into a new truck unloading conveyor. Space is reserved for two future identical BFPs and their associated horizontal and inclined conveyors. Two (2) new skid mounted polymer blending units will be installed near the new BFPs to add polymer. The existing sludge feed pumps will be relocated as shown on the drawings. A new tote based polymer storage system will be constructed just outside of the building on the North side. All interconnecting piping, structural, electrical and controls will be provided. A new electrical room will be constructed on the first floor to house of necessary electrical gear to support the dewatering system equipment.

1.02 THE EQUIPMENT (FOR EQUIPMENT SUPPLIER/MANUFACTURER)

- A. Includes supply of the following equipment:
 - 1. Two (2) 3-belt belt filter presses (BFPs) for dewatering waste activated sludge. See Specification Section 11362 for more details.
 - 2. Two (2) Skid-mounted, Emulsion Polymer Blending Units to feed a polymer solution to the BFP (one per BFP). See Specification Section 11246 for more details.

3. One (1) horizontal, One (1) inclined shaftless screw conveyor complete with supports, chutes and hoppers. See Specification Section 14555 for more details.
 4. One shaftless screw truck unloading conveyor. The unloading conveyor will receive the dewatered cake from the set of horizontal and inclined conveyor system as shown on the drawings. See Specification Section 14555 for more details.
- B. Include with the supply of each equipment described above the following as applicable:
1. Instrumentation, Controls and Programming as specified herein.
 2. Special tools and spare parts as specified herein.
 3. Field Quality Control, Testing, Inspection and Training as specified herein.
 4. Operations and Maintenance Manuals as specified herein.
 5. Freight cost (FOB – Destination).
 6. Warranty as specified herein.
- C. The BFP MANUFACTURER shall be responsible for coordination of the BFPs with the selected MANUFACTURER's of the Polymer Blending Units and the Conveyor system for all space planning, instrumentation, controls and programming requirements. The MANUFACTURER'S of the Polymer Blending Units and Conveyor system shall cooperate and coordinate with the BFP MANUFACTURER as required to ensure a fully functional and operational system.

1.03 INSTALLATION UNDER SEPARATE CONTRACT (FOR INFORMATION ONLY)

- A. The project includes construction of dewatering system improvements at the Westside Regional Water Reclamation Facility inside an existing dewatering building as shown on the drawings and specified herein. The Installing Contractor will be selected under a separate solicitation and will be responsible for the construction of the dewatering system improvements.
- B. Specific items included in the Project include, but are not limited to, the following:
1. Contractor Mobilization and Demobilization.
 2. Sludge Dewatering Improvements:
 - a. Remove and demolish existing equipment and various piping, conduits, panels on the first floor of the dewatering building including relocation of the existing sludge feed pumps as indicated on the drawings to allow construction of the dewatering improvements project.
 - b. Demolition of walls of the existing building on the first floor and installation of roll-up doors as shown on the drawings.
 - c. Construct a new climate controlled electrical room on 1st floor as shown on the drawings.
 - d. Install new MCC-3, sludge feed pump VFDs, conveyor control panels, and Owner furnished BFP control panels.
 - e. Install new Owner furnished conveyor system.
 - f. Install new Owner furnished 3-belt BFPs.
 - g. Install new Owner furnished polymer blending units and all associated piping.
 - h. Relocate and install existing pumps to feed sludge to the new dewatering BFPs. Coordinate with Owner as necessary before and during relocation.
 - i. Construct new polymer tote storage area as shown on the drawings.

- j. Integrate BFP and conveyor programming into Owner furnished BFP Master Control Panel (PCP-DW).
 - k. Pour new BFP containment area walls and pour new BFP supports.
 - l. Cut existing floor for new floor drains.
 - m. Fill all recessed areas with concrete as indicated on the drawings.
 - n. Install all new sludge and polymer piping as indicated in the drawings.
 - o. Paint walls of the new belt press room on the first floor.
 - p. Set up a rental 2.2 meter 3-belt trailer-mounted BFP with a feed pump, polymer storage and feed, washwater pump and loading conveyor to allow for taking the existing dewatering operation offline and be available for construction modifications. The time for the rental unit will be determined by the installing CONTRACTOR. Installing Contractor shall be required to provide a unit price for monthly rental on the bid form.
 - q. Remove and demolish all equipment associated with the four existing BFPs including hydraulic pump units, control panels, and alarm panel as shown on the drawings, located on the second floor of the existing dewatering building (Additive Bid Item).
 - r. Remove and demolish MCC-3 and other electrical items as shown on the drawings (Additive Bid Item).
 - s. Demolish existing BFP containment area, and BFP supports, odor control piping, sludge piping, panels etc. on the second floor as shown on the drawings. (Additive Bid Item).
- C. Except as specifically noted otherwise, provide and pay for:
- 1. Insurance and bonds.
 - 2. Labor, materials, and equipment.
 - 3. Tools, equipment, and machinery required for construction.
 - 4. Utilities required for construction.
 - 5. Temporary facilities as necessary.
 - 6. Erosion and dust control measures.
 - 7. Other facilities and services necessary for proper execution and completion of the Work.
- D. Owner will provide and pay for all water used for flushing, testing, and start-up activities.
- E. Comply with codes, ordinances, regulations, orders, and other legal requirements of public authorities having bearing on the performance of the Work.

1.04 LOCATION

- A. The Work and Project is located at Westside Regional Water Reclamation Facility, located at 3651 LPGA Blvd., Daytona Beach, FL 32124.

1.05 COORDINATION BETWEEN SELECTED EQUIPMENT MANUFACTURER AND SELECTED CONTRACTOR

- A. The minimum clearance requirements specified in the Contract Documents shall not relieve each EQUIPMENT MANUFACTURER from allowing additional clearances for the proper installation, operation, and maintenance of the units. The Contract Drawings only show a general layout. The EQUIPMENT MANUFACTURER shall be fully responsible to take field measurements and coordinate with the Installing CONTRACTOR, ENGINEER AND OWNER before fabrication of all equipment to

prepare a proper layout to provide sufficient access for operation and maintenance. Adequate space shall be maintained for future equipment as shown on the Contract Drawings. EQUIPMENT MANUFACTURER shall submit to the ENGINEER for approval a detailed layout of all equipment as a whole as part of the shop drawing submittal for approval.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements and procedures for submittals.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

1.02 DEFINITIONS

- A. EQUIPMENT MANUFACTURER: Manufacturer of following equipment
 - 1. BFP Manufacturer: Manufacturer of the 3-belt Belt Filter Presses and associated controls.
 - 2. Polymer Blending Unit Manufacturer: Manufacturer of skid mounted pre-piped polymer blending units with controls.
 - 3. Conveyor MANUFACTURER: Manufacturer of the entire conveyor system.
- B. INSTALLING CONTRACTOR: The Installing Contractor (services of whom will be procured under a separate solicitation) will coordinate the delivery, storage and handling of all equipment. The installing Contractor shall install all equipment, coordinate with the manufacturer and assist in testing and start-up of all equipment as shown on the drawings. Installing contractor shall construct all necessary, site/civil, structural, electrical, HVAC, plumbing and instrumentation controls as necessary to provide a complete dewatering system.
- C. Certificates: Describe certificates that document affirmations by the EQUIPMENT MANUFACTURER, installing Contractor or other entity that the work is in accordance with the Contract Documents.
- D. Extra stock materials: Describe extra stock materials to be provided for the Owner's use in facility operation and maintenance.
- E. Maintenance material submittals: Use this article to categorize maintenance materials submittals requiring no action by the ENGINEER other than confirmation of receipt under an explanatory heading.
- F. Manufacturer's instructions: Instructions, stipulations, directions, and recommendations issued in printed form by the manufacturer of a product addressing handling, installation, erection, and application of the product; manufacturer's instructions are not prepared especially for the Work.
- G. Product data: Product data usually consists of manufacturers' printed data sheets or catalog pages illustrating the products to be incorporated into the project.

- H. Samples: Samples are full-size actual products intended to illustrate the products to be incorporated into the project. Sample submittals are often necessary for such characteristics as colors, textures, and other appearance issues.
- I. Spare parts: Describe spare parts necessary for the Owner's use in facility operation and maintenance; identify the type and quantity here, but include the actual characteristics of the spare parts in Product as part of the specification of the product.
- J. Shop drawings: Shop drawings are prepared specifically for the project to illustrate details, dimensions, and other data necessary for satisfactory fabrication or construction that are not shown in the contract documents. Shop drawings could include graphic line-type drawings, single-line diagrams, or schedules and lists of products and their application.
- K. Submittals: Submittals are samples, product data, shop drawings, and others that demonstrate how the EQUIPMENT MANUFACTURER intends to conform to the Contract Documents.
- L. Tools: Tools are generally defined as items such as special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the Owner's tool kit.

1.03 GENERAL INSTRUCTIONS

- A. Provide submittals that are specified in these specifications.
- B. Provide submittal information from only 1 manufacturer for a specified product. Submittals with multiple manufacturers for 1 product will be rejected without review.
- C. Edit all submittals so that the submittal specifically applies to only the equipment furnished. Neatly cross out all extraneous text, options, models, etc. that do not apply to the equipment being furnished, so that the information remaining is only applicable to the equipment being furnished.
- D. Prepare submittals in the English language. Do not include information in other languages.
- E. Present measurements in customary American units (feet, inches, pounds, etc.).
- F. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.
- G. Where multiple submittals are required, provide a separate submittal for each specification section:
 - 1. The EQUIPMENT MANUFACTURER may make more than 1 submittal per specification section, but a single submittal may not cover more than 1 specification section:
 - 2. The only exception to this requirement is when 1 specification section covers the requirements for a component of equipment specified in another section:
 - a. For example, circuit breakers are a component of switchgear. The switchgear submittal must also contain data for the associated circuit

breakers, even though they are covered in a different specification section.

1.04 SUBMITTAL CONTENTS

- A. Submittal Transmittal Form is provided in Attachment No. 1 of this Section:
 - 1. Substitute forms require Engineer approval based on forms providing the same information, statements, and certifications.
 - 2. Required submittal numbering format: Section number-sequential number-resubmittal number:
 - a. Example: 03200-002-1:
 - 1) "03200" indicates the affected specification is Section 03200.
 - 2) "002" indicates the second submittal under this Section.
 - 3) "1" indicates the first resubmittal of the Submittal 03200-002.
 - 3. Specification section: Include with each submittal a copy of the relevant specification section, including relevant addendum updates.
 - a. Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (✓) or deviation with a consecutive number (1, 2, 3).
 - b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
 - 4. Drawings: Include with each submittal a copy of the relevant Drawing, including relevant addendum updates:
 - a. Indicate either compliance with a check (✓) or deviation with a consecutive number (1, 2, 3).
 - b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
 - c. Provide field dimensions and relationship to adjacent or critical features of the Work or materials.
 - 5. Other information or materials as needed.

1.05 SUBMITTAL FORMAT

- A. Fully indexed with a tabbed divider for every component.
- B. Sequentially number pages within the tabbed sections:
 - 1. Submittals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.
- C. Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.
- D. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is used.
- E. Attachments:
 - 1. Specification section: Include with each submittal a copy of the relevant specification section.
 - a. Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (✓) or deviation with a consecutive number (1, 2, 3).

- b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
 - 2. Drawings: Include with each submittal a copy of the relevant Drawing, including relevant addendum updates:
 - a. Indicate either compliance with a check (✓) or deviation with a consecutive number (1, 2, 3).
 - b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
 - c. Provide field dimensions and relationship to adjacent or critical features of the Work or materials.
- F. EQUIPMENT MANUFACTURER: Prepare submittal information in sufficient detail to show compliance with specified requirements:
 - 1. Determine and verify quantities, field dimensions, product dimensions, specified design and performance criteria, materials, catalog numbers, and similar data.
 - 2. Coordinate submittal with other submittals and with the requirements of the Contract Documents.
- G. Check, verify, and revise submittals as necessary to bring them into conformance with Contract Documents and actual field conditions.
- H. Consolidate electronic format submittals with multiples pages into a single file.

1.06 SUBMITTAL METHOD

- A. Submittals in electronic media format:
 - 1. General: Provide all information in PC-compatible format using Windows® operating system as utilized by the Owner and Engineer.
 - 2. Text: Provide text documents and manufacturer's literature in Portable Document Format (PDF).
 - 3. Graphics: Provide graphic submittals (drawings, diagrams, figures, etc.) utilizing Portable Document Format (PDF).

1.07 SUBMITTAL PROCEDURE

- A. EQUIPMENT MANUFACTURER: Prepare submittal information in sufficient detail to show compliance with specified requirements:
 - 1. Determine and verify quantities, field dimensions, product dimensions, specified design and performance criteria, materials, catalog numbers, and similar data.
 - 2. Coordinate submittal with other submittals and with the requirements of the Contract Documents.
 - 3. Check, verify, and revise submittals as necessary to bring them into conformance with Contract Documents and actual field conditions.
- B. EQUIPMENT MANUFACTURER: stamp, sign and date submittals indicating review and approval:
 - 1. Signature indicates EQUIPMENT MANUFACTURER has satisfied submittal review responsibilities and constitutes EQUIPMENT MANUFACTURER's written approval of submittal.
 - 2. Submittals without EQUIPMENT MANUFACTURER's signature will be returned to the EQUIPMENT MANUFACTURER (as applicable) un-reviewed.

Subsequent submittal of this information will be counted as the first resubmittal.

3. Submittal with EQUIPMENT MANUFACTURER signature but that clearly have not received a thorough review by the EQUIPMENT MANUFACTURER will be returned un-reviewed.

C. EQUIPMENT MANUFACTURER: Send submittal to ENGINEER:

1. Provide specified number of copies of submittal.
2. Delivery: Deliver submittals to ENGINEER electronically. However, should a particular submittal element require mailing, deliver submittals to ENGINEER at 200 East Robinson Street, Suite 1400, Orlando, FL 32801, attn: Carollo Engineers, Inc., unless another mutually agreeable place is designated.
3. Timeliness: Schedule and make submissions in accordance with the requirements of the individual specification sections and in such as sequence as to cause no delay in Work.
4. EQUIPMENT MANUFACTURER assumes risk of expense and delays when proceeding with work related to required submittals without review and acceptance.

D. Engineer: Review submittal and provide response:

1. Review description:
 - a. Engineer will be entitled to rely upon the accuracy or completeness of designs, calculations, or certifications made by licensed professionals accompanying a particular submittal whether or not a stamp or seal is required by Contract Documents or Laws and Regulations.
 - b. Engineer's review of submittals shall not release EQUIPMENT MANUFACTURER from EQUIPMENT MANUFACTURER's responsibility for performance of requirements of Contract Documents. Neither shall Engineer's review release EQUIPMENT MANUFACTURER from fulfilling purpose of installation nor from EQUIPMENT MANUFACTURER's liability to replace defective work.
 - c. Engineer's review of shop drawings, samples, or test procedures will be only for conformance with design concepts and for compliance with information given in Contract Documents.
 - d. Engineer's review does not extend to:
 - 1) Accuracy of dimensions, quantities, or performance of equipment and systems designed by EQUIPMENT MANUFACTURER's.
 - 2) EQUIPMENT MANUFACTURER's means, methods, techniques, sequences, or procedures except when specified, indicated on the Drawings, or required by Contract Documents.
 - 3) Safety precautions or programs related to safety which shall remain the sole responsibility of the EQUIPMENT MANUFACTURER's.
 - e. Engineer can accept or reject any exception at their sole discretion.
2. Review timeframe:
 - a. Except as may be provided in technical specifications, a submittal will be returned within 30 days.
 - b. When a submittal cannot be returned within the specified period, Engineer will, within a reasonable time after receipt of the submittal, give notice of the date by which that submittal will be returned.
 - c. Critical submittals:
 - 1) EQUIPMENT MANUFACTURER will notify Engineer in writing that timely review of a submittal is critical to the progress of Work.

- d. Engineer will provide decision on request:
 - 1) Written acceptance of request:
 - a) Written agreement by Engineer to reduce submittal review time will be made only for unusual situations.
 - 2) Written rejection of request.
- 3. Schedule delays:
 - a. No adjustment of Contract Times or Contract Price will be allowed due to Engineer's review of submittals, unless all of the following criteria are met:
 - 1) Engineer has failed to review and return first submission within the agreed upon time frame.
 - 2) EQUIPMENT MANUFACTURER demonstrates that delay in progress of Work is directly attributable to Engineer's failure to return submittal within time indicated and accepted by Engineer.
- 4. Review response will be returned to EQUIPMENT MANUFACTURER with one of the following dispositions:
 - a. Approved:
 - 1) No Exceptions:
 - a) There are no notations or comments on the submittal and the EQUIPMENT MANUFACTURER may release the equipment for production.
 - 2) Make Corrections Noted - See Comments:
 - a) The EQUIPMENT MANUFACTURER may proceed with the work, however, all notations and comments must be incorporated into the final product.
 - b) Resubmittal not required.
 - 3) Make Corrections Noted - Confirm:
 - a) The EQUIPMENT MANUFACTURER may proceed with the work, however, all notations and comments must be incorporated into the final product.
 - b) Submit confirmation specifically addressing each notation or comment to the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.
 - b. Not approved:
 - 1) Correct and resubmit:
 - a) EQUIPMENT MANUFACTURER may not proceed with the work described in the submittal.
 - b) EQUIPMENT MANUFACTURER assumes responsibility for proceeding without approval.
 - c) Resubmittal of complete submittal package is required within 30 calendar days of the date of the Engineer's submittal review response.
 - 2) Rejected - See Remarks:
 - a) EQUIPMENT MANUFACTURER may not proceed with the work described in the submittal.
 - b) The submittal does not meet the intent of the Contract Documents. Resubmittal of complete submittal package is required with materials, equipment, methods, etc. that meet the requirements of the Contract Documents.
 - 3) Receipt acknowledged: Filed for record:
 - a) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as

schedules and work plans, conformance test reports, health and safety plans, etc.

- E. EQUIPMENT MANUFACTURER: Prepare resubmittal, if applicable:
1. Clearly identify each correction or change made.
 2. Include a response in writing to each of the Engineer's comments or questions for submittal packages that are resubmitted in the order that the comments or questions were presented throughout the submittal:
 - a. Acceptable responses to Engineer's comments are listed below:
 - 1) "Incorporated" Engineer's comment or change is accepted and appropriate changes are made.
 - 2) "Response" Engineer's comment not incorporated. Explain why comment is not accepted or requested change is not made. Explain how requirement will be satisfied in lieu of comment or change requested by Engineer.
 - b. Reviews and re-submittals:
 - 1) Suppliers shall provide re-submittals which include responses to all submittal review comments separately and at a level of detail commensurate with each comment.
 - 2) Supplier responses shall indicate how the supplier resolved the issue pertaining to each review comment. Responses such as "acknowledged" or "noted" are not acceptable.
 - 3) Re-submittals which do not comply with this requirement may be rejected and returned without review.
 - 4) Submittal review comments not addressed by the EQUIPMENT MANUFACTURER in re-submittals shall continue to apply whether restated or not in subsequent reviews until adequately addressed by the EQUIPMENT MANUFACTURER to the satisfaction of the reviewing and approving authority.
 - c. Any resubmittal that does not contain responses to the Engineer's previous comments shall be returned for Revision and Resubmittal. No further review by the Engineer will be performed until a response for previous comments has been received.
 3. Re-submittal timeframe:
 - a. EQUIPMENT MANUFACTURER shall provide re-submittal within 15 days.
 - b. When a re-submittal cannot be returned within the specified period, EQUIPMENT MANUFACTURER shall notify Engineer in writing.
 4. Review costs:
 - a. Costs incurred by Owner as a result of additional reviews of a particular submittal after the second time it has been reviewed shall be borne by the EQUIPMENT MANUFACTURER.
 - b. Reimbursement to Owner will be made by deducting such costs from EQUIPMENT MANUFACTURER subsequent progress payments.

1.08 SUBMITTALS

- A. General:
1. Number of copies: 3 when a submittal element cannot be submitted electronically:
 - a. Owner: 2 copies.
 - b. ENGINEER: 1 copy.

- B. Shop Drawings:
 - 1. EQUIPMENT MANUFACTURER to field verify elevation, coordinates, and pipe material for pipe tie-in prior to the preparation of shop drawings.
 - 2. Details:
 - a. Fabrication drawings: drawn to scale and dimensioned.
 - b. Front, side, and, rear elevations, and top and bottom views, showing all dimensions.
 - c. Locations of conduit entrances and access plates.
 - d. Component layout and identification.
 - e. Weight.
 - f. Finish.
 - g. Temperature limitations, as applicable.
 - h. Nameplate information.
 - 3. Minor or incidental products and equipment schedules:
 - a. Details:
 - 1) Shop Drawings of minor or incidental fabricated products will not be required, unless requested.
 - 2) Submit tabulated lists of minor or incidental products showing the names of the manufacturers and catalog numbers, with Product Data and Samples as required to determine acceptability.
- C. Product Information:
 - 1. Product Data:
 - a. Details:
 - 1) Supplier name and address.
 - b. Include:
 - 1) Catalog cuts.
 - 2) Bulletins.
 - 3) Brochures.
 - 4) Manufacturer's Certificate of Compliance: signed by product manufacturer along with supporting reference data, affidavits, and tests, as appropriate.
 - 5) Manufacturer's printed recommendations for installation of equipment.
 - 6) Quality photocopies of applicable pages from manufacturer's documents.
 - 2. Completely fill out a Motor Data Sheet, as specified in Section 16405, for every motor furnished:
 - a. Submit one copy of the Motor Data Sheet to the Engineer for review as part of the associated equipment submittal.
 - 3. Samples:
 - a. Number of samples: 3 minimum.
 - b. Details:
 - 1) Submit labeled samples.
 - 2) Samples will not be returned.
 - 3) Provide samples from manufacturer's standard colors, materials, products, or equipment lines:
 - a) Clearly label samples to indicate any that represent non-standard colors, materials, products, or equipment lines and that if selected, will require an increase in Contract Time or Contract Price.

4. Minor or incidental products and equipment schedules:
 - a. Details:
 - 1) Shop Drawings of minor or incidental fabricated products will not be required, unless requested.
 - 2) Submit tabulated lists of minor or incidental products showing the names of the manufacturers and catalog numbers, with Product Data and Samples as required to determine acceptability.
- D. Design calculations:
 1. Details:
 - a. Defined in technical sections.
 - b. Calculations must bear the original seal and signature of a Professional Engineer licensed in the state where the project is located and who provided responsible charge for the design.
- E. Qualifications Statements:
 1. Details:
 - a. Defined in technical sections.
 - b. Licensing documentation.
 - c. Certification documentation.
 - d. Education documentation.
- F. Quality assurance/control submittals:
 1. Mill test reports:
 - a. Details:
 - 1) Submit certified copies of factory and mill test reports.
 - 2) Do not incorporate Products in the Work which have not passed testing and inspection satisfactorily.
 - 3) Pay for mill and factory tests.
 2. Test reports:
 - a. Details:
 - 1) Include the following information:
 - a) A description of the test.
 - b) List of equipment used.
 - c) Name of the person conducting the test.
 - d) Date and time the test was conducted.
 - e) Ambient temperature and weather conditions.
 - f) All raw data collected.
 - g) Calculated results.
 - h) Clear statement if the test passed or failed the requirements stated in Contract Documents.
 - i) Signature of the person responsible for the test.
 3. Factory Acceptance Test:
 - a. Details: Include complete test procedure and all forms to be used during test.
 4. Certificates:
 - a. Details: Defined in technical sections.
 5. Manufacturers' field reports:
 - a. Details: Certificate of proper installation.
 6. Field Samples:
 - a. Details: Defined in technical sections.

- 7. Test Plans:
 - a. Details: Defined in technical sections.

1.09 CLOSEOUT SUBMITTALS

- A. Provide closeout submittals as specified in Section 01770.
- A. Operation and Maintenance Manuals: final documents shall be submitted as specified in Section 01782.
- B. Extra materials, spare parts, etc.: Submittal forms shall indicate when actual materials are submitted.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

EQUIPMENT MANUFACTURER SUBMITTAL TRANSMITTAL FORM



**EQUIPMENT MANUFACTURER SUBMITTAL
TRANSMITTAL**

Owner: City of Daytona Beach

Submittal Number:

Equipment Manufacturer:

Package Number:

Date:

Project Number:

TO: CAROLLO ENGINEERS Eola Park Center, 200 E. Robinson Center, Suite 1400, Orlando, FL 32801	
From: Enter Name & Address Here	
SPECIFICATION NO.	SUBJECT OF SUBMITTAL / EQUIPMENT SUPPLIER

Check Either (A) or (B):

- ☐ (A) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings with no exceptions.
- ☐ (B) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings except for the following deviations (list deviations):

EQUIPMENT MANUFACTURER's Authorized Signature:

PM/CM Office Use

Date Received GC to PM/CM:

Date Received PM/CM to Reviewer:

Date Received Reviewer to PM/CM:

Date Sent PM/CM to GC:

SECTION 01410
REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Regulatory authorities and codes:
 - 1. Building Code.
 - 2. Electrical Code.
 - 3. Fire Code.
 - 4. Mechanical Code.
 - 5. Plumbing Code.
 - 6. City of Daytona Beach Engineering Standards.

1.02 AUTHORITIES HAVING JURISDICTION

- A. Building Department: City of Daytona Beach.
- B. Fire Department: City of Daytona Beach.

1.03 APPLICABLE CODES

- A. Florida Building Commission (FBC):
 - 1. Building code:
 - a. Florida Building Code: (5th Edition) 2017.
 - 2. Electrical code:
 - a. National Electrical Code: NEC 2017.
 - 3. Energy Conservation:
 - a. Florida Energy Conservation Code – 2017.
 - 4. Fire prevention code:
 - a. Florida Fire Prevention Code - 2017.
 - 5. Fuel gas code:
 - a. Florida Building Code: Fuel Gas - 2017.
 - 6. Mechanical code:
 - a. Florida Building Code: Mechanical - 2017.
 - 7. Plumbing code:
 - a. Florida Building Code: Plumbing Draft - 2017.
 - 8. Test protocols:
 - a. Florida Building Code: Test Protocols for High-Velocity Hurricane Zones 2017.
- B. Local regulatory requirements.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

PORTIONS PERTAINING TO THE INSTALLING CONTRACTOR IN THESE SPECIFICATIONS IS PROVIDED TO THE EQUIPMENT MANUFACTURERS FOR INFORMATIONAL PURPOSES ONLY. EQUIPMENT MANUFACTURERS WILL SUBMIT BIDS FOR EQUIPMENT ONLY UNDER THIS SOLICITATION. INSTALLING CONTRACTOR (CONSTRUCTION) WILL BE CONTRACTED UNDER A SEPARATE SOLICITATION

1.01 SUMMARY

- A. Section includes: Product requirements; product selection; product options and substitutions; quality assurance; delivery, handling, and storage; and manufacturer's instructions.

1.02 DEFINITIONS

- A. Execution: Inclusive of performance, workmanship, installation, erection, application, field fabrication, field quality control, and protection of installed products.
- B. Products: Inclusive of material, equipment, systems, shop fabrications, mixing, source quality control.

1.03 REFERENCES

- A. American National Standards Institute (ANSI).

1.04 PRODUCT REQUIREMENTS

- A. Comply with Specifications and referenced standards as minimum requirements.
- B. Provide products by same manufacturer when products are of similar nature, unless otherwise specified. Note several product specifications name only one supplier and the Installing Contractor in such circumstances shall offer product from the named supplier only. Where one or more suppliers are named, Installing Contractor shall offer products from the named suppliers only.
- C. Provide identical products when products are required in quantity.
- D. Provide products with interchangeable parts whenever possible.
- E. Require each EQUIPMENT MANUFACTURER to have maintenance facilities meeting the following requirements:
 - 1. Minimum 10 years operational experience.
 - 2. Location in continental United States.
 - 3. Equipment and tools capable of making repairs.
 - 4. Staff qualified to make repairs.
 - 5. Inventory of maintenance spare parts.

1.05 PRODUCT SELECTION

- A. When products are specified by standard or specification designations of technical societies, organizations, or associations only, provide products that meet or exceed reference standard and Specifications.
- B. When products are specified with names of manufacturers but no model numbers or catalog designations, provide:
 - 1. Products by one of named manufacturers that meet or exceed Specifications.
 - 2. Products from other manufacturers will not be accepted.
- C. When products are specified with names of manufacturers and model numbers or catalog designations, provide:
 - 1. Products with model numbers or catalog designations by one of named manufacturers.
 - 2. Products from other manufacturers will not be accepted.
- D. When products are specified with names of manufacturers, but with brand or trade names, model numbers, or catalog designations by one manufacturer only, provide:
 - 1. Products specified by brand or trade name, model number, or catalog designation.
 - 2. Product(s) by one of the named manufacturers submitted "as equal" with requirements of the specification shall meet or exceed quality, appearance and performance of specified brand or trade name, model number, or catalog designation.
 - 3. Products from other manufacturers will not be accepted.
- E. When Products are specified with name of manufacturers followed by "or Approved Equal," other manufacturers shall meet the following requirements:
 - 1. Manufacturers not listed in this specifications will need to submit the following to be considered as "Approved Equal" and shall meet the following qualification requirements:
 - a. The manufacturer and the business shall have at least 10 years of experience in the design and manufacture of the equipment. As part of the submittal package described below, the manufacturer shall submit the following:
 - 1) Evidence that equipment of similar capacity and service capability has been in successful operation for at least 5 years in at least 10 separate installations.
 - 2) If above condition is met then comply with the following.
 - 2. Submit the following:
 - a. Submit a written formal request to the Owner for consideration of the product a minimum 10 days before opening of the bids.
 - b. Owner will notify initial opinion and request for additional information within 5 working days of receiving the formal request.
 - c. Owner will notify in writing of decision of acceptance or rejection in an addendum before the opening of the bids.
 - 3. Formal substitution request contents:
 - a. Manufacturer's literature including:
 - 1) Manufacturer's name and address.
 - 2) Product name.
 - 3) Product description.
 - 4) Reference standards.
 - 5) Certified performance and test data of equipment offered for similar service at other full-scale installations.
 - 6) Operation and maintenance data.
 - b. Shop drawings, if available.

- c. Reference projects where the product has been successfully used:
 - 1) Name and address of project.
 - 2) Year of installation.
 - 3) Year placed in operation.
 - 4) Name of product installed.
 - 5) Point of contact: Name and phone number.
- d. Itemized comparison of the proposed substitution with product specified including a list of significant variations:
 - 1) Design features.
 - 2) Design dimensions. Certify the proposed equipment will fit within the existing available space with no modifications to any structures or other equipment and shall have sufficient access on all sides for proper operation and maintenance. Manufacturer shall be fully responsible to field verify all available space.
 - 3) Installation requirements.
 - 4) Operations and maintenance requirements.
- 4. Substitutions will not be considered for acceptance under the following conditions:
 - a. No formal substitution request is made.
 - b. Substitution requests are submitted after the deadline.
- 5. Owner's decision on a substitution requests will be final and binding.
 - a. Approved substitutions will be considered at bid opening.
 - b. Requests for time extensions and additional costs based on submission of, approval of, or rejection of substitutions will not be allowed.

1.06 QUALITY ASSURANCE

- A. Employ entities that meet or exceed specified qualifications to execute the Work.
- B. Inspect conditions before executing subsequent portions of the Work. Accept responsibility for correcting unsatisfactory conditions upon executing subsequent portions of the Work.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.07 DELIVERY, HANDLING, STORAGE, AND PROTECTION

- A. EQUIPMENT MANUFACTURER shall prepare products for shipment by:
 - 1. Applying grease and lubricating oil to bearings and similar items.
 - 2. Separately packing or otherwise suitably protecting bearings.
 - 3. Tagging or marking products to agree with delivery schedule or shop drawings.
 - 4. Including complete packing lists and bills of material with each shipment.
 - 5. Packaging products to facilitate handling and protection against damage during transit, handling, and storage.
 - 6. Securely attach special instructions for proper field handling, storage, and installation to each piece of equipment before packaging and shipment.
 - 7. Coordinate with the Installing Contractor on the timing of the shipment.
- B. Mandatory requirements prior to shipment of equipment:
 - 1. Engineer accepted shop drawings.
 - 2. Engineer accepted Manufacturer's Certificate of Source Testing as specified in Section 01756.
 - 3. Submit draft operations and maintenance manuals, as specified in Section 01782.

- C. EQUIPMENT MANUFACTURER shall transport products by methods that avoid product damage. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.
- D. Installing Contractor shall provide equipment and personnel to handle products by methods to prevent soiling or damage.
- E. Upon delivery, installing Contractor in coordination with the Owner and ENGINEER shall promptly inspect shipments:
 - 1. Verify compliance with Contract Documents, correct quantities, and undamaged condition of products.
 - 2. Immediately store and protect products and materials until installed in Work.
 - 3. Acceptance of shipment does not constitute final acceptance of equipment.
- F. Installing Contractor shall furnish covered, weather-protected storage structures providing a clean, dry, noncorrosive environment for all mechanical equipment, valves, architectural items, electrical and instrumentation equipment and special equipment to be incorporated into this project:
 - 1. Storage of equipment shall be in strict accordance with the "instructions for storage" of each equipment supplier and manufacturer including connection of heaters, placing of storage lubricants in equipment, etc.
 - 2. The EQUIPMENT MANUFACTURER shall furnish a copy of the manufacturer's instructions for storage to the Installing Contractor and ENGINEER prior to storage of all equipment and materials.
 - 3. Corroded, damaged, or deteriorated equipment and parts shall be replaced before acceptance of the project.
 - 4. Equipment and materials not properly stored will not be included in an application for payment.
- G. Installing Contractor shall store products with seals and legible labels intact.
- H. Installing Contractor shall store moisture sensitive products in weathertight enclosures.
- I. Installing Contractor shall maintain products within temperature and humidity ranges required or recommended by manufacturer.
- J. Installing Contractor shall maintain storage areas at ambient temperatures recommended by manufacturer.
- K. Installing Contractor shall protect painted surfaces against impact, abrasion, discoloration, and other damage. Repaint damaged painted surfaces. Installing Contractor shall store all products in a manner to prevent surface oxidation (rust).
- L. Exterior storage of fabricated products:
 - 1. Place on aboveground supports that allow for drainage.
 - 2. Cover products subject to deterioration with impervious sheet covering.
 - 3. Provide ventilation to prevent condensation under covering.
- M. Store loose granular materials on solid surfaces in well-drained area. Prevent materials mixing with foreign matter.
- N. Provide access for inspection.

- O. Installing Contractor shall maintain equipment per the manufacturer's recommendation and industry standards, including oil changes, rotation, etc. Provide a log of equipment maintenance to the Engineer and Plant Superintendent on a monthly basis:
 - 1. Rotation log shall include, as a minimum, the equipment identification, date stored, date removed from storage, copy of manufacturer's recommended storage guidelines, date of rotation of equipment, and signature of party performing rotation.
- P. Protection after installation:
 - 1. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove covering when no longer needed.

1.08 MANUFACTURER'S INSTRUCTIONS FOR INSTALLING CONTRACTOR

- A. Deliver, handle, store, install, erect, or apply products in accordance with manufacturer's instructions, Contract Documents, and industry standards.
- B. Periodically inspect to assure products are undamaged and maintained under required conditions.
- C. Provide operations and maintenance manuals as specified in Section 01782:
 - 1. Draft versions submitted prior to equipment shipment to project.
 - 2. Final version submitted and accepted no later than 60 days prior to Owner training.

1.09 SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

- A. Provide spare parts, maintenance products, and special tools as required by Specifications.
- B. Box, tag, and clearly mark items.
- C. Store spare parts, maintenance products, and special tools in enclosed, weather-proof, and lighted facility during the construction period:
 - 1. Installing Contractor is responsible for spare parts and special tools until acceptance by Owner.
 - 2. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.

PART 2 PRODUCTS

2.01 SPARE PARTS AND SPECIAL TOOLS

- A. Spare parts and special tools inventory list, see Attachment No. 1:
 - 1. Equipment tag number.
 - 2. Equipment manufacturer.
 - 3. Subassembly component, if appropriate.
 - 4. Quantity.
 - 5. Storage location.
- B. Large items:
 - 1. Weight: Greater than 50 pounds.
 - 2. Size: Greater than 24 inches wide by 18 inches high by 36 inches long.
 - 3. Stored individually.

4. Clearly labeled:
 - a. Equipment tag number.
 - b. Equipment manufacturer.
 - c. Subassembly component, if appropriate.
- C. Smaller items:
 1. Weight: Less than 50 pounds.
 2. Size: Less than 24 inches wide by 18 inches high by 36 inches long.
 3. Stored in spare parts box.
 4. Clearly labeled:
 - a. Equipment tag number.
 - b. Equipment manufacturer.
 - c. Subassembly component, if appropriate.
- D. Spare parts and special tools box:
 1. Wooden box:
 - a. Size: 24 inches wide by 18 inches high by 36 inches long.
 2. Hinged wooden cover:
 - a. Strap type hinges.
 - b. Locking hasp.
 - c. Spare parts inventory list taped to underside of cover.
 3. Coating: As specified in Section 09960.
 4. Clearly labeled:
 - a. The words "Spare Parts and/or Special Tools."
 - b. Equipment tag number.
 - c. Equipment manufacturer.

PART 3 EXECUTION

3.01 COMMISSIONING AND PROCESS START-UP

- A. As specified in Section 01756.

3.02 CLOSEOUT ACTIVITIES

- A. Owner may request advanced delivery of spare parts and special tools:
 1. Deduct the delivered items from inventory and provide transmittal documentation.
- B. Immediately prior to the date of Substantial Completion, arrange to deliver spare parts and special tools to Owner (Plant Superintendent) at a location on site chosen by the Owner:
 1. Provide itemized list of spare parts and special tools that matches the identification tag attached to each item.
 2. Owner (Plant Superintendent) and Engineer will review the inventory and the itemized list to confirm it is complete and in good condition prior to signing for acceptance.

3.03 ACCESS BY THE INSTALLING CONTRACTOR, SUBCONTRACTORS, AND ALL REPRESENTATIVES TO THE WESTSIDE REGIONAL WATER RECLAMATION FACILITY

- A. Plant Superintendent must receive a list of all personnel to be admitted to the Facility.
- B. Guard is on duty Monday through Friday from 0630 to 1630 hours.

- C. If under special circumstances the EQUIPMENT MANUFACTURER's and/or Installing Contractor and/or their subcontractors need access to the Facility, after hours when the guard is absent, that access must be granted by the Plant Superintendent.
- D. Plant Superintendent will give special instructions as to how to access the Facility once permission is granted.

3.04 ATTACHMENTS

- A. Attachment No. 1 - Spare Parts and Special Tools Inventory List.

END OF SECTION

Attachment No. 1
SPARE PARTS AND SPECIAL TOOLS INVENTORY LIST

[Specification Number and Title]				
[Equipment Tag Number]				
[Equipment Manufacturer]				
Quantity	Subassembly Component	Description	Manufacturer's Part Number	Storage Location

SECTION 01610

PROJECT DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Project design criteria such as temperature and site elevation.

1.02 PROJECT DESIGN CRITERIA

- A. All equipment and materials for the project are to be suitable for performance in domestic water treatment plant environment and under following conditions:
 - 1. Design temperatures are:
 - a. Outdoor temperatures: 0 to 100 degrees Fahrenheit.
 - 2. Design groundwater elevation: 3 feet below grade.
 - 3. Moisture conditions: Defined in individual equipment sections.
 - 4. Site elevation: Approximately 30 feet above mean sea level.
 - 5. Wind Design Criteria - As noted on Structural Drawings.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01756

TESTING, TRAINING, AND FACILITY START-UP

PART 1 GENERAL

1.01 SUMMARY

- A. The work specified in this SECTION consists of start-up and final check out of Mechanical (all equipment), Electrical, Communications, Pneumatic, Hydraulic, Conveyance or Special Construction or any other discipline as called for by the technical specifications of the Contract Documents. These systems (heating, ventilating, air conditioning, plumbing, fire protection systems, HVAC and control system, communications and alarm systems, lighting, power distribution, controls, and other electrical systems and elevators) and other operating equipment as required; will be demonstrated, to ENGINEER, to operate in the manner prescribed by the Contract Documents to ensure a complete operating system, ready for City of Daytona Beach Utilities Department (OWNER) use.
- B. Section includes: Requirements for equipment and system testing and facility start-up, including the following:
 - 1. Start-up plan.
 - 2. Performance testing.
 - 3. General start-up and testing procedures.
 - 4. Functional testing.
 - 5. Operational testing.
 - 6. Certificate of proper installation.
 - 7. Services of manufacturer's representatives.
 - 8. Training of Owner's personnel.
- C. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Installing Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Installing Contractor's Work.
 - 3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Equipment Manufacturer and the Installing Contractor to see that the completed Work complies accurately with the Contract Documents:
 - a. Section 15050 - Common Work Results for Mechanical Equipment.
 - b. Section 11246 - Polymer Blending and Feed Equipment - Liquid.
 - c. Section 11362 - Belt Filter Press.
 - d. Section 14555 - Shaftless Conveyors.

1.02 DEFINITIONS

- A. Commissioning – The process of planning, testing, and process start-up of the installation for compliance with contract requirements and demonstrating, through

documented verification, that the project has successfully met the Contractual requirements. It includes training the Owner's staff to operate the facility.

- B. Commissioning Phases – The work activities of facility commissioning are grouped into the phases defined in the table below.

Commissioning		
Planning Phase	Testing and Training Phase	Process Start-Up Phase
Owner Training Plan and Schedule	Source Testing	Process Start-up
Commissioning Schedule	Owner Training	Process Operational Period
Subsystem Testing Plan	Installation Testing	Instrumentation and Controls Fine-Tuning
Clean Water Facility Testing Plan	Functional Testing	
	Clean Water Facility Testing	
	Closeout Documentation	

- C. Component – A basic building block of equipment, subsystems, and systems that requires installation or functional testing but does not have an electrical connection or internal electronics. (Examples: Belt filter presses and manual isolation valves).
- D. Device – A basic building block of equipment, subsystems, and systems that requires installation or functional testing and does have an electrical connection or internal electronics. (Examples: pump pressure transmitter).
- E. Equipment – An assembly of component(s) and devices(s) that requires installation or functional testing. (Examples: Pump, motor, VFD, Mechanical Surface Aerators, RAS/WAS Pumps, etc.).
- F. Facility – A grouping of process areas, systems, subsystems, equipment, components, and devices (Examples: treatment plant, pump station, etc.).
- G. Functional Testing – Testing performed on a completed subsystem to demonstrate that equipment/system meets manufacturers' calibration and adjustment requirements and other requirements as specified. Functional testing includes operating equipment/system manually in local, manually in remote (or remote manual), and automatically in remote (in remote auto).
- H. Installation Testing – Testing to demonstrate that subsystem component (piping, power, networks, devices, etc.) is ready and meets the project requirements in advance of functional testing. Installation testing also includes manufacturers' certification of installation and other requirements as specified to prepare equipment/system for Functional Testing. Also referred to as Field Acceptance Testing.

- I. Manufacturer's Certificate of Source Testing – When applicable, the form is used during Source Testing for the manufacturer to confirm that the applicable source tests have been performed and results conform to the Contract Documents. The form is provided at the end of this Section.
- J. Manufacturer's Certificate of Installation and Functionality Compliance – The form is used during Installation Testing and Functional Testing. It is submitted at the end of Functional Testing to confirm that the equipment/system is installed in conformance with the Contract Documents and that it meets the Functional Testing requirements defined in the Contract Documents. The form is provided at the end of this Section.
- K. Process Area – A grouping of systems, subsystems, equipment, components, and devices that divide a facility into functional areas. (Examples: Filter Process Area).
- L. Process Operational Period – A period of time after completion of the process start-up set aside for final Operational Testing to verify facility performance meets the Contract Document requirements. This period may specifically limit other construction activities.
- M. Process Start-up Phase - Operating the facility to verify performance meets the Contract Document requirements.
- N. Process Start-Up – Activities conducted after the testing and training phase that are necessary to place systems or process areas into operational service.
- O. Product – A system, subsystem, or component.
- P. Subsystem – A building block of systems made up from a grouping of components, devices, and equipment that perform a definable function. (Examples: Filter No. 1).
- Q. System – A grouping of subsystems, equipment, components, and devices that perform a definable function. (Examples: Filter No. 1, RAS Pumping).

1.03 GENERAL TESTING, TRAINING, AND START-UP REQUIREMENTS

- A. Contract requirements: Testing, training, and start-up are requisite to the satisfactory completion of the Contract.
- B. Complete testing, training, and start-up within the Contract Times.
- C. Allow realistic durations in the Progress Schedule for testing, training, and start-up activities.
- D. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing.
- E. Provide competent, experienced technical representatives of equipment manufacturers for assembly, installation and testing guidance, and operator training.

1.04 START-UP PLAN

- A. BFP MANUFACTURER working with the Polymer Blending Unit manufacturer and the conveyor manufacturer and the Installing Contractor shall submit start-up plan for each piece of equipment and each system not less than 3 weeks prior to planned initial start-up of equipment or system. BFP MANUFACTURER will take a lead on this.
- B. Provide detailed sub-network of Progress Schedule with the following activities identified:
 - 1. Manufacturer's services.
 - 2. Installation certifications.
 - 3. Operator training.
 - 4. Submission of Operation and Maintenance Manual.
 - 5. Functional testing.
 - 6. Performance testing.
 - 7. Operational testing.
- C. Provide testing plan with test logs for each item of equipment and each system when specified. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.
- D. Provide summary of shutdown requirements for existing systems that are necessary to complete start-up of new equipment and systems.
- E. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.05 PERFORMANCE TESTING

- A. BFP MANUFACTURER working with the Polymer Blending Unit manufacturer and the conveyor manufacturer and the Installing Contractor shall test equipment for proper performance at point of manufacture or assembly when specified. BFP MANUFACTURER will take a lead on this.
- B. When source quality control testing is specified:
 - 1. Demonstrate equipment meets specified performance requirements.
 - 2. Provide certified copies of test results.
 - 3. Do not ship equipment until certified copies have received written acceptance from Engineer. Written acceptance does not constitute final acceptance.
 - 4. Perform testing as specified in the equipment sections.

1.06 GENERAL START-UP AND TESTING PROCEDURES

- A. Performed by Installing Contractor under direction/supervision of BFP Manufacturer's Representative/Technician.
- B. Mechanical systems: As specified in the individual equipment sections and Section 15050:
 - 1. Remove rust preventatives and oils applied to protect equipment during construction.
 - 2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.

3. Flush fuel system and provide fuel for testing and start-up.
4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
7. Perform cold alignment and hot alignment to manufacturer's tolerances.
8. Adjust V-belt tension and variable pitch sheaves.
9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to insure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.
10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
11. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.

C. Electrical systems: See Division 16 specifications.

D. Instrumentation systems: See Division 17 specifications.

1.07 FUNCTIONAL TESTING

- A. Installing Contractor shall perform checkout and performance testing as specified in the individual equipment sections (performed by the Installing Contractor under direction/supervision of BFP Manufacturer's Representative/Technician).
- B. Functionally test mechanical and electrical equipment, and instrumentation and controls systems for proper operation after general start-up and testing tasks have been completed.
- C. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of and with the assistance of the manufacturer's representative.
- D. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation, and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.
- E. Conduct continuous 8-hour test under full load conditions. Replace parts that operate improperly.

1.08 OPERATIONAL TESTING

- A. After completion of operator training, conduct operational test of the entire dewatering system. Demonstrate satisfactory operation of equipment and systems in actual operation. (Performed by the Installing Contractor under direction/supervision of BFP Manufacturer's Representative/Technician). Installing Contractor shall coordinate with BFP MANUFACTURER as necessary.
- B. Owner will provide operations personnel, power, fuel, and other consumables for duration of test.

- C. Immediately correct defects in material, workmanship, or equipment that became evident during operational test.
- D. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.09 CERTIFICATE OF PROPER INSTALLATION

- A. At completion of Functional Testing, BFP MANUFACTURER working with the Polymer Blending Unit manufacturer and the conveyor manufacturer and the Installing Contractor shall furnish written report prepared and signed by manufacturer's authorized representative, certifying equipment:
 - 1. Has been properly installed, adjusted, aligned, and lubricated.
 - 2. Is free of any stresses imposed by connecting piping or anchor bolts.
 - 3. Is suitable for satisfactory full-time operation under full load conditions.
 - 4. Operates within the allowable limits for vibration.
 - 5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.
 - 6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown have been tested and are properly functioning.
- B. BFP MANUFACTURER working with the Polymer Blending Unit manufacturer and the conveyor manufacturer and the Installing Contractor shall furnish written report prepared and signed by the electrical and/or instrumentation subcontractor certifying:
 - 1. Motor control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.
 - 2. Control logic for equipment start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly operating.
 - 3. Co-sign the reports along with the manufacturer's representative and subcontractors.

1.10 SERVICES OF EQUIPMENT MANUFACTURER'S REPRESENTATIVES

- A. Qualification of manufacturer's representative as specified in the Contract Documents technical sections include the following:
 - 1. Authorized representative of the manufacturer, factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment/system with full authority by the equipment/system manufacturer to issue the certifications required of the manufacturer.
 - 2. Competent, experienced technical representative of equipment/system manufacturer for assembly, installation, testing guidance, and training.
 - 3. Additional qualifications may be specified in the individual sections.
 - 4. Submit qualifications of the manufacturer's representative no later than 30 days in advance of required observations.
 - 5. Representative subject to approval by Owner and Engineer.
 - 6. No substitute representatives will be allowed until written approval by Owner and Engineer has been obtained.
- B. Completion of manufacturer on-site services: Engineer approval required.

- C. Manufacturer is responsible for determining the time required to perform the specified services:
 - 1. Minimum times specified in the Contract Documents are estimates.
 - 2. No additional costs associated with performing the required services will be approved.
 - 3. Manufacturer required to schedule services in accordance with the Installing Contractor's project schedule up to and including making multiple trips to project site when there are separate milestones associated with installation of each occurrence of manufacturer's equipment.
- D. Manufacturer's on-site services as specified in the Contract Documents include the following:
 - 1. Assistance during Commissioning Phase and Process Start-Up Phase.
 - 2. Provide daily copies of manufacturer's representative's field notes and data to Engineer.
 - 3. Other requirements as specified in the Contract Documents.

1.11 TRAINING OF OWNER'S PERSONNEL

- A. BFP MANUFACTURER working with the Polymer Blending Unit manufacturer and the conveyor manufacturer and the Installing Contractor shall provide operations and maintenance training for items of mechanical, electrical, and instrumentation equipment. Utilize manufacturer's representatives to conduct training sessions.
- B. BFP MANUFACTURER working with the Polymer Blending Unit manufacturer and the conveyor manufacturer shall submit training materials to the FDEP Training Center as per FAC 62-602 in advance of all equipment training sessions to allow for operators to receive continuing education credits for their participation in the equipment training sessions.
- C. Coordinate training sessions to prevent overlapping sessions. Arrange sessions so that individual operators and maintenance technicians do not attend more than 2 sessions per week.
- D. Provide Operation and Maintenance Manual for specific pieces of equipment or systems 1 month prior to training session for that piece of equipment or system.
- E. Satisfactorily complete functional testing before beginning operator training.
- F. Training should be relevant and useful for the subject matter and should include a standard operating procedure (SOP) customized to the requirements of the Plan including a section on trouble shooting of the equipment. Coordinate with Engineer to prepare a detailed SOP to meet the requirements of the staff. Engineer will coordinate with Plant Superintendent appropriately.
- G. All training will be scheduled from 7:00 am to 3:30 pm with at least a half hour uninterrupted lunch period. To cover all shifts, personnel training shall be done in two separate sessions. All scheduling of training sessions will be with the approval of the Owner.
- H. Training sessions: Provide training sessions for equipment as specified in the individual equipment sections.

- I. The Installing Contractor shall videotape all training sessions and provide a copy for the Owner.
- J. The Installing Contractor shall designate and provide 1 or more persons to be responsible for coordinating and expediting his/her training duties. The person or persons so designated shall be present at all training coordination meetings with the Owner.
- K. The Installing Contractor's coordinator shall coordinate the training periods with Owner personnel and manufacturer's representatives, and shall submit a training schedule for each piece of equipment or system for which training is to be provided. Such training schedule shall be submitted not less than 21 calendar days prior to the time that the associated training is to be provided and shall be based on the current plan of operation. Coordinate with Plant Superintendent for training periods.

1.12 RECORD KEEPING

- A. Installing Contractor shall maintain and submit following records generated during start-up and testing phase of Project:
 - 1. Daily logs of equipment testing identifying all tests conducted and outcome.
 - 2. Logs of time spent by manufacturer's representatives performing services on the job site.
 - 3. Equipment lubrication records.
 - 4. Electrical phase, voltage, and amperage measurements.
 - 5. Insulation resistance measurements.
 - 6. Data sheets of control loop testing including testing and calibration of instrumentation devices and setpoints.
- B. Installing Contractor shall provide copy of these records to Owner's representative (Plant Superintendent) at Substantial Completion.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

Comments: _____

I hereby certify Source Testing has been performed on the above-referenced equipment/system as defined in the Contract Documents, and results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: _____, 20____

Manufacturer: _____

Manufacturer's Authorized Representative Name (*print*): _____

(Authorized Signature)

If applicable, Witness Name (*print*): _____

(Witness Signature)

**MANUFACTURER'S CERTIFICATE OF
INSTALLATION AND FUNCTIONALITY COMPLIANCE**

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

I hereby certify that the above-referenced equipment/system has been: (Check Applicable)

- ☐ Installed in accordance with manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical/instrumentation and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functionally tested.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements.

NOTES:

Attach test results with collected data and test report.

Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20 ____

Manufacturer: _____

Manufacturer's Authorized Representative Name (*print*): _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

MANUFACTURER'S CHECK CERTIFICATION

	CITY OF DAYTONA BEACH		NO. OF COPIES
	ENGINEER		NO. OF COPIES
	DESIGN ENGINEER		NO. OF COPIES
	INSTALLING CONTRACTOR		NO. OF COPIES
	FIELD		NO. OF COPIES
	OTHER		NO. OF COPIES

PROJECT DATA AND CONTRACT DATA

NAME OF PROJECT: WEST SIDE REGIONAL WRF IMPROVEMENTS

PROJECT NUMBER:

LOCATION: _____ DATE: _____

CITY: _____ DRAWING NO.: _____

OTHER: _____

SYSTEM DESCRIPTION: _____

Name of equipment checked:

Name of manufacturer or equipment:

1. The equipment furnished by us has been checked on the job by us. We have reviewed (where applicable) the performance verification information.
2. The equipment is properly installed, except for items noted below.
3. The equipment is operating satisfactorily, except for items noted below.
4. The written operating and maintenance information (where applicable) has been presented to the Owner, and has been reviewed with him in detail. Five (5) copies of all applicable operating and maintenance information and parts lists have been furnished to the Owner for insertion in each of the Equipment Brochures.

MANUFACTURER'S CHECK CERTIFICATION SIGNATURE PAGE

	MANUFACTURER	INSTALLING CONTRACTOR	INSTALLING SUBCONTRACTOR
Checked By:			
Address and Phone:			
Authorized Signature:			
Date:			

Manufacturer's Representative Notations: Exception noted at time of check were:

Manufacturer's Representative to note adequacy of related equipment that directly affects operation, performance, or function of equipment checked. (No comment presented herein will indicate adequacy of related systems or equipment):

DEMONSTRATION/START-UP CERTIFICATION

	CITY OF DAYTONA BEACH		NO. OF COPIES
	ENGINEER		NO. OF COPIES
	DESIGN ENGINEER		NO. OF COPIES
	INSTALLING CONTRACTOR		NO. OF COPIES
	FIELD		NO. OF COPIES
	OTHER		NO. OF COPIES

PROJECT DATA AND CONTRACT DATA

NAME OF PROJECT: WESTSIDE REGIONAL WRF IMPROVEMENTS

PROJECT NUMBER:

LOCATION: _____ DATE: _____

CITY: _____ DRAWING NO.: _____

OTHER: _____

SYSTEM DESCRIPTION: _____

Note to Installing Contractor and Owner:

Submit five (5) copies of all information listed below for checking at least one week before scheduled startup demonstration of the system. After all information has been approved by Engineer, give Owner a start-up demonstration as specified and have the Owner sign five copies of this form. After this has been done, a written request for a final inspection of the system shall be made.

MEMORANDUM:

This memo is for the information of all concerned that the Owner has been given a start-up demonstration on the system described above. This start-up demonstration consisted of the system operation, during which all major items of equipment were explained and demonstrated, and the following items were given to the Owner:

- a. Owner's copy of Operation and Maintenance manual for the system containing approved submittal sheets on all items, including the following:
 - Maintenance information published by manufacturer on equipment items.
 - Printed warranties by manufacturers on equipment items.
 - Performance verification information as recorded by Installing Contractor.
 - Check-out Memo on equipment by Manufacturer's representative.
 - Written operating instructions on any specialized items.
 - Explanation of warranties and guarantees on the system.
- b. Prints showing actual "as-built" conditions.

- c. A demonstration of the system in operation and of the maintenance procedures which will be required.

NAME OF INSTALLING CONTRACTOR:

BY: _____
(Authorized Signature, Title, & Date)

NAME OF SUBCONTRACTOR: _____

BY: _____
(Authorized Signature, Title, & Date)

Operation and Maintenance Manual, Instruction Prints, Start-up Demonstration and Instruction in Operation Received:

(CITY OF DAYTONA BEACH)

BY: _____
(Authorized Signature, Title, & Date)

START-UP/CHECK-OUT

TRAINING EVALUATION FORM

EQUIPMENT/SYSTEM ITEM: _____

VENDOR/MANUFACTURER: _____

DATE: _____ NAME OF REPRESENTATIVE: _____

- | | | | | | |
|-----|--|------------|--------------|----|-----|
| 1. | Was representative prepared? | Acceptable | Unacceptable | or | N/A |
| 2. | Was an overview description presented? | Acceptable | Unacceptable | or | N/A |
| 3. | Were specific detail presented for system components? | Acceptable | Unacceptable | or | N/A |
| 4. | Were alarm and shutdown conditions clearly presented? | Acceptable | Unacceptable | or | N/A |
| 5. | Were step-by-step procedures for starting, stopping, and trouble-shooting presented? | Acceptable | Unacceptable | or | N/A |
| 6. | Were routine/preventative maintenance items clearly identified? | Acceptable | Unacceptable | or | N/A |
| 7. | Was the lubrication schedule (if any) discussed? | Acceptable | Unacceptable | or | N/A |
| 8. | Was the representative able to answer all questions? | Acceptable | Unacceptable | or | N/A |
| 9. | Did the representative agree to research and answer unanswered questions? | Acceptable | Unacceptable | or | N/A |
| 10. | Comments: _____ | | | | |

11. Overall Rating: Satisfactory Unsatisfactory

Notes:

Sessions judged “Unsatisfactory” by a majority of attendees shall be revised and conducted again until a satisfactory rating is achieved.

END OF SECTION

SECTION 01770
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Contract closeout requirements including:
 - 1. Touch-up and repair.
 - 2. Preparation and submittal of closeout documents.
 - 3. Final completion certification.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

1.02 REFERENCES

- A. American Water Works Association (AWWA).

1.03 TOUCH-UP AND REPAIR

- A. Installing Contractor shall touch-up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for Substantial Completion.
- B. Refinish or replace entire surfaces which cannot be touched-up or repaired satisfactorily.

1.04 CLOSEOUT DOCUMENTS (by Equipment Manufacturer and Installing Contractor, as applicable based on their responsibilities)

- A. Submit following Closeout Submittals upon Substantial Completion and at least 7 days prior to submitting Application for Final Payment:
 - 1. Punch list of items to be completed or corrected with the request for issuance of Substantial Completion.
 - 2. Evidence of Compliance with Requirements of Governing Authorities.
 - 3. Project Record Documents.
 - 4. Operation and Maintenance Manuals.
 - 5. Warranties and Bonds.
 - 6. Keys and Keying Schedule.
 - 7. Evidence of Payment as outlined in Conditions of the Contract.
 - 8. Release of claims as outlined in Conditions of the Contract.
 - 9. Survey Record Documents.
 - 10. Certificate of Final Completion.

1.05 EVIDENCE OF COMPLIANCE WITH REQUIREMENTS OF GOVERNING AUTHORITIES

- A. Submit the following:
 - 1. Certificate of Occupancy.
 - 2. Certificates of Inspection:
 - a. Mechanical.
 - b. Plumbing.
 - c. Electrical.
 - d. Overall Buildings.
 - 3. Permits.

1.06 WARRANTIES AND BONDS

- A. Equipment Manufacturer and Installing Contractor (as applicable) shall provide executed Warranty or Guaranty Form as required by Contract Documents. See General Conditions.
- B. Provide specified additional warranties, guarantees, and bonds from manufacturers and suppliers.

1.07 SUBSTANTIAL COMPLETION (by Installing Contractor)

- A. Obtain Certificate of Substantial Completion.

1.08 CERTIFICATE OF FINAL COMPLETION (by Installing Contractor)

- A. When 7-day operational test has been successfully completed, Owner will certify that new facilities are operationally complete. Owner will submit a list of known items (punch list) still to be completed or corrected prior to contract completion.
- B. List of items to be completed or corrected will be amended as items are resolved by the Installing Contractor and BFP MANUFACTURER (as applicable).
- C. When all items have been completed or corrected, Installing Contractor and BFP MANUFACTURER (as applicable) shall submit written certification that the entire work is complete in accordance with the Contract Documents and request final inspection.
- D. Upon completion of final inspection, Owner will either prepare a written acceptance of the entire work or advise the Installing Contractor and BFP MANUFACTURER (as applicable) of work not complete. If necessary, inspection procedures will be repeated.

1.09 FINAL ADJUSTMENT OF ACCOUNTS (by Installing Contractor)

- A. Submit a final statement of accounting to the Owner and Engineer at least 7 days prior to final Application for Payment.
- B. Statement shall reflect all adjustments to the Contract amount:
 - 1. The original Contract amount.
 - 2. Additions and deductions resulting from:
 - a. Change Orders.
 - b. Units installed and unit prices.

- c. Set-offs for uncorrected or incomplete Work.
- d. Set-offs for liquidated damages.
- e. Set-offs for reinspection payments.
- f. Extended engineering and/or inspection services and inspection overtime.
- g. Excessive shop drawings review cost by the Engineer.
- h. Other adjustments.
- 3. Total Contract amount, as adjusted.
- 4. Previous payments.
- 5. Remaining payment due.

- C. Engineer will prepare a final Change Order reflecting approved adjustments to the Contract amount which were not previously made by Change Orders.

1.10 FINAL APPLICATION FOR PAYMENT

- A. Equipment Manufacturer and Installing Contractor shall submit the relevant final Application for Payment reflecting the agreed upon information provided in the final statement of accounting.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01782

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Preparation and submittal of Operation and Maintenance Manuals.
- B. Related section:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

1.02 SUBMITTALS

- A. EQUIPMENT MANUFACTURER shall submit Operation and Maintenance Manuals before field quality control testing and before training of each piece of equipment or system.
- B. Draft Operation and Maintenance Manuals:
 - 1. Submit prior to shipment of equipment or system to site.
 - 2. Shipment will be considered incomplete without the draft Operation and Maintenance Manuals.
 - 3. Quantity:
 - a. Hard copy: 2 sets.
 - b. Electronic: 2 Flash Drives.
- C. Final Operation and Maintenance Manuals:
 - 1. Make additions and revisions in accordance with Owner's and Engineer's review comments on draft manuals.
 - 2. Submit approved Operation and Maintenance Manuals at least 30 days prior to Functional Testing and at least 60 days prior to Owner Training.
 - 3. Quantity:
 - a. Hard copy: 2 sets.
 - b. Electronic: 2 Flash Drives.
- D. Make manuals available at project site for use by construction personnel and Owner and Engineer.
- E. Make additions and revisions to the manuals in accordance with Engineer's review comments.

1.03 OPERATION AND MAINTENANCE MANUALS

- A. Preparation:
 - 1. Provide hardcopy Operations and Maintenance Manuals in 3-ring binders with rigid covers. Utilize numbered tab sheets to organize information.
 - 2. Provide electronic copy Operations and Maintenance Manuals in the latest Microsoft WORD and searchable PDF Format.

3. Provide original and clear text on reproducible non-colored paper.
4. Provide all dimensions in English units.
5. Engineer will work with the Installing Contractor, equipment supplier and Plant Superintendent to prepare customized Operations and Maintenance Manuals for the various portions of the work. EQUIPMENT MANUFACTURER shall submit to Engineer all requirements described below as applicable in the format as described above for all equipment and processes.

B. Contents of Operation and Maintenance Manuals:

1. Cover page:
 - a. Equipment name, equipment tag number, project name, Owner's name, appropriate date.
2. Table of Contents:
 - a. General description of information provided within each tab section.
3. Equipment Summary Form:
 - a. Completed form in the format shown in Attachment No. 1.
 - b. The manufacturer's standard form will not be acceptable.
4. Lubrication information:
 - a. Required lubricants and lubrication schedules.
5. Control diagrams:
 - a. Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.
 - b. Complete set of 11-inch by 17-inch drawings of the control system.
 - c. Complete set of control schematics.
6. Programming:
 - a. Copies of all Installing Contractor furnished programming.
7. Start-up procedures:
 - a. Recommendations for installation, adjustment, calibration, and troubleshooting.
8. Operating procedures:
 - a. Step-by-step procedures for starting, operating, and stopping equipment under specified modes of operation.
 - b. Include safety precautions and emergency operating shutdown instructions.
9. Preventative maintenance procedures:
 - a. Recommended steps and schedules for maintaining equipment.
10. Overhaul instructions:
 - a. Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.
11. Parts list:
 - a. Complete parts list for all equipment being provided.
 - b. Availability and service locations.
 - c. Catalog data for all products or equipment furnished including generic title and identification number of each component part of equipment.
 - 1) Include bearing manufacturer, model and ball or roller pass frequencies for every bearing.

12. Spare parts list:
 - a. Recommended number of parts to be stored at the site and special storage precautions.
13. Drawings:
 - a. Exploded view or plan and section views with detailed callouts.
 - b. Complete set of 11-inch by 17-inch drawings of equipment.
 - c. Provide electrical and instrumentation schematic record drawings.
14. Source (factory) quality control test results:
 - a. Provide copies of factory test reports as specified in the equipment section.
15. Field quality control test results:
 - a. After field-testing is completed, insert field test reports as specified in the equipment section.

C. General requirements:

1. Provide dimensions in English units.
2. Assemble material, where possible, in the same order within each volume.
3. Reduce drawings and diagrams to 8 1/2 by 11-inch size, if possible unless otherwise specified.
4. Complete forms on computer, handwriting not acceptable.
5. Delete items or options not provided in the supplied equipment or system.
6. Provide package control system annotated ladder logic for PLC, if applicable.

D. Hard copy requirements:

1. Binders: 3-ring with rigid covers:
 - a. Break into separate binders as needed to accommodate large size.
2. Utilize numbered tab sheets to organize information.
3. Provide original and clear text on reproducible non-colored paper, 8 1/2 by 11-inch size, 24 pound paper.
4. Drawings larger than 8 1/2 by 11 inch:
 - a. Fold drawings separately and place in envelope bound into the manual.
 - b. Label each drawing envelope on the outside regarding contents.

E. Electronic requirements:

1. File format:
 - a. Entire manual in PDF format:
 - 1) Include text and drawing information.
 - 2) Provide a single PDF file even if the hard copy version is broken into separate binders due to being large.
 - 3) Create PDF from the native format of the document (Microsoft Word, graphics programs, drawing programs, etc.):
 - a) If material is not available in native format and only available in paper format, remove smudges, fingerprints, and other extraneous marks before scanning to PDF format.
 - b) Hard copy record drawing requirements:
 - (1) Provide a single multipage PDF file of each set of the scanned drawings.
 - (2) Page 1 shall be the cover of the drawing set.

- c) At file opening, display the entire cover:
 - (1) Scan drawings at 200 to 300 dots per inch (DPI), black and white, Group IV Compression, unless otherwise specified.
 - (2) Scan drawings with photos in the background at 400 dots per inch (DPI), black and white, Group IV Compression.
 - 4) Pagination and appearance to match hard copy.
 - 5) Searchable.
 - 6) Scanned images are not acceptable.
 - 7) Bookmarks:
 - a) Bookmarks shall match the table of contents.
 - b) Bookmark each section (tab) and heading.
 - c) Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
 - d) At file opening, display all levels of bookmarks as expanded.
 - 8) Thumbnails optimized for fast web viewing.
 - b. Drawing requirements:
 - 1) Provide additional copy of drawings in most current version of AutoCAD and PDF format.
 - 2) Drawings shall have a white background.
 - 3) Drawing shapes shall not degrade when closely zoomed.
 - 4) Screening effects intended to de-emphasize detail in a drawing must be preserved.
 - 5) Delete items or options not provided in the supplied equipment or system.
- 2. Media:
 - a. DVD-ROM compatible with Microsoft Windows.
 - b. Flash drive.
 - c. LiquidFiles.
- 3. Label media with the following information:
 - a. Operation and Maintenance Manual.
 - b. Equipment name.
 - c. Specification Section Number.
 - d. Equipment tag number.
 - e. Owner's name.
 - f. Project number and name.
 - g. Date.
- 4. If multiple submittals are made together, each submittal must have its own subdirectory that is named and numbered based on the submittal number.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

Attachment No. 1
EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM _____
2. MANUFACTURER _____
3. EQUIPMENT IDENTIFICATION NUMBER(S) _____
(maps equipment number)
4. LOCATION OF EQUIPMENT _____
5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

NAMEPLATE DATA -

Horsepower _____
Amperage _____
Voltage _____
Service Factor (S.F.) _____
Speed _____
ENC Type _____
Capacity _____
Other _____

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name _____
Address _____
Telephone Number _____

8. MAINTENANCE REQUIREMENTS _____

9. LUBRICANT LIST _____

10. SPARE PARTS (recommendations) _____

11. COMMENTS _____

SECTION 11246

POLYMER BLENDING AND FEED EQUIPMENT-LIQUID

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for provision of 2 complete and operational automatic polymer blending and feed systems to handle dilution of concentrated liquid polymer and delivery of activated polymer for waste activated sludge dewatering using belt filter presses. Provide a skid-mounted vendor supplied control panel for each polymer system and all drivers and controllers necessary for a complete and operational automated dewatering polymer solution system.
- B. The BFP MANUFACTURER shall supply and integrate with the polymer blending and feed equipment as specified herein and in Section 11362.
- C. The other elements of the dewatering polymer solution system include the following and will be furnished and installed by the Installing CONTRACTOR (under a separate contract):
 - 1. Two bulk liquid polymer storage totes.
- D. Tag numbers:
 - 1. PDS-01: Westside Regional Polymer Dilution Skid System 1.
 - 2. PDS-02: Westside Regional Polymer Dilution Skid System 2.
 - 3. PDS-03: Westside Regional Polymer Dilution Skid System 3 (Future Unit).
 - 4. PDS-04: Westside Regional Polymer Dilution Skid System 4 (Future Unit).
- E. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the MANUFACTURER and the installing Contractor to see that the completed Work complies accurately with the Contract Documents:
 - a. Section 01010 - Summary of Work.
 - b. Section 01600 - Product Requirements
 - c. Section 01756 - Testing, Training, and Facility Start-Up.
 - d. Section 01782 - Operation and Maintenance Data.
 - e. Section 09960 - High-Performance Coatings.
 - f. Section 15050 - Common Work Results for Mechanical Equipment.
 - g. Section 15958 - Mechanical Equipment Testing.
 - h. Section 16405 - Electric Motors.
 - i. Section 16485 - Variable Frequency Drives.
 - j. Section 17000 - Instrumentation and Controls.
- F. Inclusion of a specific manufacturer's name in the Specifications does not mean that the specific manufacturer's standard product will be acceptable. Specified

manufacturer's or other manufacturer's standard product shall be modified as required to meet the Specifications.

1.02 REFERENCES

- A. CSA International (CSA).
- B. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
- C. Underwriters Laboratories, Inc. (UL).

1.03 DEFINITIONS

- A. NEMA:
 - 1. NEMA Type 4 enclosure in accordance with NEMA 250.
 - 2. NEMA Type 4X enclosure in accordance with NEMA 250.

1.04 SYSTEM DESCRIPTION

- A. Design requirements:
 - 1. Provide 2 integrated polymer blending units capable of automatically metering, diluting, blending, activating, and feeding liquid polymer and water. Activate concentrated emulsion polymer in a multi-zone hydro-mechanical or hydraulic mixing vessel with a tapered mixing regime.
 - 2. Provide a NEMA 4X 316 Stainless steel skid mounted control panel for each polymer blending unit (2 in total) and all drivers, controllers, microprocessors, and/or PLCs necessary for a complete and operational automated system. The polymer system control panel shall be programmed and provided by the manufacturer of the polymer blending units in accordance with these specifications. BFP MANUFACTURER shall coordinate with the manufacturer of the polymer blending units as necessary.
 - 3. Under automatic control, the dewatering polymer blending system shall be capable of producing and maintaining a setpoint dilute polymer solution concentration through ratio control at a rate sufficient to meet the demands of each belt filter press downstream. There will be one polymer blending system dedicated for each belt filter press.
- B. Pre-assemble and shop-test system to ensure compliance with pressure, operational, and controls requirements.
- C. Design criteria:
 - 1. Dewatering Polymer System:
 - a. Sludge type: Waste Activated Sludge.
 - b. Polymer type: Emulsion.
 - c. Neat Polymer Viscosity Range (centipoise): Up to 6,000.
 - d. Polymer activity (percent active): Up to 45.
 - e. Active polymer dose: Maximum 30 pounds per dry ton of solids.
 - f. Maximum Sludge Feed rate: 1,410 pounds per day of dry solids.
 - g. Active polymer volumetric consumption (design flow):
 - 1) Westside Regional WRF: 1 - 6 gallons per hour.
 - h. Final percent solution desired: Normally 0.25 with a range up to 0.5.
 - i. Percent solids of waste activated sludge feed: 0.6.

- j. Polymer injection location: Sludge feed lines on suction side of the existing double-disk sludge feed pumps.
- k. Anticipated backpressure: 5 to 15 psig.
- 2. Dilution Water:
 - a. Dilution water shall be non-potable water. Blending systems shall be suitable for this dilution water.
 - b. Dewatering:
 - 1) Dilution water flow rate range: 200 to 2,200 gallons per hour.
 - c. Minimum consistent water pressure available for dilution water is 30 psig:
 - 1) For polymer systems relying on higher than available working differential pressures for dilution water, manufacturer must provide integral, skid mounted booster pumps and appurtenances as a part of a fully operational, pre-packaged system:
 - a) Pressure regulating valve with stainless steel, liquid filled pressure gauges to monitor and control the pressure from the booster pump.
 - b) Booster pump to be controlled by polymer blending unit and must be able to fit in area indicated on the Drawings without any interferences or changes to the specified system.
 - 2) Pressure regulating valves with stainless steel, liquid filled pressure gauges shall be provided to protect systems against over-pressure from varying dilution water pressure.
- 3. Neat Polymer Metering Pump:
 - a. General:
 - 1) Each blender unit shall have 1 progressive cavity neat polymer metering pump integrally mounted on the system skid in a configuration that provides access and is easy to maintain.
 - 2) All motors shall meet the requirements of Section 16405.
 - 3) All variable frequency drives, if provided, shall meet the requirements of Section 16485.
 - b. Size:
 - 1) Type: Progressive Cavity.
 - 2) Minimum output range: 1 - 6 gallons per hour.
 - 3) Minimum pump motor requirements: 1/2 horsepower, 1,750 revolutions per minute:
 - a) 480 VAC inverter duty TEFC wash down motor for pumps requiring variable frequency drives.
 - b) Otherwise, 90 VDC, TEFC wash down motor.
- 4. Mixing motor (if hydro-mechanical mixer is used):
 - a. All motors shall meet the requirements of Section 16405.
 - b. All variable frequency drives, if provided, shall meet the requirements of Section 16485.
 - c. Dewatering:
 - 1) Minimum 0.5 horsepower, 480 VAC inverter duty or 90 VDC, 1,750 revolutions per minute, TEFC, wash down motor.
 - 2) Alternatively, if variable frequency drive is not required, minimum 1 horsepower, 480 VAC, TEFC, wash down duty, 3,450 rpm.

1.05 SUBMITTALS

- A. Submit as specified in Section 15050 and 01330.

- B. Submit motor information as required per Section 16405.
- C. Product data:
 - 1. Submit data completely describing product, including plan and section views, and listing of all components and materials of construction.
 - 2. Hydrostatic level transmitter information.
- D. Shop drawings:
 - 1. Submit detailed specifications and shop drawings with both isometric and orthogonal views of the proposed installation, including dimensions, weights, and complete parts list.
 - 2. Submit wiring, control schematics, and control logic diagrams for all electrical and control components furnished.
 - 3. Submit hydraulic characteristics of the mixer.
 - 4. Submit polymer system local control panel layout, bill of materials, wiring diagrams, and associated cut sheets.
- E. Manufacturer's Qualifications: Submit all information proving conformance with manufacturer's qualifications requirements.
- F. Manufacturer's installation instructions:
 - 1. Installation and checkout instructions including lubrication and initial start-up procedures.
 - 2. Do not install equipment until all installation instructions have been supplied.
- G. Operations and Maintenance Manuals: As specified in Section 01782.
- H. Warranties.
- I. Certificates.
- J. Technician Qualifications Resume: Submit resume of technician to perform polymer system adjustments, inspections, performance testing, and training.
- K. Training Course Outline.

1.06 QUALITY ASSURANCE AND CONSIDERATION OF ALTERNATIVES

- A. Polymer Blending Unit Manufacturer Qualifications:
 - 1. Manufacturer must have at least 10 years' experience in the design, application, and supply of polymer blending systems of the type described in this Specification for the municipal wastewater market. Manufacturer shall provide a signed affidavit stating conformance with these requirements.
 - 2. Manufacturer must provide references for at least 10 currently operating installations of equipment of the same type as that to be provided under this project at municipal wastewater treatment plants in the United States.
- B. System to be pre-assembled and shop-tested to assure compliance with the pressure, operational, and control requirements, as specified in Section 01756 and Section 15050.
- C. Components and installation shall comply with the Uniform, Standard and National Building and Fire Codes.

- D. Certifications: Furnish affidavit from polymer blending unit manufacturer stating that the polymer feed systems have been tested and ready for installation as specified in Section 01756.
- E. BFP MANUFACTURER shall assume system responsibility by proper coordination with the manufacturer of the Polymer Blending Units as described herein.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. MANUFACTURER shall coordinate delivery, shipping and handling, field dimensions and coordination with the installing Contractor and Owner. The MANUFACTURER shall deliver the polymer blending units at agreed upon dates with the installing Contractor and Owner. MANUFACTURER shall request the construction schedule from the Installing Contractor after the Contractor receives the Notice-to-Proceed (NTP) from the OWNER for the construction of dewatering system improvements. MANUFACTURER shall request the equipment delivery schedule confirmation at a minimum 60 days in advance and another at a minimum 15 days in advance of shipping the unit(s). MANUFACTURER shall provide the installing Contractor all necessary information to proper handling of the delivery and storage of the equipment and any assembly required on-site as necessary before installation.
- B. As specified in Section 01600.

1.08 WARRANTY

- A. The complete polymer blending units shall be covered by a minimum 2 year warranty against defects in materials and workmanship:
 - 1. Warranty period shall commence after on-site acceptance (after successful start-up and testing) of equipment by the Owner.
 - 2. The polymer blending mixing chamber shall be warranted for 2 years to be free of defects in workmanship or materials:
 - a. The polymer blending mixing chamber shall be warranted against failure due to mixing chamber plugging for any reason.
 - b. If the mixing chamber plugs a replacement mixing chamber will be provided at no cost to the Owner.
 - c. This extended warranty shall not apply if the damage is caused by freezing or other weather related damage or over-pressure.
 - d. Mixing chamber motors and seals shall be covered under the system warranty rather than this lifetime warranty.
 - 3. The warranty shall apply regardless whether potable or non-potable water is used for the dilution water.

1.09 MAINTENANCE

- A. As specified in Section 15050.
- B. Provide:
 - 1. One (1) complete set of special tools needed to assemble, disassemble, and clean the system.
 - 2. Other spare parts as recommended by system supplier.

PART 2 PRODUCTS

2.01 POLYMER BLENDING UNIT MANUFACTURERS

- A. One of the following only, no substitutions or equal:
 - 1. USGI PolyBlend, appropriate model.
 - 2. VeloDyne, appropriate model.
 - 3. Acrison, appropriate model.
 - 4. Approved Equal.
- B. For manufacturers to be considered as "Approved Equal", submit all documentation to the Owner as per Specification 01600, Section 1.05.E.

2.02 IDENTIFICATION

- A. Identify each unit of equipment with a corrosion resistant nameplate, securely affixed in a conspicuous place:
 - 1. Nameplate information to include equipment model number, serial number, manufacturer's name, and location.

2.03 MATERIALS

- A. General:
 - 1. Turbine and shaft of mechanical mixers shall be Brass or Type 316 stainless steel:
 - a. Impellers constructed of other materials are not acceptable.
 - 2. Mixing chamber shall be constructed of clear Lexan or acrylic.
 - 3. Neat Polymer Check Valve:
 - a. Body shall be constructed of stainless steel, PVC or Teflon with Viton seals.
 - b. Valve poppet and spring shall be stainless steel.
 - 4. Brass, bronze, or stainless steel mixing chamber pressure or neat polymer pump relief valve and drain valve.
 - 5. System shall be constructed with a Type 316 stainless steel chassis.
 - 6. Hardware shall be Type 316 stainless steel.
 - 7. Piping and valves shall be Schedule 80 PVC.
 - 8. Hose shall be braided vinyl and hose fittings shall be Schedule 80 PVC. Nylon fittings are not acceptable.
 - 9. Any other components in contact with polymer or water shall be constructed of brass, stainless steel or an inert plastic.

2.04 EQUIPMENT

- A. Mixing requirements:
 - 1. Mixing energy shall be provided by a stainless steel or bronze mixing impeller or through a non-mechanical hydrodynamic blending device:
 - a. For systems with hydro-mechanical mixers:
 - 1) Mixing impellers shall be designed to produce both axial and radial flow.
 - 2) Plastic impellers are not acceptable.
 - 3) The volume of mixing chamber shall be 1.0 gallon minimum to provide sufficient residence time for polymer activation.

- b. Systems relying on differential hydraulic pressure for mixing shall be designed to provide necessary mixing energy with a dilution water pressure of 30 psig above the mixing chamber discharge pressure. If additional pressure is required systems shall be supplied with integral dilution water booster pumps as specified in Article 1.04 of this Section.
2. Mixing system shall be specifically designed to invert, disperse, and activate in solution emulsion polymers with viscosities up to 6,000 cps and active contents up to 45 percent.
3. The mixing system shall be designed to effectively induce high, non-damaging mixing energy over the system's full flow range.

B. Mixing chamber:

1. Mixing chamber shall be made of a suitable clear composite material such as Lexan, polycarbonate, or acrylic to view the mixing action and blending effectiveness.
2. Mixing chamber shall provide two stage mixing. The initial high energy mixing zone shall prevent fisheye formation with a G-value of $14,000 \text{ sec}^{-1}$ (if applicable), followed by the low energy mixing zone with G-value of lower than $3,500 \text{ sec}^{-1}$ (if applicable) to minimize fracturing hydrated polymer molecules.
3. Mixing chamber shall have a minimum rated pressure of 100 pounds per square inch.
4. Provide a stainless steel, brass, or bronze mixing chamber pressure relief valve and drain valve.
5. All bearings shall be external from the mixing chamber.
6. Neat polymer check valve:
 - a. Specifically designed to isolate neat polymer from dilution water.
 - b. Readily accessible for cleaning without the use of tools.
 - c. Installation inside the mixing chamber not allowed.
 - d. Mixing chamber disassembly for access not allowed.
 - e. Conventional ball type check valves, valves that rely on ball seals, and/or check valves installed inside the mixing chamber, or which require mixing chamber disassembly for servicing not allowed.

C. Dilution water system:

1. The dilution water will be provided as follows:
 - a. Owner will provide non-chlorinated UV-disinfected dilution water for the dewatering polymer system via the in-plant reclaimed service water system. Each polymer blending unit shall include an adjustable pressure regulator to maintain water flow and pressure to the necessary system pressure.
2. The plant reuse water will meet the Florida regulations for public access reuse and will have total suspended solids (TSS) less than 5 mg/L.
3. The dilution water shall have primary mixing and post-dilution (as part of the manufacturer's skid mounted unit, as applicable based on the polymer blending unit manufacturer) to expedite polymer activation by maximizing the value of breaker surfactant present in emulsion polymer, as per the AWWA Standard for Polymers (ANSI/AWWA B453-06).
4. Primary water flow shall supply the mixing chamber to make higher polymer solution concentration (0.5 percent - 1.0 percent optimum). Secondary water flow shall be used to post dilute the activated polymer solution to feed concentration (as part of the manufacturer's unit. These two streams shall be completely blended by a static mixer prior to exiting the polymer system.

5. The dilution water inlet assembly for each unit shall be ANSI 150 lb flange connection.
 6. The common dilution water supply line shall have a 40 mesh strainer unit, furnished and installed by the installing Contractor.
 7. Each polymer blending unit shall include:
 - a. A motorized ball valve for open/close control of dilution water.
 - b. A separate linear actuated flow control valve for automatic modulation of dilution water flow in response to the ratio controller.
 - c. The dilution water flow rate shall be monitored by a magnetic flow meter that meets the requirements of Section 17000 whichever is applicable.
 - d. The flow meter shall provide the dilution water flow rate to the ratio controller.
 - e. Unions or flanges shall be provided on the inlet and outlet of the flowmeter to allow easy removal for cleaning or inspection.
 - f. A 2 1/2 inch stainless steel liquid filled pressure gauge to monitor dilution water inlet pressure. The pressure gauge shall read from 0 to 160 psig. Pressure gauges shall meet additional requirements as specified in Section 17000.
- D. Solution discharge system:
1. Pressure gauge:
 - a. Size: 2-inch.
 - b. Materials: Type 316 stainless steel.
 - c. Liquid filled with diaphragm seal.
 - d. The pressure gauge shall read from 0 to 160 psig.
 - e. Pressure gauges shall meet additional requirements as specified in Section 17000.
 2. Check valve:
 - a. Type: Flapper or diaphragm.
 - b. Materials: PVC and Viton.
 - c. Size: Same size as the solution discharge piping.
- E. System skid:
1. Frame:
 - a. Material: Type 316 stainless steel:
 - 1) Constructed of minimum 3/16-inch angle or structural stainless steel tubing.
 - 2) Mild steel not accepted.
 - b. Design: Easy access to all components.
 2. All piping rigidly supported with stainless steel supports.
 3. The skid shall include anchoring locations for mounting to concrete equipment pads.
- F. Neat polymer metering pump:
1. General:
 - a. Each blender unit shall have 1 progressive cavity neat polymer metering pump integrally mounted on the system skid in a configuration that provides access and is easy to maintain:
 - 1) Systems shall not exceed the footprint shown on the Drawings.
 - b. Manufacturers: Moyno, or Seepex, (appropriate model) no equal.
 - c. Materials of Construction:
 - 1) Type 316 stainless steel for all wetted components.

- 2) Viton stators.
- 3) Stuffing box and seal type as recommended by polymer blending and feed equipment manufacturer for neat polymer service.
- d. Each pump shall conform to the requirements herein, and mechanical requirements of Section 15050.
- e. Capable of pumping polymer with apparent viscosities of up to 6,000 cps.
- f. Metering pumps shall be capable of accurately metering the specified neat liquid polymers.
- g. Pump capacity adjustments shall give accurate and repeatable flows within 5 percent of calibrated values, and shall be free of drift during operation.
- h. Gear reducers shall be provided to produce a maximum pump shaft speed of not more than 350 rpm.
- i. Provide thermal flow switches for each pump to shut down due to run dry condition.
- j. Controllers:
 - 1) SCR motor controllers or VFDs located in the vendor supplied master control panel.

G. Accessories:

- 1. For each blender unit, provide a calibration column sized and calibrated for 1 minute of drawdown at the maximum pump rate.
 - a. Graduation:
 - 1) Increments read in both mL and gph.
 - b. Construction: Clear polyvinyl chloride.
 - c. Configuration:
 - 1) Nipple and plug for system operation without cylinder.
 - 2) Full port PVC ball valves having Viton O-rings:
 - a) Locate 1 ball valve on the discharge of the calibration column.
 - b) Locate 1 ball valve on the neat polymer inlet pipe up stream of the calibration column discharge valve.
 - d. Assembly:
 - 1) Furnished and rigidly installed on polymer system skid.
 - 2) Use of piping for support is not acceptable.
- 2. For each blender unit, provide a polymer flow sensor to monitor the metering pump rate and protect the pump from running dry:
 - a. Polymer flow sensor:
 - 1) Meter polymer flow based on the progressing cavity meter pump rotational speed. Include a thermal switch in the stator of the meter pump to serve as a low polymer flow switch.
 - 2) Mount on system skid with Type 316 stainless steel bracket.
- 3. For each blender unit, provide pressure relief valve:
 - a. Materials: PVC and Viton.
 - b. Location: Discharge line of the pump.
 - c. Factory plumbed back to suction of the pump.
- 4. Pressure gauge:
 - a. Size: 2-inch.
 - b. Materials: Type 316 stainless steel.
 - c. Liquid filled with diaphragm seal.
 - d. Location: Discharge line of the pump.
 - e. The pressure gauge shall read from 0 to 160 psig.

- f. Pressure gauges shall meet additional requirements as specified in Section 17000.

2.05 CONTROLS

- A. BFP MANUFACTURER shall coordinate with polymer blending unit manufacturer. Polymer blending unit manufacture shall cooperate and provide all necessary assistance.
- B. General:
 - 1. The polymer blending unit manufacturer's standard control packages shall be modified to provide the controls described herein.
 - 2. Dewatering Polymer Solution System:
 - a. Provide a skid mounted control panel for each polymer blending unit for control of the dewatering polymer blender units based on signals from the Plant SCADA system.
 - b. The control panel enclosure and all electrical and instrumentation components shall conform to the requirements stated in the Contract Documents.
 - c. Control panels and all components shall be UL listed and labeled.
 - d. Under AUTO control, the dewatering polymer solution system shall accept a polymer solution concentration setpoint and shall maintain that setpoint through ratio control. The system shall operate to produce the same volume of polymer solution as the volume used in the dewatering process by accepting a sludge flow and a TSS meter signal, calculating the incoming mass of dry solids in tons and maintaining a flowrate which meets an operator selected polymer dose rate in pounds of polymer per dry tons of incoming solids.
 - e. System shall include instruments to sense loss of dilution water. Upon sensing that dilution water flow has been interrupted, system shall place the neat polymer pump on standby and annunciate a common fail alarm. The system shall restart the neat polymer pump automatically when flow is restored.
 - f. System shall include instruments to sense loss of polymer flow. Upon sensing that polymer flow has been interrupted, system shall stop and annunciate a common fail alarm. A manual local reset of the alarm condition will be required before the system can resume operation.
- C. Dewatering Polymer Solution System Vendor Supplied Control Panels (VCP):
 - 1. Enclosures and control panel features:
 - a. Each VCP shall be powered from a 480 volt, 20 amp, 3-phase, 60 hertz power supply:
 - 1) Provide main breaker rated 20 amp, 480 volt, 3-phase with external handle disconnect.
 - 2) The panel shall have 18kAIC rating for fault current.
 - 3) Provide control power transformers as required for any other required voltages. Size control power transformers according to the actual loads.
 - 4) Provide 480 volt, 3-phase surge protection device wired to protect motors and control equipment from lightning induced line surges.
 - b. Components:

- 1) Panel to have Allen-Bradley Micrologix 1400 PLC controllers with expansion analog cards to provide the control functions as indicated on the Drawings and as specified in this Section and in Section 17000. Provide Allen Bradley Panelview Plus touchscreen (minimum 5.7") on VCP. Provide UPS for PLC system.
- 2) Front panel controls:
 - a) Provide in accordance with Section 17000.
 - b) Provide an emergency stop pushbutton.
 - c) System HAND/OFF/AUTO.
 - d) 1-turn potentiometer - mixer speed (if polymer solution system is supplied with a variable speed mixer).
 - e) 10-turn potentiometer - progressive cavity metering pump control.
 - f) Booster pump HAND/OFF/AUTO switch (if applicable and provided by the MANUFACTURER). If booster pump is needed, provide NEMA starter in the vender control panel.
 - g) Main power ON light/Running Indication.
 - h) LCD display:
 - (1) Metering pump rate.
 - (2) Water flow rate.
 - (3) Solution concentration.
 - i) Low water differential pressure or low water flow alarm light:
 - (1) Metering pump goes to stand-by mode when low dilution water flow occurs. The pump automatically restarts when flow returns. Should the water flow not return within adjustable time delay, the system stops and requires manual reset.
 - j) Low polymer flow alarm light:
 - (1) When low/loss of polymer flow occurs, the system stops and requires manual restart. An adjustable time delay relay shall be provided to prevent nuisance alarms from occurring.
 - k) Solution concentration fault light:
 - (1) When solution concentration is outside of the acceptable range, the PLC will stop the system and require manual restart. An adjustable time delay shall be provided to prevent nuisance alarms from occurring
- 3) Remote monitoring and control:
 - a) Provide dry relay contact outputs for the following:
 - (1) System running.
 - (2) AUTO mode.
 - (3) Common fail alarm:
 - (a) Alarm condition shall be annunciated upon Loss of Level signal, Loss of Polymer Flow, Low Water Flow, or Solution Concentration Fault.
 - b) Accept discrete inputs for the following:
 - (1) Start/stop.
 - c) Provide 4-20mA outputs for the following:
 - (1) Neat Polymer pump speed feedback (if VFD is used).
 - (2) Polymer Dilution System water flow rate.
 - (3) Polymer Dilution System Calculated pump flow rate.
 - d) Accept 4-20mA inputs for the following:

- (1) Polymer Solution Concentration Setpoint:
 - (a) Single setpoint shall be used to control either duty or standby unit.
 - (2) Polymer Pump Speed Command (if VFD is used).
 - c. Enclosure and associated components:
 - 1) In accordance with Section 17000 unless otherwise specified in this Section.
 - 2) NEMA Type 4X fiberglass reinforced plastic.
 - 3) Provide main disconnect handle.
 - 4) Provide a manual thermal magnetic circuit breaker to disconnect power from each motor installed within VCP.
 - d. Panel shall be skid-mounted:
 - 1) The control panel shall be a maximum of 48 inches wide by 48 inches high by 10 inches deep. Provide components necessary to assure adequate cooling.
 - e. Mixing chamber motor:
 - 1) Motor starter.
 - f. Neat polymer pump motor:
 - 1) Motor starter.
 - 2) SCR controllers or VFDs:
 - g. All components of each polymer blending unit shall be pre-wired to each control panel by the manufacturer. This includes motors, instruments, and ancillary devices.
 - h. Neat Polymer Pump protection:
 - 1) Supply each pump with self-contained pump protection components as follows.
 - 2) 120 VAC, 1-phase, power supply.
 - 3) Wired directly to the internal pump monitoring devices, including:
 - a) Stator thermal switches.
 - b) Motor temperature switch.
 - 4) Provide the following output contacts:
 - a) Stator thermal switches.
 - b) Motor temperature switch.
- 2. Control Description:
 - a. The BFP MANUFACTURER in coordination with the polymer blender manufacturer and the installing Contractor's ISS (as necessary) shall provide all necessary controls/programming to provide the functionality described herein.
 - b. The system shall be provided with LOCAL /REMOTE operating modes:
 - 1) LOCAL: In local manual mode, the neat polymer pump speed, the polymer dilution water pump and water flow rate shall respond to manual input at the panel.
 - 2) REMOTE: In remote mode the system shall accept remote start/stop dry contacts and 4-20 mA polymer solution concentration setpoint signal.
 - c. Under Remote Mode:
 - 1) The polymer activation unit shall provide activated polymer solution at a setpoint solution concentration to continuously maintain a dose setpoint based on analog sludge flow and TSS transmitter signals on the belt filter press sludge feed line.
 - 2) The solution concentration shall be maintained at a constant setpoint percentage using a microprocessor-based or PLC-based ratio control

algorithm. In the remote mode the solution concentration set point shall be adjustable via a 4-20mA signal from the Plant SCADA system. Once the system is sent a start command, the system shall send polymer directly into the belt filter press feed manifold.

- 3) The solution flow rate shall be variable to maintain a constant setpoint dosage in pounds of polymer per dry tons of incoming solids to the belt filter press. The polymer blending unit shall calculate this flow rate based on incoming flow and TSS signals. In the remote mode, the polymer dose shall be adjustable via a 4-20mA signal from the Plant SCADA system.

2.06 SOURCE QUALITY CONTROL

- A. Witnessing: Source or factory testing shall be witnessed by the Engineer or the Owner when scheduled; provide advanced notice of source testing. All travel expenses for the witnessing party shall be covered by the Manufacturer.
- B. Variable frequency drive and motor factory tests: Test as specified in the variable frequency drive section.
- C. Hydrostatic pressure tests: As specified for components in this Section.

PART 3 EXECUTION

3.01 EXAMINATION

- A. As specified in Section 15050.

3.02 INSTALLATION

- A. Polymer blending units shall be installed and programmed with adequate coordination with the BFP MANUFACTURER in strict conformance with the manufacturer's installation instructions and with favorable review shop drawings.
- B. Checkout of final installation, start-up, calibration, and instruction of operating personnel shall be performed by an authorized representative of the polymer blending unit manufacturer:
 1. Manufacturer shall provide Certificate of Proper Installation in accordance with Section 01756.
- C. Alignment of piping may vary from that indicated on the Drawings:
 1. Upon acceptance by the Engineer, align piping to suit the equipment furnished, without additional cost to the Owner.
- D. Installing Contractor to flush out reuse water line until water discharged from line is clear and free of debris.
- E. Installing Contractor to avoid exposing neat polymer lines to water at any point of the system.

3.03 FIELD COATING

- A. Pumps, piping, valves, and accessories: Field coat as specified in Section 09960.

3.04 TESTING

- A. Functional testing of the entire polymer feed system to be conducted following installation and cleaning of the polymer blending units.
- B. Testing to be conducted by the polymer blending unit manufacturer's representative, BFP Manufacturer's Representative in coordination with the installing Contractor in the presence of the OWNER and Engineer to demonstrate that equipment is capable of performing its specified function in a satisfactory manner without mechanical or electrical defects, binding, or operational difficulties.
- C. Excessive vibration or noise shall be corrected, as specified in Section 15050.
- D. Installing Contractor shall verify and affirm that all connections are watertight.
- E. Accuracy of all polymer feed components shall be demonstrated and brought within the limits specified in this Section.
- F. During testing, installing Contractor shall make all final adjustments necessary to place equipment in satisfactory working order.
- G. BFP Manufacturer's representative in coordination with the polymer blending unit manufacturer's representative and the installing Contractor shall test and calibrate all controls, switches, automatic valves, and other instrumentation and control equipment associated with the polymer feed system specified, in accordance with the manufacturer's printed instruction over the full operating range of the equipment.
- H. Provide certified test report as specified in Section 01756.
- I. Coordinate testing with functional testing of other sludge dewatering equipment.

3.05 POLYMER BLENDING UNIT MANUFACTURER'S FIELD SERVICES

- A. Coordinate field service work with the BFP MANUFACTURER, installing Contractor, the Owner, and Engineer prior to initiating such work.
- B. Require Polymer Blending Unit Manufacturer's Representative to perform the following services as described below and as specified in Section 01756. The specified durations are the minimum required time on the jobsite. Additional services and/or longer durations shall be provided as needed at no cost to the Owner to meet the required quality of work:
 - 1. Dewatering Polymer Solution System:
 - a. Installation Assistance: 1 workday.
 - b. Installation Inspection: 1 Workday.
 - c. Start-up/Testing Assistance: 2 Workdays.
 - d. Training per Section 01756 and as further described below: 16 hours:
 - 1) Operations Training: 8 hours.
 - 2) Mechanical Maintenance Training: 6 hours.
 - 3) Electrical Maintenance Training: 2 hours.

- e. Final Acceptance and Checkout: 1 Workday.
- f. Post Start-up Field Visit: 1 Workday.

C. Additional Training Requirements:

- 1. The BFP MANUFACTURER in coordination with the Polymer Blending Unit Manufacturer shall submit a training course outline plan one month before training starts, with proposed class material and class schedule to the Owner for approval. Training will begin only if the class material and class schedule have been reviewed and approved by the Owner.
- 2. Training will begin only after the dewatering system has successfully passed the performance test, has been started-up for at least one belt filter press, and has provided beneficial use to the Owner.
- 3. Subjects of instruction shall include the following:
 - a. Start-up and shutdown procedures.
 - b. Troubleshooting.
 - c. System operation.
 - d. Operating adjustments for performance optimization.
 - e. Preventative mechanical and electrical maintenance.
 - f. Removal and replacement of system components.
 - g. Mechanical and electrical maintenance procedures.
 - h. Emergency procedures.
 - i. Record keeping.
 - j. Mechanical unit function and description.
 - k. Variable frequency drives and SCR controllers.
 - l. System controls.

3.06 DEMONSTRATION

- A. Provide system start-up as specified in Section 01756.

END OF SECTION

SECTION 11362

BELT FILTER PRESS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for belt filter press (BFP) systems for dewatering waste activated sludge complete with auxiliary equipment, and control panels.
- B. The BFP MANUFACTURER shall furnish the BFPs and assume the full responsibility of coordinating with the manufacturers of the shaftless screw conveyors, and the polymer blending units for all instrumentation, controls and integration of programming.
- C. The BFP MANUFACTURERS as listed in this specification section shall provide complete dewatering belt filter press systems including two (2) dewatering BFP units. The two (2) units will be installed by the Installing Contractor at the Westside Regional Water Reclamation Facility (WRF) under a separate contract.
- D. The BFP MANUFACTURERS as listed in this specification section shall provide associated BFP local control panel (LCP) and BFP master control panel (PCP-DW) as shown on Instrumentation drawings and as describes in this specification. Refer to Instrumentation communication block diagram for anticipated network connection between belt filter press LCP's, conveyor control panels, and a BFP master control panel (PCP-DW).
- E. Related sections:
 - 1. Section 01010 - Summary of Work.
 - 2. Section 01330 - Submittal Procedures.
 - 3. Section 01600 - Product Requirements.
 - 4. Section 01756 - Testing, Training, and Facility Start-Up.
 - 5. Section 01782 - Operation and Maintenance Data.
 - 6. Section 11246 - Polymer Blending Units.
 - 7. Section 14555 - Shaftless Screw Conveyors.
 - 8. Division 15 - Mechanical.
 - 9. Division 16 - Electrical.
 - 10. Division 17 - Instrumentation and Control.
- F. Tag numbers:
 - 1. WR-BFP-01 - Dewatering BFP No. 1.
 - 2. WR-BFP-02 - Dewatering BFP No. 2.
 - 3. WR-BFP-03 - Dewatering BFP No. 3 (Future).
 - 4. WR-BFP-04 - Dewatering BFP No. 4 (Future).
 - 5. LCP-BFP1 - BFP#1 Local Control Panel.
 - 6. LCP-BFP2 - BFP#2 Local Control Panel.
 - 7. LCP-BFP3 - BFP#3 Local Control Panel (Future).
 - 8. LCP-BFP4- BFP#4 Local Control Panel (Future).
 - 9. PCP-DW - BFP Master Control Panel.

1.02 REFERENCES

- A. American Bearing Manufacturer's Association (ABMA):
 - 1. 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. American Society of Mechanical Engineers (ASME):
 - 1. B36.19 - Stainless Steel Pipe.
- C. ASTM International (ASTM):
 - 1. A36 - Standard Specification for Carbon Structural Steel.
 - 2. A48 - Standard Specification for Gray Iron Castings.
 - 3. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. A242 - Standard Specification for High-Strength Low-Alloy Structural Steel.
 - 5. A276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 6. A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - 7. A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
 - 8. A519 - Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing.
 - 9. D394 - Method of Test for Abrasion Resistance of Rubber Compounds.
 - 10. D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - 11. D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 12. D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
 - 13. D638 - Standard Test Method for Tensile Properties of Plastics.
 - 14. D785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
 - 15. D789 - Standard Test Methods for Determination of Solution Viscosities of Polyamide (PA).
 - 16. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
 - 17. D2240 - Standard Test Method for Rubber Property-Durometer Hardness.
 - 18. D2294 - Standard Test Method for Creep Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal).
 - 19. D2632 - Standard Test Method for Rubber Property—Resilience by Vertical Rebound.
 - 20. D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- D. International Organization for Standardization (ISO).
- E. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
- F. Society for Protective Coatings (SSPC):
 - 1. 10 - Near-White Blast Cleaning.
- G. Underwriters Laboratories, Inc. (UL).

1.03 DEFINITIONS

- A. NEMA Type 4X enclosure in accordance with NEMA 250.

1.04 SYSTEM DESCRIPTION

- A. Description of sludge to be fed to belt press:
1. Type of sludge: Waste activated sludge from 5-stage Bardenpho process.
 2. Feed solids: 0.5 to 1.0 percent.
 3. Volatile suspended solids: 78 to 85 percent.
 4. pH range: 5 - 8 with normal pH range of 6.5 to 7.5.
 5. Sludge temperature: 50 to 95 degrees F with normal range of 65-75 degrees Fahrenheit.
 6. Suitable for sludge containing the following trace compounds: Hydrogen sulfide, nitrogen, carbon dioxide, and methane gas.
 7. Operation: Designed to operate continuously.
- B. Performance requirements: As a minimum, each belt filter press shall be capable of operating at the following conditions with piping, pumping, and auxiliary systems rated for a higher hydraulic capacity when operating in accordance with project conditions and under normal sludge feed conditions specified above.

Hydraulic feed rate (sludge only)	
Maximum	425 gallons per minute (@ 0.6 percent inlet solids concentration)
Design	275 gallons per minute (@ 0.6 percent inlet solids concentration)
Minimum	200 gallons per minute (@ 0.6 percent inlet solids concentration)
Solids feed rate	
Maximum	1,410 lbs/hour at inlet solids of 0.6%
Design	840 lbs/hour at inlet solids of 0.6%
Minimum	580 lbs/hour at inlet solids of 0.6%
Belt washwater	120 gpm
Belt washwater pressure	120 psi minimum
Active polymer dosage	Maximum 30 pounds polymer/ton dry solids of the polymer currently used by the Owner. Coordinate with the Owner for polymer selection and optimization.
Belt life	2,000 hours of operation minimum
Minimum Percent Dry Solids	16 - 18.0
Solids capture	Minimum 95 percent

- C. The belt filter press shall have the maximum dimensions, 117 inches high, 268 inches long, and 142 inches wide. The overall static weight of the belt filter press shall not exceed 30,000 pounds so as to minimize installation and civil work.

- D. The minimum clearance requirements specified herein shall not relieve the BFP MANUFACTURER and the installing Contractor from allowing additional clearances for the proper installation, operation, and maintenance of the units. The Contract Drawings show a general layout. BFP MANUFACTURER shall be fully responsible to take field measurements and coordinate with the Installing Contractor before fabrication of the BFPs to prepare a proper layout to provide sufficient access for operation and maintenance.

1.05 SUBMITTALS

- A. Submit as specified in Section 01330 - Submittal Procedures.
- B. Product data: As specified in Section 15050 - Common Work Results for Mechanical Equipment.
- C. Shop drawings: As specified in Section 15050 - Common Work Results for Mechanical Equipment:
 - 1. Submit "draft" standard shop drawings within 30 days of award of the contract.
 - 2. Include additional details on belt filter press, conveyors, polymer blending units, motors, gear drives, hydraulic system, control panel layouts, schematic wiring diagrams and interconnections wiring diagrams, interconnecting piping, pipe supports, and size and length of each support frame member.
 - 3. Details of the discharge deflection plate including dimensions and details for operator access to and operation of the scraper blades.
- D. Calculations: As specified in Section 15050 - Common Work Results for Mechanical Equipment:
 - 1. Structural anchor points to concrete foundation.
 - 2. Distribution of stresses through belt filter press frame.
 - 3. Seismic loads on frame and anchor bolts.
 - 4. Member deflection.
 - 5. Maximum roller deflection.
 - 6. Roller bearing compliance bearing life requirement at maximum loading, based on ABMA/ISO capacity formula.
 - 7. Roller factor of safety calculations at maximum loading conditions.
 - 8. Roller maximum deflection calculations at maximum loading conditions.
- E. Vendor operation and maintenance manuals: As specified in Section 01782 - Operating and Maintenance Data.
- F. Quality assurance submittals:
 - 1. Resume of technician for start-up and training services.
 - 2. BFP MANUFACTURER's references.
- G. Electrical drawings showing the belt filter press unit wiring, routing of conduits at the unit, and locations of all unit mounted electrical and instrumentation equipment, motors, and terminal junction boxes. Include termination wiring diagram identifying manufacturer terminations and customer terminations for power, signal and control.
- H. Schematic process & Instrumentation diagram of actual system to be supplied.

- I. Software and Programming:
 - 1. Provide electronic copy of the PLC program (operating software) and all software used to program the master BFP PLC, and all non-PLC software (all proprietary software as applicable).
 - 2. Provide hard copies or electronic pdf files of all programming and parameters stored within the PLC.
 - 3. Control logic descriptions and narrative for the intended operation of the supplied unit and the actual PLC program to be loaded into the master BFP PLC panel.
 - 4. Coordinate with Owner and submit HMI (Human Machine Interface) screen captures for Owner/Engineer approval and incorporate Owner/Engineer's comments.
- J. Commissioning submittals:
 - 1. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756 - Commissioning.
 - 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.
 - 3. Provide training course materials.

1.06 PATENTS

- A. The BFP MANUFACTURER shall warrant that the use of this system and its equipment, in the process for which the system has been expressly designed, will not infringe any U.S. or foreign patents or patents pending. In the event of any claim of infringement the manufacturer shall defend and indemnify the owner free from any liabilities associated with the use of the patented equipment or process.
- B. The BFP MANUFACTURER shall grant to the owner, in perpetuity, a paid-up license to use any inventions covered by patent or patents pending, owned, or controlled by the manufacturer in the operation of the facility being constructed in conjunction with the equipment supplied under this contract, but without the right to grant sublicenses.

1.07 DELIVERY, SHIPPING, AND HANDLING

- A. BFP MANUFACTURER shall coordinate delivery, shipping and handling, field dimensions and coordination with the installing Contractor and Owner. The BFP MANUFACTURER shall deliver the BFPs at agreed upon dates with the installing Contractor and Owner. BFP MANUFACTURER shall request the construction schedule from the Installing Contractor after the Contractor receives the Notice-to-Proceed (NTP) from the OWNER for the construction of dewatering system improvements. BFP MANUFACTURER shall request the equipment delivery schedule confirmation at a minimum 60 days in advance and another at a minimum 15 days in advance of shipping the unit(s). BFP MANUFACTURER shall provide the installing Contractor all necessary information to proper handling of the delivery and storage of the equipment and any assembly required on-site as necessary before installation.

- B. A tentative schedule for the delivery of the equipment is described below. It should be noted that the final delivery of these units will vary and actual dates shall be coordinated with the Owner and installing Contractor:
 - 1. Westside Regional WRF - Delivery of two (2) BFP units on or before October, 2019.
- C. Also see as specified in Section 15050.

1.08 SCHEDULE AND SEQUENCING

- A. Coordinate with Installing Contractor and Owner for work restrictions, scheduling constraints, and sequencing requirements.

1.09 WARRANTY

- A. General:
 - 1. BFP MANUFACTURER shall supervise any disassembly of the shipped units and reassembly of the units in place inside the dewatering building by the installing Contractor (as applicable). Coordinate with installing Contractor on this.
 - 2. BFP MANUFACTURER shall assume full responsibility for proper installation of all equipment and provide complete warranty of the equipment and parts as described below.
- B. The following warranties shall be for each BFP:
 - 1. Provide a standard warranty of 12 months from substantial completion (beneficial use), unless otherwise noted for individual components below.
 - 2. Frame and coating:
 - a. Warrant for 5 years to be free of manufacturing defects without preventative maintenance.
 - b. Defects or corrosion occurring within the 5 years to the frame shall be repaired or replaced by BFP MANUFACTURER at no cost to the Owner.
 - 3. Belt life:
 - a. Warrant belt life for a minimum of 2,000 hours of continuous operation at the rated design conditions.
 - b. Minimum belt life shall cover wear and belt damage due to defects in the manufacture of the press or any of its components.
 - c. Belts not meeting the running hour minimum shall be replaced at no charge; running time begins the date of project acceptance or date of first beneficial use excluding testing and start-up use.
 - 4. Performance:
 - a. Warrant press performance as specified.
 - b. Presses not meeting the specified performance shall provide additional belt designs or shall modify the press as necessary until the specified performance level is reached at no additional cost to the Owner.
 - 5. Bearings:
 - a. Warrant the bearings for 3 years from substantial completion.
 - b. Warranty shall include all parts and labor for repairing or replacing bearings that fail during the warranty period providing the Owner has properly lubricated the bearing.

1.10 SPARE PARTS AND SPECIAL TOOLS

- A. Deliver spare parts in a crate to the Owner. Include the following for the BFPs:
 - 1. 1 set of filter belts guaranteed for 2,000 hours operating life for each press supplied:
 - a. Provide same spare belts as supplied with the presses.
 - 2. A complete set doctor blade (or discharge blade).
 - 3. 1 set of special tools and jacking tools for maintenance and belt replacement.
 - 4. 2 complete sets of sludge guides and rubber seals for the gravity and wedge zone.
 - 5. 1 set of washwater box seals and edge seals.
 - 6. Metric to English pipe coupling adapter for each metric drain pipe installed.
 - 7. Seals on drive unit.
 - 8. Oil filter screen for the hydraulic power unit for each press supplied.

PART 2 PRODUCTS.

2.01 MANUFACTURERS

- A. One of the following for the BFPs:
 - 1. BDP Industries 2.0 m 3DP.
 - 2. Alfa Laval G3 200 Klampress 3 Belt.
 - 3. Andritz SMX-S8.
 - 4. Approved Equal.
- B. For manufacturers to be considered as "Approved Equal", submit all documentation to the Owner as per Specification 01600, Section 1.05.E.
- C. Naming of the model number above does not relieve the BFP MANUFACTURER from meeting the details of manufacturing requirements within this specification.
- D. For other equipment (Polymer Blending Units) and Conveyors, see specifications Sections 11246 and 14555 respectively.
- E. The BFP MANUFACTURER shall take the lead on providing system responsibility for a completed dewatering equipment and handling system.

2.02 MATERIALS

- A. Frame: ASTM A36 steel, galvanized after fabrication in accordance with ASTM A123 (hot dipped galvanized), galvanizing process shall apply zinc at a minimum thickness of 4 to 7 mils.
- B. Drain trays: ASTM A242, Type 316 stainless steel, minimum 14 gauge.
- C. Internal piping: Schedule 80 polyvinyl chloride or ASTM A312, Type 316, schedule 10S stainless steel.
- D. Spray header housing: ASTM A242, Type 316L stainless steel, minimum 14 gauge.
- E. Belt wash spray tube: ASTM A312, Type 316 stainless steel pipe, schedule 10S.

- F. Belt wash spray nozzles: Flat non-clog ASTM A276, Type 316 stainless steel.
- G. Belt wash piping: Schedule 80 PVC.
- H. In-line venturi mixer: Flanged ASTM A276, Type 316 stainless steel housing.
- I. Polymer injection device: Flanged ultra-high molecular weight polyethylene injection ring and splitter manifold.
- J. Belt filter cloth: Seamed and fabricated of monofilament polyester twill.
- K. Belt seam closures: ASTM A276, Type 316 stainless steel.
- L. Rollers (solid):
 - 1. ASTM A36 carbon steel, or ASTM A519 tubing, minimum 1/2 inch wall thickness with 3/4-inch end plates.
 - 2. Drive rollers coated with minimum 1/4-inch thick Buna-N rubber.
 - 3. Other solid rollers coated with 25 mils minimum of thermoplastic nylon or 1/4-inch minimum of Buna-N rubber.
- M. Rollers (perforated): ASTM A242, A276, or A312, Type 316 stainless steel, minimum 10 gauge wall thickness.
- N. Inlet distribution assembly: ASTM A242, Type 316 stainless steel, minimum 10 gauge.
- O. Side skirts: ASTM A242, Type 316 stainless steel, minimum 14 gauge with replaceable rubber or urethane seals.
- P. Plows: ASTM A242, Type 316 stainless steel holders or galvanized cast iron holders with ultra-high molecular weight polyethylene (UHMW) blades.
- Q. Plow rods: ASTM A276, Type 316 stainless steel.
- R. Belt support grid: ASTM A242, Type 316 stainless steel grid (10 gauge minimum) with replaceable ultra-high molecular weight polyethylene (UHMW) wear bars.
- S. Belt support within wedge zone: ASTM A242, Type 316 stainless steel grid with replaceable ultra-high molecular weight (UHMW) wear bars or carbon steel hot-dip galvanized frame with UHMW polyethylene wear plates or ASTM A320 Type 316 stainless steel frame with perforated polyethylene sheets.
- T. Doctor blades: Ultra high molecular weight high-density polyethylene.
- U. Discharge deflection plate: ASTM A242, Type 316 stainless steel, and minimum 1/8-inch thick or 10 gauge.
- V. Anchor bolts and miscellaneous hardware, including bolts, nuts, washers, and fastener clips: ASTM A320, Type 316 stainless steel.
- W. Non-listed miscellaneous equipment: ASTM A242 or A276, Type 316 stainless steel, nylon coated.

- X. Bearing housings: ASTM A48 Class 30 cast iron.
- Y. Structural steel plates: ASTM A36 steel, minimum 1/4-inch thick, galvanized after fabrication in accordance with ASTM A123, galvanizing process shall apply zinc at a minimum thickness of 4 to 7 mils.
- Z. Electrical junction boxes (all electrical enclosures): NEMA Type 4X, Type 316 stainless steel or FRP.
- AA. Electrical conduit: Rigid steel, PVC coated.
- BB. Hydraulic cylinders:
 - 1. Body: FRP tube with high strength glass filled nylon head.
 - 2. Rod: ASTM A 242, Type 316 stainless steel with stainless steel tie rods, teflon seals, and graphite bearing.
- CC. Roller shafts: Forged steel ASTM 572 Grade 50.
- DD. Doctor blades: UHMW polyethylene.
- EE. Hydraulic tubing: Type 316 stainless steel rigid tubing.
- FF. Note: All carbon steel surfaces to be hot dip galvanized in accordance with ASTM A123 at a minimum thickness of 3.9 mils.

2.03 GENERAL REQUIREMENTS

- A. Each belt filter press shall be a complete prefabricated unit of at least a sludge conditioning system, a gravity drainage section, a pressure section, a belt alignment and tensioning system, and a belt washing system.
- B. Each belt filter press shall have a minimum effective dewatering width of 2.0 meters with 3 dewatering zones; gravity dewatering zone, wedge zone, and the pressure/shear section zone.
- C. Effective dewatering width: Belt area in contact with sludge performing a dewatering function.
- D. Belt replacement: Design system to allow belt replacement without disassembly of machine components or changes to belt pressure or alignment settings.

2.04 STRUCTURAL

- A. Framework:
 - 1. Designed to withstand operating (belt tension of 50 pounds per lineal inch, belt speed 5 meters per minute) and static loads without deformation or vibration during operation and without exceeding specified maximum deflection with the following minimum factor of safety of < 5.0 :
 - a. Maximum load shall be based upon the summation of forces applied to the frame including but not limited to roller and bearing mass forces and tension forces.
 - 2. Welded or bolted construction. No field welding of members allowed.

3. Framework surface shall be prepared for hot-dipped galvanizing in accordance with SSPC-SP-8 (pickling method) after fabrication. Galvanizing process shall apply zinc at a minimum thickness of 3.9 mils in accordance with ASTM A 123.
4. Provide permanent lifting lugs.
5. Load bearing members in the high pressure dewatering section:
 - a. Wide flange beams with minimum moment of inertia of 53 inches to the fourth power in the principal load-bearing direction.
 - b. Beams shall be a minimum flange thickness of 1/2 inch minimum web thickness of 5/16 inch.
6. Cross members: Minimum of 3 cross members each with a minimum moment of inertia of 3.01 inches to the fourth power.
7. Maximum stress in all frame members: Not more than 1/5 of the structural member's yield strength.
8. Maximum deflection in each structural member: Not more than L/480 where L equals span length.

2.05 DRAINAGE

- A. Drain pans: General:
 1. Provide drainage pans and piping to collect and discharge filtrate from the gravity dewatering and pressure/shear dewatering sections.
 2. Extend drain pans minimum of 3 inches beyond the belt width on both sides.
 3. Provide minimum of 2-inch high sides all around the drain pans.
 4. Provide minimum 6-inch diameter flanged connection at low point for drainage piping.
 5. Drain piping connection: Standard NPS American schedule pipe per ASME B36.19.
 6. Drain connections: Self-venting with flushing connections for cleaning.
 7. Drainage pan location shall not interfere with the moving belts and shall be rigidly connected to press frame.
- B. Drain pan under the entire length of the gravity zone:
 1. Drainage pan(s) and discharge pipes: Designed to withdraw a minimum of 375 gallons per minute without overflowing.
 2. Designed to prevent discharge of filtrate along the wedge zone.
 3. Gravity drainage piping combined into 1 common pipe which shall extend to allow for hard piping into a common drain line.
 - a. Drain line shall be extended to within 3 inches of the floor of the sump.
- C. Drain pan(s) in wedge and pressure zones:
 1. Interconnected and designed to allow for hard piping into a common drain line:
 - a. Drain line shall be extended to within 3 inches of the floor of the sump.
- D. Spray wash enclosure drain lines:
 1. Drain lines from each spray wash enclosure separated from drainage pan piping and interconnected into a common drain line:
 - a. Drain line shall be extended to within 3 inches of the floor of the sump.

2.06 BELT WASH SYSTEMS

- A. Manufacturers: The following or equal:
 1. Appleton Manufacturing, Menasha Corp., Menasha, WI.

- B. Design belt wash water system to use water with the following characteristics:
 - 1. Available washwater: Non-chlorinated, UV disinfected, plant reuse water.
 - 2. Minimum pressure available at the connection to the press washwater piping in accordance with specified performance requirements specified in this Section.
 - 3. Maximum pressure available at the connection to the press washwater piping: 120 pounds per square inch gauge.
 - 4. Solids content: Up to 50 milligrams per liter of suspended solids.
 - 5. Each belt press shall be provided with a 1-1/2 inch PVC connection for belt washing.
- C. Components:
 - 1. Upper and lower belt wash systems positioned so that washing is performed after the cake has been discharged from the belt.
 - 2. Pressure regulating valve: Sized to provide flow and pressure required for the belt wash system with inlet pressures as specified above.
 - 3. Nozzles: Replaceable, designed with a built in hand wheel operated stainless steel brush to provide cleaning action without disassembly; handwheel to extend to outside of press so brush can be operated without interruption of the belt press operation able to wash either side of the belt.
 - 4. Spray header housing:
 - a. Totally enclose the belt extending the full width of the belt plus 2 inches on either side.
 - b. Replaceable double rubber or nylon brush seals provided where the belt enters and exits the housing to eliminate spray in the work area.
 - c. Easily removable.
 - 5. Spray piping and nozzles:
 - a. Braced and of sufficient pressure rating to withstand pressure caused by sudden valve closure.
 - b. Spray pattern overlaps at the belt surface.
 - 6. Provide a motor operated ball valve or solenoid valve that operates the washwater system as specified.
 - 7. Low water pressure switch: Adjustable, provided to shut down the belt press and actuate alarm on the local control panel on low washwater pressure.

2.07 FILTER BELTS

- A. Belt filter cloth:
 - 1. Split type continuous belt design.
 - 2. Fixed edges along belt operating surface: Chamfered.
 - 3. Belt sides: Provide 1 inch wide protective resin coating.
 - 4. Minimum effective belt width: 2.0 meters.
 - 5. Minimum belt life: 2,000 operating hours.
 - 6. Minimum overall belt width: 2.2 meters.
- B. Belt seams:
 - 1. Repairable and easily replaceable.
 - 2. Connecting splice: designed for a minimum tensile strength equal to 5 times the normal maximum dynamic tension to which the belt is subjected.
 - 3. Seam designed to fail before the belt and constructed of Type 316 stainless steel.
 - 4. Seam designed not to interfere with doctor blades or any other equipment.

- C. Belt selection:
 - 1. As recommended by the BFP MANUFACTURER obtained from experience testing the sludge during start-up and as required to meet specifications:
 - a. The supplier shall test a minimum of 2 belts.

2.08 ROLLER AND DRUM ASSEMBLIES

- A. General:
 - 1. Provide three distinct dewatering zones, independent gravity zone, wedge compression zone and high pressure-dewatering zone. Each zone shall at a minimum have the specified minimum filtration area or working area. Independent gravity zone 92 feet square, the wedge zone 94 feet square and the high pressure zone 108 feet square.
 - 2. Provide minimum 24-inch diameter perforated drum followed by a 16" diameter perforated roll immediately following the wedge compression zone.
 - a. Perforations shall have a minimum diameter of 1 inch.
 - 3. Following the perforated roller, the belts shall travel through a series of rollers as determined by the BFP MANUFACTURER.
- B. Rollers:
 - 1. Construction:
 - a. Continuous shaft or double separated plate stub end shaft type with stub end shafts and roller heads welded in place.
 - b. Bolted-in-place stub end roller shafts are unacceptable.
 - 2. Minimum safety factor for the bending stress of the roller shafts at maximum loading as specified:
 - a. 5.0 for the pressure zone and drive rollers.
 - b. 5.0 for non-drive rollers and other rollers not in the pressure zone.
 - 3. Maximum loading: Based on the maximum summation of all forces applied to the roller including the forces exerted by the tension of the belts from the belt drive and belt tensioning devices (minimum of 200 pounds per lineal inch of belt width), friction forces, sludge and equipment loads, drive torque, and roller mass forces.
 - 4. Maximum roller deflection at maximum loading 0.05 inches at roller center:
 - a. Calculations shall include roller diameter and lengths, all shaft diameters and lengths, wall thickness, and degree of belt wrap.
 - 5. Rollers machined to ensure total concentricity.
 - 6. Pressure section roller shafts:
 - a. Minimum shaft diameter inside the roller: 5.0 inches.
 - b. Minimum shaft diameter inside the bearing journal: 2.95 inches.
 - 7. Perforated roller: Fitted with internal vanes to direct filtrate water to outlet ports at each end of the roller, to prevent re-wetting of the downstream cake.
- C. Roller surface preparation:
 - 1. Mechanical pipe sandblasted per steel structures painting council SSSP-10.
 - 2. Outside diameter tolerance to within 0.02 inch concentricity.
 - 3. End plate thickness minimum 1-inch at contact with inside diameter of roller.
 - 4. End plates welded to roller.
 - 5. Following lathing process, minimum roller wall thickness shall be 0.5 inches.
 - 6. All roller surfaces free of pits, blemishes, depressions, and ridges.

D. Roller coatings:

1. Drive rollers coated with minimum 1/4-inch thick vulcanized Buna-N rubber coating with a rubber hardness of Shore A 90-95.
2. Rollers other than drive rollers: Coated with a minimum 1/4-inch thick Buna-N or 25-mil thick coating of "Rilsan" nylon.
3. Buna-N coating properties:

Test	Value
Hardness (Shore A) (ASTM D676)	90
Hardness (Shore A) Vulcanized Buna-N	90-95
Tensile Strength (psi) (ASTM D412)	2,500
Tear Strength (pli) (ASTM D624)	250
Elongation (%) (ASTM D412)	160
Taber Wear Index (ASTM D394)	064
Resilience (%) (ASTM D2632)	17
Coefficient of friction	1-.4
Specific Gravity (water = 1.0)	1.31
Coefficient of Expansion (in/in/degree Fahrenheit)	40x10 ⁻⁶

4. "Rilsan" nylon coating properties:

Test	Conditions	Value
Shore D Hardness (ASTM D2240)	20 degrees C	77
Hardness Persoz (AFNORT 30-016)	Pendulum 20 degrees C	190
Specific Gravity (ASTM D792)	R Scale, 20 degrees C	1.06-1.20
Rockwell Hardness (ASTM D785)	20 degrees C, 20 sec. under load	106
Surface Hardness (DIN 53-456)	Clemen Apparatus	80 N/sq mm
Scratch Resistance (0.44 mm thickness)		59 N
Shear Strength (D 732)	RT & 45 degrees F	35 - 42 N/sq mm
Impact Resistance (ASTM D2294)		160 in-lbs
Elongation (ASTM D638)		15%
Abrasion Resistance (ASTM D4060)		8-18 mg wt loss
Coefficient of friction	Measured at thickness	0.10 - 0.30
Tensile Strength (ASTM D638)		6,000 psi
Inflammability greater than 3 mm (ASTM D635)		Self-extinguishing
Melting Point (ASTM D789)		370 degrees F

5. All rollers shall be coated up to the point of insertion into the bearing block, or shall have shafts and heads of Type 316 stainless steel.

2.09 BEARINGS

- A. Roller bearings:
 1. All rollers supported by externally mounted, self-aligning spherical roller bearings in sealed, splashproof, and grease lubricated horizontal split case pillow block housings.
 2. Bearings: Attached to turned, ground, and polished shaft journals on the rollers by direct mounting using an interference fit.
 3. Minimum bearing L-10 life: 600,000 hours at minimum belt speed of 5 meters per minute and belt tension of 50 pounds per inch. L-10 life calculated in accordance with ABMA 11 shall be based on the summation of all forces applied to the bearings including roller mass forces, belt tension, and drive torque on the rollers.
 4. Bearings: Series 222 spherical bearings with minimum self-alignment capability of plus or minus 3/8 of a degree and mounted in expansion and non-expansion pillow block housings.
 5. Lubrication: Required no more than every 6 months.
 6. Bearing shall be press fit to the roller shaft.
- B. Steering roller bearings:
 1. Bearings: Non-self-aligning cylindrical roller bearings in pivot mounted pillow block housings.
- C. Bearing housings:
 1. Housing: ASTM A48 Class 30 cast iron with minimum of 4 Type 316 stainless steel cap bolts and 2 mounting bolts.
 2. Housings cleaned, iron phosphated, and coated with a heat-treated thermoplastic nylon or Buna-N coating as specified with a minimum thickness of 8 - 12 mils.
 3. Located centrally on the structural beams with 2 mounting bolts on each side of the web.
 4. Outer side of the bearing housings: Solid without end caps or filler plugs.
- D. Bearing lubrication:
 1. Bearing lubrication shall be performed through Monel® or Type 316 stainless steel buttonhead grease fittings.
 2. All bearings shall be greasable while unit is in operation.

2.10 DEWATERING ZONES

- A. Gravity dewatering zone:
 1. General:
 - a. Minimum effective area of the gravity section shall be 88 square feet.
 2. Components:
 - a. Inlet distribution assembly:
 - 1) Distribute sludge evenly through a chute or distribution head box onto the horizontal section of the belt press with minimal turbulence at maximum hydraulic loading as specified in this Section.
 - 2) Provide adjustable baffles or similar devices to uniformly distribute the sludge feed across the entire working width of the filter belt.

- b. Number of plows: Minimum of 7 rows distanced laterally across the filter belt.
- c. Plastic row of plows provided with single lifting handle:
 - 1) Plows shall pivot to clear obstructions and move in either lateral direction to prevent belt seam damage.
 - 2) Plows designed to allow 1 inch vertical obstruction on the belt to pass under the plows without damage to the belt or plow with the plow able to return to its original position.
- d. Side skirts: Provide side skirts with replaceable seals along both sides of the belt to contain sludge on the belt.
- e. Belt support grid: Minimum 2 inches wider than the width of the belt spaced at a minimum of 2-1/2 inches.
- f. Wear strips: Designed to be removable and replaceable.
- g. Note: Vacuum assisted, inclined gravity section or gravity section that requires a separate belt drive motor are not acceptable.
- h. The independent gravity section shall be provided with hydraulic tension and tracking system as specified in this specification. Manual tensioning or tracking systems will not be acceptable.

B. Wedge dewatering zone:

1. General:

- a. Minimum effective filtration area of the wedge zone shall be 28 square feet (measured on one belt only).
- b. Wedge zone:
 - 1) Low pressure dewatering stage provided to gradually increase the filtration force on the cake for dewatering without leakage of sludge cake.
 - 2) Zone consists of a wedge shaped section in which the 2 pressure belts carrying the sludge are gradually converged to form a cloth/cake sandwich.
 - 3) Wedge angle shall be adjustable between 1 and 6 inches while the belt press is in operation.
- c. Splash guards: Provide to contain leakage from the wedge stage inside the belt press frame.
- d. No extrusion or spillage of sludge is allowed over solids and hydraulic loadings as specified.
- e. Maximum deflection: 0.06 inches at 2 pounds per square inch wedge pressure at mid-span.

C. Pressure/shear section:

1. General:

- a. Minimum effective working belt area of pressure/shear stage shall be 187 square feet.
- b. Effective working belt area: Effective width times the belt length in actual contact with the rollers.
- c. Pressure/shear section consisting of a minimum of 8 rollers developing an "S" shaped pattern of belt travel with decreasing diameter rollers toward the cake discharge.
- d. Pressure zone configuration: Able to remove filtrate from the sludge cake without rewetting the downstream cake.
- e. No extrusion or spilling of sludge is allowed from the belt within the pressure/shear stage.

- f. Sludge subjected to incremental increases in pressure without an increase in belt tension as sludge travels over decreasing diameter rollers.
- g. The use of impervious belts or nip rollers to apply external pressure to the sludge shall not be considered acceptable.

2.11 DOCTOR BLADES AND DEFLECTOR PLATE

- A. General: Provide doctor blades and discharge deflector plate to assist the separation of cake from the belt at the point of cake discharge.
- B. Doctor blades:
 - 1. Doctor blades:
 - a. Minimum length equal to length of roller.
 - b. Blades replaceable.
 - c. Provide lifting handle to allow quick release of the doctor blade from the belt for inspection and servicing.
 - 2. Blades with adjustable counter-weighted or spring tensioned on the ends of the doctor blade to allow adjustment of the force of the doctor blade against the belt.
- C. Deflector plate:
 - 1. If necessary to access scraper blades, provide discharge deflection plate hinged to the belt press frame on both ends to allow rotation up and designed with positive clasps to hold the deflection plate in the up and down positions.

2.12 BELT TRACKING AND TENSIONING SYSTEMS

- A. General:
 - 1. Provide automatic belt tracking and tensioning systems using hydraulic control systems:
 - a. Belt tension shall be infinitely variable up to 50 pounds per inch.
 - 2. Hydraulic piping:
 - a. Type 316 stainless steel with a design working pressure 1.25 times the operating pressure, rigidly anchored to the belt press frame.
 - b. All lines sized according to use and operating pressure with a conservative factor of safety by equipment manufacturer.
 - 3. Furnish sufficient piping for installation between the hydraulic unit or the air compressor unit and the connection to the belt press with locations indicated on the Drawings.
 - 4. Hydraulic systems: Include pumps, motor starters, reservoirs, motors, gauges, filter, oil level sight glasses, temperature gauge, valves, low/high pressure sensors, piping, and controls for system operation.
- B. Belt tracking system:
 - 1. Automatic sensing devices: Continuously monitors the position of the belt by use of a spring-loaded arm fitted with a ceramic plate which rides on the edge of the belt or a rubber covered roll situated across the machine's width.
 - 2. Alignment roller: Continuously adjusts the belt position to keep the belt within the belt track.
 - 3. Designed to smoothly adjust belt position without sharp, sudden movements of the belt or alignment roller.

4. Provide on each side of the belt filter press in NEMA Type 4X enclosures to detect malfunctioning of the tracking system:
 - a. Switches shall close on belt misalignment or over travel and shall shut down the press as specified with the controls.
 - b. The use of electric servos or systems which utilize devices that maintain alignment by a large snap action are not acceptable.
- C. Belt tensioning system:
1. Automatic sensing devices: Continuously monitor the tension of the belt shall be hydraulic actuated.
 2. Each belt shall be provided with a belt tensioning system. The belt tensioning system shall be hydraulically actuated. The design of the tensioning system shall be such that the dewatering pressure is directly proportional to belt tension and that adjustments in the tension shall result in immediate changes in dewatering pressure. Manual tensioning systems are not acceptable.
 3. Each belt tensioning shall be furnished with an individual control station such that independent adjustment for each belt is possible. The control stations shall incorporate an on/off selector, calibrated pressure regulating valve and a pressure gauge to indicate actual operating pressure on each system.
 4. Tension roller: Continuously adjusts to maintain a preset tension under varying dewatering sludge thicknesses.
 5. Capable of tensioning the belts to 50 pounds force per lineal inch of belt width.
 6. Limit switches: Provide manual adjustment to belt tensioning which can operate without stopping the belt press.
 7. Design tension rollers such that the dewatering pressure is directly proportional to the belt tension and that adjustments in tension shall result in immediate changes in dewatering pressure.
 8. Belt tensioning accomplished through parallel and simultaneous movement of the tension rollers.
 9. Tension rollers to have a pressure ram or piston on each end of the roller with mechanisms to ensure parallel and simultaneous movement of the tension rollers.
 10. Pressure gauge or similar device shall be provided to indicate belt tension in pounds per linear inch:
 - a. Indicate normal operating range on the gauge.
 11. Designed to accommodate a minimum of 2.5 percent increase in belt length.
 12. Provide sensor able to detect belt breakage and signal an alarm to the local control panel to shut down the belt press.
 13. Each belt shall be provided with a belt tensioning system:
 - a. Manual or electro servo tensioning systems are not acceptable.

2.13 HYDRAULIC SYSTEM

- A. General: Each belt filter press system shall be provided with a dedicated hydraulic power system to provide pressurized oil for the steering and tensioning.
- B. Hydraulic system:
 1. Unit shall consist of appropriately sized oil reservoir (316 SS), variable-displacement pressure compensated hydraulic oil pump and drive motor, oil filters, pressure switches and gauges, piping, valves, and other components required for a complete steering and tensioning system for each belt filter press.

2. The pump, motor, reservoir, oil filter, and valves shall be mounted directly to the belt filter press frame. Alternatively, the hydraulic unit shall be mounted away from the press with a minimum ½ inch 316 SS tubing connecting the hydraulic unit to the press. Hydraulic systems schematics and catalog cuts must be included in the equipment bid package.
3. Pressurized lines shall be 316 SS tubing and shall be rigidly supported on the structural frame of the press.
4. Hydraulic reservoir shall be made of 316 SS and include a 316L stainless steel drain valve to allow for draining to the hydraulic oil.
5. Reservoir and legs or base: Type 316 stainless steel.
6. Provide a variable displacement pressure compensated hydraulic pump with directly connected TEFC electric motor:
 - a. Reservoir capacity shall be 2 gallons or as applicable.
7. Provide fill, drain, clean out, and level gauge connections in each reservoir.
8. System to include oil strainer and line valves, pressure reducing valves, pressure gauge, flow control valves, hydraulic oil, and appurtenances.
9. Hydraulic pump motor:
 - a. Minimum 1 horsepower, maximum speed 1,200 revolutions per minute with motor starter mounted in the local control panel.
 - b. Motor shall not exceed noise level of 70 dBA.
10. Provide air cooled heat exchanger if necessary to prevent hydraulic fluid temperature from exceeding 140 degrees Fahrenheit.
11. Piping and valves: Minimum 1/4 inch size.
12. Provide pressure gauges at each point of application of hydraulic oil to the belt tracking and tensioning system.
13. Hydraulic tubing: Type 316 stainless steel.
14. All hydraulic devices including hydraulic cylinders and micro torque tracking devices connected by hydraulic tubing to a single manifold mounted on each press frame.
15. Provide a high and a low-pressure switch on hydraulic system to actuate an alarm at the press local control panel and shut down the press on high or low hydraulic pressure as specified with the controls.
16. All hydraulic components rated for maximum system operating pressure of 1,000 pounds per square inch.
17. Hydraulic system controls shall be grouped for easy access and ease of operation.
18. There shall be means provided to retract the belt tension cylinders for service.

2.14 EMERGENCY STOP TRIP CORDS

- A. Provide an emergency stop trip cord around each press with a switch mounted in a NEMA Type 4X enclosure. The switch shall be factory pre-wired to the control/signal terminal junction box. The switch shall have two contacts – one shall be connected to the associated BFP local control panel.

2.15 BELT PRESS DRIVE UNIT

- A. Variable speed drive units for each drive will be provided by Division 16 Installing Contractor and not part of the BFP supplier's scope:
 1. Speeds shall be adjustable while the machine is running.

2. Variable frequency drive will be provided in the MCC line-up by Division 16 Installing Contractor and not part of the BFP supplier's scope. MCC will be located in the new Electrical room.
- B. Electric motor shall be premium efficiency type drive unit meeting the requirements as specified in Section 16405 - Electric Motors:
1. Manufacturers: The following or equal:
 - a. Eurodrive.
 - b. Baldor
- C. Variable frequency drives to be provided by Division 16 Installing Contractor will meet the requirements as specified in Section 16485 - Variable Frequency Drives 0.50 - 50 Horsepower:
1. Variable frequency drive controls both motors wired in parallel so that rotational timing at the 2 drive rollers is controlled and frequency is matched, unless the Belt Filter Press Manufacturer is controlling drive rollers differently.
- D. Drive unit:
1. Helical bevel right angle gearshaft mounted gear reducer totally enclosed with all gears running in oil and all drive chains and sprockets completely enclosed in a housing.
 2. AC motor mounting to be C face.
- E. Safety guards: Type 316 stainless steel meeting the requirements as specified in Section 15050 - Common Work Results for Mechanical Equipment.
- F. Drive data:
1. Quantity per machine: 2.
 2. Variable speed driven:
 - a. Output speed: 0 to 7.50 revolutions per minute.
 - b. Belt speed: 0 to 19 feet per minute minimum.
 - c. AGMA HO Rating (input): 4.64.
 - d. Service factor: Minimum 1.5.
 - e. Service rating: AGMA Class II.
 3. Motor data:
 - a. Quantity per machine: 2 (Ashbrook) 2 (Andritz).
 4. Horsepower: Minimum 3 horsepower.
 5. Power requirements: 460 volts, 3 phase, 60 hertz.
 6. Maximum speed: 1,800 revolutions per minute.
 7. NEMA design: B.
 8. Ambient temperature: 40 degrees Celsius.
 9. Insulation class: F.
 10. Full load amps: 4.45
 11. Service factor: 1.15.
 12. Rated for continuous duty.
 13. Enclosure: TEFC, mill and chemical severe duty.

2.16 BELT FILTER PRESS LOCAL CONTROL PANEL

- A. Enclosures:
1. NEMA Type 4X, Type 316 stainless steel panel.
 2. Panel suitable for mounting free standing as shown on drawings.

3. Panels shall be free-standing vertical panels as specified in Section 17000 - Control Systems: Panels, Enclosures, and Panel Components modified to meet the above specification.
 4. Panel shall be U.L. listed and shall be assembled in a U.L. listed facility. Panel shall have a UL label affix to the panel.
 5. Provide a minimum of one LED light strip inside each panel that shall turn on when the door is opened. Provide and limit switch to active the interior light.
 6. Panels shall come with enough room to allow for construction of all planned mechanical equipment as shown in the Drawings without the need to construct or enlarge any future panel space (with the exception of the local control panels).
- B. Each belt filter press local control panel shall be prewired and tested with terminal strips for external wiring connections and shall have the following:
1. 120 VAC, 60 hertz, 1 phase power input.
 2. Main disconnect circuit breaker.
 3. Each belt filter press local control panel shall have a remote I/O (input/output) system and RIO system shall meet the requirements as specified in Section 17000 - Control Systems: There are no "or equal" substitutions allowed:
 - a. Allen-Bradley Compactlogix PLC (5370-L33ER) family remote I/O system including power supply, Ethernet communication module, discrete input, discrete output, analog input, analog output modules, etc.
 - b. Furnish and install fiber optic patch panel, Ethernet switch, Panelview touchscreen HMI, power supply, surge suppressors, terminal blocks, wireways, wirings, etc. as needed for a complete and functional belt filter press local control panels.
 - c. Furnish and install UPS (minimum size of 550VA) with bypass switch in each BFP local control panel.
 4. Alarm horn and strobe alarm light: LED alarm light on top of the local control panel to illuminate on any alarm condition with silence/reset buttons.
 5. LED Lights, pushbuttons, and switches as specified in this Section.
 6. Allen-Bradley Panelview Plus 6 graphic terminal, minimum 10.4 inch shall be provided on each belt filter press local control panel. Refer to Section 17000 for additional requirements. Panelview shall be mounted to the front of the belt filter press local control panel and operator shall be able to operate without needing to open the panel.
 7. Refer to Section 17000 for wiring, wiring marking, terminal blocks, fuse, surge protection device (SPD), surge arrestors, and other accessories requirements.
- C. Each belt filter press control system shall be in accordance with requirements specified:
1. The local control panel design will allow local manual operation or remote automatic operation of the BFPs. Furnish all necessary selector switches, E-stop mushroom type button, LED indication lights, push buttons, etc. for manual operation of the BFP and as listed in this specification and as shown on Instrumentation drawings (N-series drawings).
 2. The local control panel shall accept hard-wired I/O points as shown on Instrumentation drawings (N-series drawings). If additional I/O points are needed by BFP system such as pull cord trip signal, E-stop signal, etc. shall be included in the local control panel I/O system.

- D. Each belt filter press local control panel shall have the following control and LED indication lights located on the front of the control panel:
1. MANUAL/OFF/AUTO selector switch.
 2. Control power ON/OFF switch and LED indicator light.
 3. Emergency stop pushbutton (Red mushroom type).
 4. Belt press system alarm horn and strobe indication light.
 5. Alarm silence pushbutton.
- E. Located on the front of the control panel shall be a control power ON/OFF switch:
1. When in the ON position, the control power ON pilot light will be illuminated and control power shall be distributed to the control system.
 2. When in the OFF position, the control system shall be held de-energized.
 3. Also located on the control panel shall be an emergency stop pushbutton.
 4. It shall be an illuminated mushroom head style pushbutton that when depressed shall immediately de-energize all moving equipment in the system.
 5. An alarm horn shall be included for audible alarm annunciation.
- F. Panelview Touchscreen HMI located on the front of each belt filter press local control panel shall have a minimum of the following:
1. Auto Start pushbutton (Only visible in Auto Selection mode).
 2. Auto Stop pushbutton (Only visible in Auto Selection mode).
 3. Washdown cycle on indicator.
 4. Washwater valve OPEN pushbutton and OPEN indicator.
 5. Washwater valve CLOSE pushbutton and CLOSED indicator.
 6. Low washwater pressure alarm.
 7. Hydraulic pump START pushbutton.
 8. Hydraulic pump STOP pushbutton.
 9. Hydraulic pump RUNNING indicator (or air compressor RUNNING).
 10. Hydraulic HIGH PRESSURE FAULT alarm indicator.
 11. Hydraulic LOW PRESSURE FAULT alarm indicator.
 12. Belt drive START pushbutton with belt drive RUNNING indicator.
 13. Belt drive STOP pushbutton.
 14. Belt drive FAIL indicator.
 15. Belt speed potentiometer.
 16. Belt speed indicator in feet/minute.
 17. Sludge feed pump AUTO indicator.
 18. Sludge feed pump RUNNING indicator.
 19. Sludge feed pump FAIL alarm indicator.
 20. Sludge pump speed potentiometer.
 21. Sludge flow rate indicator (gallons per minute).
 22. Belt misaligned alarm indicator.
 23. Belt broken alarm indicator.
 24. High sludge alarm indicator.
 25. Emergency stop alarm indicator.
 26. Sludge feed pump START and STOP push buttons.
 27. Timer Shut-Off Mode ON/OFF indicator.
 28. 24-hour timer in 15-minute increments.
 29. Horizontal Conveyor system ON.
 30. Inclined Conveyor system ON.
 31. Conveyance system fail alarm indicating.
 32. And additional indicators and push buttons, if required by belt filter press manufacturer.

- G. BFP Control Description:
1. The control system for the presses will allow unattended operation, and must provide automated shutdown and system clean-up in AUTO mode.
- H. Operation - Belt Filter Press No. 1, and No. 2:
1. Each belt filter press local control panel (LCP) shall have a MANUAL/OFF/AUTO switch and HMI Panelview touchscreen.
 2. In the MANUAL mode, the BFP and all associated equipment necessary to operate the press will be manually started and controlled from the LCP thru HMI Panelview touchscreen.
 3. In AUTO mode, operator presses the AUTO START pushbutton at the LCP thru HMI Panelview touchscreen or the press receives the START signal from the PLC. The automatic start sequence involves a series of adjustable time delayed steps as described below. The adjustable time delays are set by the operator at the PLC.
 4. In AUTO, the start sequence is as follows:
 - 1) Washwater motorized valve opens.
 - 2) Hydraulic unit starts and the belts are automatically tensioned.
 - 3) After a preset time delay for belt tensioning, the belt drives start and the horizontal and incline conveyor system starts.
 - 4) The press operates for an adjustable time (initial setting 5 minutes) to pre-wet the belts.
 - 5) After the belts are pre-wetted, a signal shall be sent to start the sludge feed pump and polymer solution pump. The sludge feed pump and polymer solution pump shall start simultaneously. Note that the polymer feed pump and belt filter press feed pump are interlocked only when both units are in AUTO mode.
 - 6) In Auto mode, the sludge feed rate, and belt speed shall be automatically controlled by the PLC to the adjustable preset setpoints. Refer to specification 11246 (Polymer Blending and Feed Equipment – Liquid) for new Polymer system information. New polymer feed pump shall be automatically controlled by the PLC.
 - 7) Sludge and polymer feed rate and polymer usage shall be monitored by the PLC, if applicable. Sludge and polymer feed flow shall be indicated on the LCP Panelview HMI touchscreen.
 - 8) An emergency trip cord mounted on the press shall stop the press at any time. An emergency stop pushbutton on the LCP and graphical emergency stop pushbutton at the Panelview HMI touchscreen shall also stop the press and all associated equipment and pumps at any time. An emergency stop alarm light shall be indicated on the LCP. The emergency stop shall be interlocked to shut down all belt filter press system equipment whether in MANUAL or AUTO mode.
 - 9) The above sequence shall be programmed such that in each case, for a particular equipment (or motor) to start, the preceding equipment (or motor) in the sequence must be running. Otherwise, an alarm shall be annunciated and the sequence shall not resume until all alarms have been cleared.
 5. Under AUTO, the stop sequence is as follows:
 - a. Initiated by pressing the AUTO STOP pushbutton or by receiving a STOP signal from the PLC.
 - b. The sludge feed pump shall stop. The polymer pump shall also stop.
 - c. Horizontal and Inclined conveyors will stop after a preset time delay.

- d. The press shall enter washdown mode and the WASHDOWN ON indicator will be active on Panelview HMI screen.
 - e. After a preset time delay, the belt drives and hydraulic unit shall stop and the washwater motorized valve shall close:
 - 1) The time delay shall be adjustable.
6. The belt press may be started in manual mode by placing the MANUAL/OFF/AUTO selector switch in MANUAL. In MANUAL mode, the start sequence is as follows:
- a. MANUAL mode indicator is illuminated in HMI screen.
 - b. Operator presses the washwater valve OPEN pushbutton thru HMI screen.
 - c. Operator presses the hydraulic pump START pushbutton thru HMI screen.
 - d. After the belts are fully tensioned, the operator presses the belt drive START pushbutton thru HMI screen.
 - e. After a pre-wet time delay, the PRESS READY indicator light in HMI screen will be illuminated.
 - f. The sludge feed pump may be controlled at the LCP via HMI screen, if the pump HAND/OFF/REMOTE switches at each sludge feed pump VFD are in the REMOTE position. The polymer feed pump may be controlled at the LCP via HMI screen, if the polymer dilution system HAND/OFF/REMOTE switches at each polymer dilution system are selected in the REMOTE position. The sludge feed pump shall be controlled at the LCP with start/stop pushbuttons and speed adjustment thru HMI screen. When the sludge feed pumps are operated in HAND mode, the pumps must be started from their respective VFD panels with speed adjusted locally at the MCC.
7. The belt press systems and associated pumps are stopped manually by pressing the respective STOP push buttons in the reverse order to that stated above.
8. When any of the following fault conditions occur, whether the belt press is in AUTO or MANUAL mode, the appropriate fault indicator will be illuminated in HMI screen, and the belt press and all associated equipment will be shut down:
- a. Emergency stop.
 - b. Low washwater pressure.
 - c. Hydraulic low-pressure fault.
 - d. Belt misaligned.
 - e. Belt broken.
 - f. Belt drive fail.
 - g. Conveyor failure.
9. The following fault conditions will cause the AUTO STOP sequence to be initiated in the automatic mode. In MANUAL mode, the fault conditions will immediately stop the belt press and all associated equipment. Associated equipment includes all devices started in MANUAL mode as specified in this Section:
- a. No cake.
 - b. Sludge feed pump fail.
 - c. Loss of sludge flow.

- I. Polymer Feed Control:
 - 1. As part of on-going RAS/WAS project, there will be two TSS analyzers installed to the sludge feed pipes connected to the Dewatering Feed Box. The PLC program shall message with other Plant PLC to get the TSS values and perform an average calculation. PLC program shall use sludge feed flowmeter for each belt filter press and the calculated TSS values to determine the appropriate Polymer feed rate for each skid mounted polymer dilution system.

2.17 TERMINAL JUNCTION BOXES

- A. Each belt filter press shall be supplied with power terminal junction box and separate control/signal terminal junction box mounted on the belt filter press unit. Each terminal junction box shall be NEMA 4X 316 stainless steel and size as per NEC requirements. Factory installed wiring and raceways between each termination junction box and associated motor and belt filter press devices that are part of belt filter press assembly shall be provided with each belt filter press. Field wiring from belt filter press control panel, MCC, and other field devices shall be interfaced at the terminal junction.
- B. Electrical system components as specified in Division 16, including wiring, raceway, etc.

2.18 BELT FILTER PRESS MASTER CONTROL PANEL (PCP-DW)

- A. Enclosures:
 - 1. NEMA Type 12, minimum of 14 gauge or thicker aluminum, three-point latching mechanisms.
 - 2. Panel suitable for mounting free standing as shown on drawings.
 - 3. Panels shall be free-standing vertical panels as specified in Section 17000 - Control Systems: Panels, Enclosures, and Panel Components modified to meet the above specification.
 - 4. Panel shall be U.L. listed and shall be assembled in a U.L. listed facility. Panel shall have a UL label affix to the panel.
 - 5. Provide a minimum of one LED light strip inside the panel that shall turn on when the door is opened. Provide and limit switch to active the interior light.
- B. BFP master control panel shall be prewired and tested with terminal strips for external wiring connections and shall have the following:
 - 1. 120 VAC, 60 hertz, 1 phase power input.
 - 2. Main disconnect circuit breaker.
 - 3. BFP master control panel shall have a PLC and associated remote I/O (input/output) system. The PLC and RIO system shall meet the requirements as specified in Section 17000 - Control Systems: There are no "or equal" substitutions allowed:
 - a. Allen-Bradley Compactlogix PLC (5370-L33ER) family CPU and remote I/O system including power supply, Ethernet communication module, discrete input, discrete output, analog input, analog output modules, etc.
 - b. Furnish and install fiber optic patch panel, Ethernet switch, Panelview touchscreen HMI, other power supply, surge suppressors, terminal blocks, wireways, wirings, etc. as needed for a complete and functional PLC control panel.

- c. Furnish and install UPS (minimum size of 550VA) with bypass switch in the BFP master control panel.
 4. LED Lights, pushbuttons, and switches as specified in this Section.
 5. Allen-Bradley Panelview Plus 6 graphic terminal, minimum 10.4 inch shall be provided on each belt filter press local control panel. Refer to Section 17000 for additional requirements. Panelview shall be mounted to the front of the BFP master control panel and operator shall be able to operate without needing to open the panel.
 6. Refer to Section 17000 for wiring, wiring marking, terminal blocks, fuse, surge protection device (SPD), surge arrestors, and other accessories requirements.
- C. BFP master control panel shall be provided a minimum of 12-ports fiber optic patch panel with ST connectors, Allen-Bradley Stratix 2000 industrial unmanaged switch (model 1783-US6T2TG2F) and N-tron/Red Lion PoE switch Model 1000-POE4+. N-tron/Red Lion switch is for future camera system to be installed by installing Contractor.
- D. BFP master control panel shall communicate with BFP local control panels via Ethernet communication protocol thru fiber optic media and shall accept hard-wired signals from new truck loading conveyor control panel, new conveyor control panel, new polymer dilution skids, new MCC-3, and other miscellaneous system as shown on Instrumentation drawings. BFP master control panel shall be provided with all signals shown on instrumentation drawings and spare 25 percent input/output active spare points of each I/O type supplied plus additional 25 percent input/output module expansion capacity/spare slot in the I/O rack. The PLC power supply shall have sufficient capability to handle the power requirements of all the PLC components and I/O points and spare I/O points as describes in specification 17000. Below are the I/O list to assist with Contractor to identify the I/O point type and quantity. If any conflicts between the I/O list and the instrumentation drawings, Contractor shall adjust as needed and bring the conflicts to Engineer's attention with the proposed resolution. If the I/O listed below are connecting to the associated BFP local control panel, BFP supplier shall have the option to eliminate those signals from the BFP master control panel:
1. Polymer Tote No.1 Weight (AI – Analog Input), WI-TKPL01.
 2. Polymer Tote No.2 Weight (AI), WI-TKPL02.
 3. Polymer Dilution System No.1 Start/stop (DO – Discrete Output), HS-PDS01.
 4. Polymer Dilution System No.1 Running Indication (DI – Discrete Input), QI-PDS01.
 5. Polymer Dilution System No.1 Fail Alarm (DI), QA-PDS01.
 6. Polymer Dilution System No.1 In Auto (DI), QI-PDS01A.
 7. Polymer Dilution System No.1 Speed Command (AO – Analog Output), SC-PDS01.
 8. Polymer Dilution System No.1 Speed Indication (AI), SI-PDS01.
 9. Polymer Dilution System No.1 Water Flow Rate (AI), FI-PDS01A.
 10. Polymer Dilution System No.1 Calculated Pump Flow (AI), FI-PDS01B.
 11. Polymer Dilution System No.1 Polymer Solution Concentration Setpoint (AO), SP-PDS01.
 12. Polymer Dilution System No.2 Start/stop (DO), HS-PDS02.
 13. Polymer Dilution System No.2 Running Indication (DI), QI-PDS02.
 14. Polymer Dilution System No.2 Fail Alarm (DI), QA-PDS02.
 15. Polymer Dilution System No.2 In Auto (DI), QI-PDS02A.

16. Polymer Dilution System No.2 Speed Command (AO – Analog Output), SC-PDS02.
17. Polymer Dilution System No.2 Speed Indication (AI), SI-PDS02.
18. Polymer Dilution System No.2 Water Flow Rate (AI), FI-PDS02A.
19. Polymer Dilution System No.2 Calculated Pump Flow (AI), FI-PDS02B.
20. Polymer Dilution System No.2 Polymer Solution Concentration Setpoint (AO), SP-PDS02.
21. Future Polymer Dilution System No.3 Start/stop (DO), HS-PDS03.
22. Future Polymer Dilution System No.3 Running Indication (DI), QI-PDS03.
23. Future Polymer Dilution System No.3 Fail Alarm (DI), QA-PDS03.
24. Future Polymer Dilution System No.3 In Auto (DI), QI-PDS03A.
25. Future Polymer Dilution System No.3 Speed Command (AO), SC-PDS03.
26. Future Polymer Dilution System No.3 Speed Indication (AI), SI-PDS03.
27. Future Polymer Dilution System No.3 Water Flow Rate (AI), FI-PDS03A.
28. Future Polymer Dilution System No.3 Calculated Pump Flow (AI), FI-PDS03B.
29. Future Polymer Dilution System No.3 Polymer Solution Concentration Setpoint (AO), SP-PDS03.
30. Future Polymer Dilution System No.4 Start/stop (DO), HS-PDS04.
31. Future Polymer Dilution System No.4 Running Indication (DI), QI-PDS04.
32. Future Polymer Dilution System No.4 Fail Alarm (DI), QA-PDS04.
33. Future Polymer Dilution System No.4 In Auto (DI), QI-PDS04A.
34. Future Polymer Dilution System No.4 Speed Command (AO), SC-PDS04.
35. Future Polymer Dilution System No.4 Speed Indication (AI), SI-PDS04.
36. Future Polymer Dilution System No.4 Water Flow Rate (AI), FI-PDS04A.
37. Future Polymer Dilution System No.4 Calculated Pump Flow (AI), FI-PDS04B.
38. Future Polymer Dilution System No.4 Polymer Solution Concentration Setpoint (AO), SP-PDS04.
39. BFP Feed Pump No.1 Start/stop (DO), HS-FP001.
40. BFP Feed Pump No.1 Running Indication (DI), QI-FP001.
41. BFP Feed Pump No.1 Fail Alarm (DI), QA-FP001.
42. BFP Feed Pump No.1 In Remote (DI), QI-FP001A.
43. BFP Feed Pump No.1 Speed Command (AI), SC-FP001.
44. BFP Feed Pump No.1 Speed Indication (AO), SI-FP001.
45. BFP Feed Pump No.2 Start/stop (DO), HS-FP002.
46. BFP Feed Pump No.2 Running Indication (DI), QI-FP002.
47. BFP Feed Pump No.2 Fail Alarm (DI), QA-FP002.
48. BFP Feed Pump No.2 In Remote (DI), QI-FP002A.
49. BFP Feed Pump No.2 Speed Command (AI), SC-FP002.
50. BFP Feed Pump No.2 Speed Indication (AO), SI-FP002.
51. BFP Feed Pump No.3 Start/stop (DO), HS-FP003.
52. BFP Feed Pump No.3 Running Indication (DI), QI-FP003.
53. BFP Feed Pump No.3 Fail Alarm (DI), QA-FP003.
54. BFP Feed Pump No.3 In Remote (DI), QI-FP003A.
55. BFP Feed Pump No.3 Speed Command (AI), SC-FP003.
56. BFP Feed Pump No.3 Speed Indication (AO), SI-FP003.
57. BFP Feed Pump No.4 Start/stop (DO), HS-FP004.
58. BFP Feed Pump No.4 Running Indication (DI), QI-FP004.
59. BFP Feed Pump No.4 Fail Alarm (DI), QA-FP004.
60. BFP Feed Pump No.4 In Remote (DI), QI-FP004A.
61. BFP Feed Pump No.4 Speed Command (AI), SC-FP004.
62. BFP Feed Pump No.4 Speed Indication (AO), SI-FP004.
63. BFP Feed Pump No.5 Start/stop (DO), HS-FP005.

64. BFP Feed Pump No.5 Running Indication (DI), QI-FP005.
65. BFP Feed Pump No.5 Fail Alarm (DI), QA-FP005.
66. BFP Feed Pump No.5 In Remote (DI), QI-FP005A.
67. BFP Feed Pump No.5 Speed Command (AI), SC-FP005.
68. BFP Feed Pump No.5 Speed Indication (AO), SI-FP005.
69. BFP No.1 Sludge Feed TSS (AI), AI-BFP01.
70. BFP No.2 Sludge Feed TSS (AI), AI-BFP02.
71. Future BFP No.3 Sludge Feed TSS (AI), AI-BFP03.
72. Future BFP No.4 Sludge Feed TSS (AI), AI-BFP04.
73. BFP No.1 Sludge Feed Flow (AI), FI-BFP01.
74. BFP No.2 Sludge Feed Flow (AI), FI-BFP02.
75. Future BFP No.3 Sludge Feed Flow (AI), FI-BFP03.
76. Future BFP No.4 Sludge Feed Flow (AI), FI-BFP04.
77. BFP Inlet Valve No.1 In Remote (DI), QI-BFPV01.
78. BFP Inlet Valve No.1 Position Command (AO), ZC-BFPV01.
79. BFP Inlet Valve No.1 Position Indication (AI), ZI-BFPV01.
80. BFP Inlet Valve No.2 In Remote (DI), QI-BFPV02.
81. BFP Inlet Valve No.2 Position Command (AO), ZC-BFPV02.
82. BFP Inlet Valve No.2 Position Indication (AI), ZI-BFPV02.
83. Future BFP Inlet Valve No.3 In Remote (DI), QI-BFPV03.
84. Future BFP Inlet Valve No.3 Position Command (AO), ZC-BFPV03.
85. Future BFP Inlet Valve No.3 Position Indication (AI), ZI-BFPV03.
86. Future BFP Inlet Valve No.4 In Remote (DI), QI-BFPV04.
87. Future BFP Inlet Valve No.4 Position Command (AO), ZC-BFPV04.
88. Future BFP Inlet Valve No.4 Position Indication (AI), ZI-BFPV04.
89. BFP No.1 Washwater Valve In Remote (DI), QI-WWV01.
90. BFP No.1 Washwater Valve Open Command (DO), ZCO-WWV01.
91. BFP No.1 Washwater Valve Close Command (DO), ZCC-WWV01.
92. BFP No.1 Washwater Valve Open Indication (DI), ZIO-WWV01.
93. BFP No.1 Washwater Valve Close Indication (DI), ZIC-WWV01.
94. BFP No.2 Washwater Valve In Remote (DI), QI-WWV02.
95. BFP No.2 Washwater Valve Open Command (DO), ZCO-WWV02.
96. BFP No.2 Washwater Valve Close Command (DO), ZCC-WWV02.
97. BFP No.2 Washwater Valve Open Indication (DI), ZIO-WWV02.
98. BFP No.2 Washwater Valve Close Indication (DI), ZIC-WWV02.
99. Future BFP No.3 Washwater Valve In Remote (DI), QI-WWV03.
100. Future BFP No.3 Washwater Valve Open Command (DO), ZCO-WWV03.
101. Future BFP No.3 Washwater Valve Close Command (DO), ZCC-WWV03.
102. Future BFP No.3 Washwater Valve Open Indication (DI), ZIO-WWV03.
103. Future BFP No.3 Washwater Valve Close Indication (DI), ZIC-WWV03.
104. Future BFP No.4 Washwater Valve In Remote (DI), QI-WWV04.
105. Future BFP No.4 Washwater Valve Open Command (DO), ZCO-WWV04.
106. Future BFP No.4 Washwater Valve Close Command (DO), ZCC-WWV04.
107. Future BFP No.4 Washwater Valve Open Indication (DI), ZIO-WWV04.
108. Future BFP No.4 Washwater Valve Close Indication (DI), ZIC-WWV04.
109. BFP No.1 Washwater Flow (AI), FI-WW001.
110. BFP No.2 Washwater Flow (AI), FI-WW002.
111. Future BFP No.3 Washwater Flow (AI), FI-WW003.
112. Future BFP No.4 Washwater Flow (AI), FI-WW004.
113. BFP No.1 Washwater Pressure (AI), PI-WW001.
114. BFP No.2 Washwater Pressure (AI), PI-WW002.
115. Future BFP No.3 Washwater Pressure (AI), PI-WW003.

116. Future BFP No.4 Washwater Pressure (AI), PI-WW004.
117. Horizontal Conveyor No.1 Start/stop (DO), HS-HSC001.
118. Horizontal Conveyor No.1 Running Indication (DI), QI-HSC001.
119. Horizontal Conveyor No.1 Fail (DI), QA-HSC001.
120. Horizontal Conveyor No.1 In Remote (DI), QI-HSC001A.
121. Inclined Conveyor No.1 Start/stop (DO), HS-ISC001.
122. Inclined Conveyor No.1 Running Indication (DI), QI-ISC001.
123. Inclined Conveyor No.1 Fail (DI), QA-ISC001.
124. Inclined Conveyor No.1 In Remote (DI), QI-ISC001A.
125. Future Horizontal Conveyor No.2 Start/stop (DO), HS-HSC002.
126. Future Horizontal Conveyor No.2 Running Indication (DI), QI-HSC002.
127. Future Horizontal Conveyor No.2 Fail (DI), QA-HSC002.
128. Future Horizontal Conveyor No.2 In Remote (DI), QI-HSC002A.
129. Future Inclined Conveyor No.2 Start/stop (DO), HS-ISC002.
130. Future Inclined Conveyor No.2 Running Indication (DI), QI-ISC002.
131. Future Inclined Conveyor No.2 Fail (DI), QA-ISC002.
132. Future Inclined Conveyor No.2 In Remote (DI), QI-ISC002A.
133. Truck Loading Conveyor Running Left (DI), QI-TLC001A.
134. Truck Loading Conveyor Running Right (DI), QI-TLC001B.
135. Truck Loading Conveyor Start/stop (DO), HS-TLC001.
136. Truck Loading Conveyor Fail (DI), QA-TLC001.
137. Truck Loading Conveyor In Remote (DI), QI-TLC001C.
138. Truck Loading Gate No.1 In Remote (DI), QI-EMG01.
139. Truck Loading Gate No.1 Open Command (DO), ZCO-EMG01.
140. Truck Loading Gate No.1 Close Command (DO), ZCC-EMG01.
141. Truck Loading Gate No.1 Open Indication (DI), ZIO-EMG01.
142. Truck Loading Gate No.1 Close Indication (DI), ZIC-EMG01.
143. Truck Loading Gate No.2 In Remote (DI), QI-EMG02.
144. Truck Loading Gate No.2 Open Command (DO), ZCO-EMG02.
145. Truck Loading Gate No.2 Close Command (DO), ZCC-EMG02.
146. Truck Loading Gate No.2 Open Indication (DI), ZIO-EMG02.
147. Truck Loading Gate No.2 Close Indication (DI), ZIC-EMG02.
148. Truck Loading Gate No.3 In Remote (DI), QI-EMG03.
149. Truck Loading Gate No.3 Open Command (DO), ZCO-EMG03.
150. Truck Loading Gate No.3 Close Command (DO), ZCC-EMG03.
151. Truck Loading Gate No.3 Open Indication (DI), ZIO-EMG03.
152. Truck Loading Gate No.3 Close Indication (DI), ZIC-EMG03.
153. Truck Loading Gate No.4 In Remote (DI), QI-EMG04.
154. Truck Loading Gate No.4 Open Command (DO), ZCO-EMG04.
155. Truck Loading Gate No.4 Close Command (DO), ZCC-EMG04.
156. Truck Loading Gate No.4 Open Indication (DI), ZIO-EMG04.
157. Truck Loading Gate No.4 Close Indication (DI), ZIC-EMG04.
158. Truck Loading Gate No.5 In Remote (DI), QI-EMG05.
159. Truck Loading Gate No.5 Open Command (DO), ZCO-EMG05.
160. Truck Loading Gate No.5 Close Command (DO), ZCC-EMG05.
161. Truck Loading Gate No.5 Open Indication (DI), ZIO-EMG05.
162. Truck Loading Gate No.5 Close Indication (DI), ZIC-EMG05.
163. Truck Loading Gate No.6 In Remote (DI), QI-EMG06.
164. Truck Loading Gate No.6 Open Command (DO), ZCO-EMG06.
165. Truck Loading Gate No.6 Close Command (DO), ZCC-EMG06.
166. Truck Loading Gate No.6 Open Indication (DI), ZIO-EMG06.

- 167. Truck Loading Gate No.6 Close Indication (DI), ZIC-EMG06.
- 168. PLC Panel power fail alarm (DI), QA-PCPDW.

- E. BFP master control panel shall have a minimum of 120V surge protection device (SPD) for incoming 120V, 1-phase power supply and surge arrester for 4-20mA signals coming from field instruments located outside the building.

2.19 BELT FILTER PRESS SYSTEM PLC PROGRAMMING AND COORDINATION MEETINGS

- A. The PLC program of belt filter press, horizontal and incline conveyor, polymer dilution system, sludge feed pumps, truck loading conveyor, etc. shall reside in the BFP master control panel (PCP-DW). The BFP master control panel (PCP-DW) will be located in the new Electrical Room. BFP's software programmer shall program BFP control strategy, including horizontal and incline conveyor, polymer dilution system, truck loading conveyor and associated motorized gates, etc. in the BFP master control panel PLC system. BFP's software programmer shall be mainly responsible for PLC programming associated with the Owner's pre-purchased packages (belt filter press system, polymer dilution system, and shaftless screw conveyors system). The installing Instrumentation Contractor shall be responsible for PLC programming associated with everything relating to the dewatering building system, except belt filter press systems, horizontal and incline conveyor, polymer dilution system, truck loading conveyor and associated motorized gates, etc. Belt filter press manufacturer shall provide HMI screens of local control panel and BFP master control panel. Installing Instrumentation Contractor shall create other HMI screens such as sludge feed pump system, other miscellaneous instruments, etc. that are not covered in the belt filter press manufacturer's scope.
- B. Belt filter press manufacturer shall include a minimum of three coordination meetings with the installing Instrumentation Contractor to coordinate the PLC programming of the BFP master control panel PLC and perform accordingly. The above coordination meetings shall be held at the construction site, unless otherwise agree by Owner/Engineer. Additionally, BFP manufacturer shall include 24 hours of phone calls and 24 hours of face-to-face meetings, a total of 48 hours.
- C. BFP's software programmer shall include an additional 60 hours on-site to fine tune control system and make minor software modifications in order to resolve any logic discrepancies encountered during start-up and testing. This shall be part of the bid price with no additional cost to the Owner. Only main control strategy will be listed in this specification. BFP's software programmer shall also provide other minor control strategies not specifically listed but stated in the drawings or in other specifications. The additional programming hours additional to the time required to perform start-up and testing of the system.

2.20 BELT FILTER PRESS SYSETM HMI PROGRAMMING

- A. Belt filter press manufacturer shall be responsible for HMI programming of the Panelview touchscreen HMI at each belt filter press local control panel.

2.21 SOURCE QUALITY CONTROL

- A. Un-witnessed Factory Testing (non-witness test):
 - 1. The complete BFP control system shall be an un-witnessed factory test, as much as possible before the witness test. Provide a written un-witnessed Factory Test Report for review and approval from Owner/Engineer prior to the witness test.
- B. Factory Acceptance Testing (Witness test):
 - 1. BFP supplier shall test the entire control system at the BFP's supplier factory. The BFP's software programmer shall simulate all inputs and outputs as applicable to the BFP system supplied. The BFP's software programmer shall load the application program into the PLC and HMI system. BFP supplier shall provide a daily schedule for FAT and at the end of each day to have a meeting to review the day's test results.
 - 2. BFP supplier and BFP's software programmer shall check each loop, including I/O mapping, scaling, setpoints, alarms, displays, and HMI screens. Correct deficiencies found and complete correction of deficiencies prior to shipment to site.
 - 3. BFP supplier and BFP's software programmer shall test the applicable control strategy listed in this specification and other specifications. Failed tests shall be repeated and witnessed by the Owner/Engineer.
 - 4. BFP supplier shall include in his bid for travel expenses for 2 persons (Engineers) and 2 Owner personnel, a total of 4 persons for the entire system WFT duration. WFT duration shall be a maximum of 2 days. Travel expense shall include airfare (one round trip per person), accommodation and food, and car rental for each person during WFT period.
- C. Instrumentation and Controls Meeting:
 - 1. In addition to the field services required per the sections, the BFP MANUFACTURER shall provide a qualified instrument and controls engineer to coordinate with the installing Contractor's Instrumentation System Supplier (ISS) during construction for the following meeting:
 - a. Pre-Construction Meeting:
 - 1) Meeting to coordinate all controls required from and to BFP vendor control panels to Plant SCADA. BFP MANUFACTURER shall share HMI screens with ISS for duplication at Plant SCADA for monitoring.
 - b. Pre-Start-up Meeting:
 - 1) Meeting to coordinate all loop check and functional readiness test, and start-up procedures before start-up of the BFP system. BFP MANUFACTURER shall coordinate with ISS for loading the BFP control function into the master BFP PLC panel and perform functional readiness test. ISS will perform loop check for all instrument and panels to be provided by BFP as well as provided by ISS.

PART 3 EXECUTION

3.01 INSTALLATION (BY INSTALLING CONTRACTOR – THIS IS PROVIDED FOR INFORMATION ONLY)

- A. Install products in accordance with manufacturer's instructions.
- B. Connect electrical power, water piping, polymer solution piping, and sludge piping.
- C. BFPs shall not, under any conditions be allowed to sit out-of-doors unprotected. At a minimum BFP units shall be covered with a waterproof material in the event of any precipitation and also at all times that construction does not require exposure of the equipment. Covering shall be securely anchored.

3.02 ADJUSTING

- A. Within 30 days after equipment is installed, prior to start-up testing and training, allow a minimum of 8 hours for factory-trained technician to adjust equipment.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Provide training as specified in Sections 01756 and 01010; require factory trained technician to train Owner in proper operation and maintenance of equipment:
 - 1. Allow minimum 4 training sessions of maximum 4 hours each following a course outline acceptable to the Design Engineer.
 - 2. Training sessions shall occur on 4 consecutive days at times acceptable to the Owner.
 - 3. Training to include both classroom and field training. As a minimum, cover the following subjects:
 - a. Start-up procedures.
 - b. Shutdown procedures.
 - c. Troubleshooting.
 - d. Selection of polymer types and dosages.
 - e. Replacement of dewatering belts.
 - f. Operating adjustments for performance optimization.
 - g. Preventive maintenance.
 - h. Maintenance procedures.
 - i. Emergency procedures.
 - j. Records keeping.
- B. Provide training within 30 days after completion of initial start-up and before handing over the operations to the Owner:
 - 1. Start training when sufficient experience with sludge character has been obtained.
- C. Produce and deliver electronic format of training to Owner upon completion of training.
- D. The BFP MANUFACTURER shall also provide three hard copies of the Engineer-approved Operations and Maintenance (O&M) Manuals 30 days prior to the training sessions.

3.04 PERFORMANCE TESTING

- A. Provide manufacturer's services for conducting field performance test to demonstrate equipment can meet specified performance requirements as specified in 01756 and below.
- B. Each belt filter press will be tested one at a time. The test period shall consist of one 6-hour steady state test runs on 3 consecutive days with sludge feed, sludge cake, and effluent (combined filtrate and washwater) samples taken at the start of each run and every hour thereafter resulting in a total of 7 samples of each type per day and 21 samples for the 3 day test per belt filter press. At a minimum, the testing shall be done at the design feed rate (both hydraulic and solids loading) during the test. If sufficient WAS is available, the testing shall be done at the maximum feed rate (both hydraulic and solids) to the extent possible. Coordinate with the Owner and installing Contractor to determine the test loading rates before the test and submit a field performance test protocol in coordination with the BFP manufacturer, to the Owner and Engineer for approval. The BFP manufacturer shall hire and pay for the services of a certified laboratory for all lab analysis:
 - 1. The sludge feed, dewatered cake, and effluent samples shall be analyzed for total suspended solids content. The sludge feed shall also be tested for percent VSS and percent ash content.
 - 2. The resulting solids contents shall be averaged and the average value of each type shall be used to judge satisfactory performance.
 - 3. Polymer solution strength and flow rate shall be recorded and dose in active pounds per dry ton. Maximum polymer usage shall be less than or equal to 30 active lb/DT.
 - 4. Sludge feed rate shall also be recorded.
- C. The BFP MANUFACTURER's representative shall operate the equipment during the test:
 - 1. The Owner shall furnish personnel to assist in the operation and to take samples.
 - 2. The Owner working with the installing Contractor shall also furnish sludge, water, utilities, sludge cake disposal, and routine test equipment.
- D. The BFP MANUFACTURER in consultation with the Owner and the Owner's current polymer supplier shall recommend the most suitable and cost effective polymer. BFP MANUFACTURER shall perform necessary polymer testing to determine the most appropriate polymer. If necessary, the BFP MANUFACTURER may choose to perform prior testing with different polymer types to determine the type of polymer and optimum dose for meeting the performance requirements. For any such testing, BFP MANUFACTURER shall coordinate with the installing Contractor and Owner and provide a detailed polymer test plan and also supply the polymer for this test. The BFP MANUFACTURER shall also provide field service staff to collect samples and also hire an outside laboratory for all analysis. Submit the test plan and results to the Owner and ENGINEER for review and approval. BFP MANUFACTURER shall coordinate with the installing Contractor for any instrumentation for measuring sludge feed or polymer feed rates.
- E. The equipment shall have passed the performance test if the specified cake solids, solids capture, and polymer use requirements are met with the press operating under design and maximum hydraulic and solids loading rates.

- F. Should the installed equipment fail to meet the specified performance requirements, the BFP MANUFACTURER shall within 30 days make changes in the equipment or method of operation as necessary and the equipment shall be retested at no cost to the Owner. If after a second 30-day period, the equipment still does not meet the performance criteria, the equipment shall have failed the performance test and the Owner shall require its removal and replacement with the specified equipment at no additional cost to the Owner.

END OF SECTION

SECTION 14555

SHAFTLESS SCREW CONVEYORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Shaftless screw conveyors.
- B. The Manufacturer shall be responsible for the supply of the shaftless screw conveyor system as described herein.
- C. Equipment Tag Numbers:
 - 1. H-CON-01 - Horizontal Conveyor No. 1.
 - 2. I-CON-01 - Inclined Conveyor No. 1.
 - 3. L-CON-01 - Loading Conveyor No. 1.
 - 4. H-CON-02 – Horizontal Conveyor No. 2 (future).
 - 5. I-CON-02 – Inclined Conveyor No. 2 (future).
 - 6. CK-E-SE-00X (X=1 thru 6) - six motorized gates for truck loading conveyor.
 - 7. LCP-CCP – Conveyor Control Panel.
 - 8. LCP-TLCP – Truck Loading Conveyor Control Panel.
 - 9. LCP-TLRCP – Truck Loading Remote Control Panel.

1.02 REFERENCES

- A. American Gear Manufacturer's Association (AGMA).
- B. American Institute of Steel Construction (AISC).
- C. American Iron and Steel Institute (AISI).
- D. American Welding Society (AWS).
- E. Conveyor Equipment Manufacturers Association (CEMA):
 - 1. 350-Screw Conveyors.
- F. National Electrical Code (NEC).
- G. National Electrical Manufacturer's Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

1.03 DEFINITIONS

- A. NEMA: Type 4X enclosure in accordance with NEMA 250.

1.04 SYSTEM DESCRIPTION

A. General:

1. Two (2) shaftless screw conveyors - one horizontal and one inclined per Belt Filter Press, and one reversible unloading conveyor with eight (8) drops, of which six (6) will have powered gates to collect and transport a continuous load of dewatered municipal waste activated sludge from belt filter presses (BFPs) to one of two tractor trailer loading zones. The unloading conveyor shall be designed to accept and handle cake from the future inclined conveyor.
2. The shaftless screw conveyor system equipment shall include, but not be limited to, the following items, all of which shall be supplied by the shaftless screw conveyor manufacturer:
 - a. Spiral fighting.
 - b. End shaft.
 - c. Drive.
 - d. Troughs and liners.
 - e. Covers.
 - f. Chutes and hoppers.
 - g. Conveyor supports.
 - h. Zero speed switches.
 - i. Safety accessories.
3. The conveyors shall be suitable for both intermittent and continuous loading and operation.
4. Controls and control strategy: As specified in Section 17000 - Instrumentation and Controls and as indicated on the Drawings.

B. Design Requirements and Criteria:

1. Base the standards for conveyor selection on these specifications and the operational experience of the manufacturer with shaftless screw conveyors and not standards developed for shafted screw conveyors.
2. Design the shaftless screw conveyor system to meet the following performance and design requirements.

Conveyor	H-CON-01	I-CON-01	L-CON-01
Design capacity - cu ft/hr	290 /each	290 /each	435 /each
Conveyed material density - lbs/cu ft	50	50	50
Conveyed material solids concentration (min) - %	14	14	14
Conveyed material solids concentration (max) - %	20	20	20
Length - feet	See Drawings (Note 1)	See Drawings (Note 1)	See Drawings (Note 1)
Incline angle	Horizontal	20°	Horizontal
Screw speed (max) - rpm	≤ 20	≤ 20	≤ 20
Maximum filling factor at design capacity (based on 100% being the circular area	≤ 45	≤ 45	≤ 45

Conveyor	H-CON-01	I-CON-01	L-CON-01
calculated from the screw outside diameter, not trough cross-sectional area) - %			
Loss of volumetric capacity due to incline - %	0	50	0
Flight outside screw diameter (min) - inches	≥ 11.25	≥ 11.25	≥ 13.25
Inner spiral required	By Mfgr	By Mfgr	By Mfgr
Trough width (min) - inches	≥ 12	≥ 12	≥ 14
Trough height (max) - inches	≤ 21	≤ 21	≤ 21
Trough thickness (min) - inches	11 gauge	11 gauge	10 gauge
Trough liner thickness (min) - inches	3/8	3/8	1/2
Cover thickness (min)	11 gauge	11 gauge	10 gauge
Drive end plate thickness (min) - inches	3/8	3/8	3/8
Non-drive end plate thickness (min) - inches	3/8	3/8	3/8
Location of drive (Note 3)	Per manufacturer	Per manufacturer	Per manufacturer
Minimum Drive horsepower	7.5	5.0	10.0
Reversing screw	No	No	Yes
Notes: (1) The drawings are based on available record drawings. The dimensions shown on the drawings should be field verified. The exact dimensions shall be verified by the installing Contractor and Conveyor Manufacturer's representative(s) and shall be finalized during shop drawing preparation. (2) Provide constant torque or current limiting soft starts as indicated on the electrical drawings. (3) For the inclined conveyor if the drive is located at the truck loading station, Contractor shall verify dimensions to ensure the drive can be located and supported off the existing truck loading station.			

3. The spiral flights shall be designed with the stability to prevent distortion and jumping in the trough. Hold-down provisions shall be provided described below.
4. The "spring effect" (maximum compression or elongation) of the spiral shall not exceed 0.10 inch per 1 foot of length at design load conditions when the following equation is used:

$$\text{Deflection} = 7.29nr^3P(b^2+h^2)/b^3h^3Gk$$

where:

$$k = (4c-1)/(4c-4) + 0.615/c$$

$$c = 2r/b$$

r = spiral radius

n = number of pitches

b = spiral width

h = spiral thickness

P = Load

G = 11,000,000 psi

(Mark's Handbook for Mechanical Engineers, latest edition)

5. In the extreme condition of start-up with 50 percent trough filling, at 250 percent of the motor nameplate horsepower, the maximum torque produced by the drive unit shall be not more than 75 percent of the torsional rating of the outermost fibers of the spiral flight.
6. The torque capacity of the drive unit shall be sufficient to start the conveyor with 100 percent trough loading.

C. Supports:

1. Provide full structural steel supports:
 - a. The inclined and horizontal conveyors shall be supported from the concrete floor as shown in the drawings.
 - b. The loading conveyor shall be suspended from concrete structural members over the truck loading area as shown in the drawings.
2. Provide conveyor supports fabricated of Type 316L stainless steel structural members:
 - a. The conveyor manufacturer shall be responsible for sizing the support structural members and anchors and shall include all required bracing to meet the application and Specification requirements.
 - b. For support design, assume the transport conveyor troughs 100 percent full with material weighing 60 pound per cubic feet.
3. All structural supporting members shall be designed such that the ratio of the unbraced length to least radius of gyration (slenderness ratio) shall not exceed 120 for any compression member and shall not exceed 240 for any tension member (of angles about Z-Z axis).
4. Design the supports to avoid interference with other equipment or equipment supports.
5. Conveyor support spacing shall not exceed 12 feet:
 - a. The conveyor manufacturer shall allow for 1-inch of grout beneath each support footpad for the installing contractor to compensate for uneven floor elevation.
6. Supports shall be shop fabricated, assembled, fitted to the conveyor, and match marked with the associated conveyor segments prior to shipment to the job site.
7. All shop welding shall conform to the latest standards of the AWS.

1.05 SUBMITTALS

- A. Submit as specified in Section 01330 - Submittal Procedures and Section 15050 - Common Work Results for Mechanical Equipment.
- B. Installation List:
 1. To verify conformance with the specified Manufacturer Qualifications as specified in Article 1.06.
 2. Must be included with the Substitution Request Form as part of the Proposed Substitutes "Or Equal" Submittal, and the regular Shop Drawing Submittal in accordance with Section 01330.
 3. Include the following information as a minimum:
 - a. Name and location of installation.
 - b. Name and telephone number of person in direct responsible charge of the equipment.
 - c. Month and year the equipment was placed in operation.
 - d. Size of Equipment: Length and diameter of shaftless screw.

- e. Design capacity and corresponding filling factor.
- f. Indicate whether single or double (outer plus inner) spiral was used.
- g. Manufacturer of spiral.
- h. Conveyor incline angle.
- i. Location of Drive: Push or pull system.
- j. Drive horsepower.
- k. Number of units installed.
- l. Service and material conveyed.
- m. Liner material.
- n. Panel layout, bill of materials, wiring diagrams, component cut sheets, etc.

C. Product data.

- D. Shop drawings: Include manufacturer's complete erection, installation, and adjustment instructions and recommendations, details of parts individually and severally, and detailed test procedures for field-testing. Also include screw diameter, pitch, rotational speed and torque tube diameter, equipment performance specifications, drive details, including service factor of gear reducer based on absorbed horsepower and installed motor horsepower. All drawings to be generated using a 3D Computer Aided Drafting program including but not limited to Autodesk Inventor, PTC ProEngineer, Dassault Systèmes SOLIDWORKS, or equal.

- E. Calculations: prepared, signed, and sealed by Professional Engineer registered in the State of Florida. Submit certified capacity, power and elongation calculations for the screw conveyor and spiral, respectively. Submit bearing life calculations for the gear reducer bearings and/or drive end bearings.

F. Operation and Maintenance Manuals.

- G. Submit structural design calculations and all other product drawings and information required for a complete submittal:

- 1. The structural calculations for the supports and anchoring of the unit and associated accessories as well any other structural supports as part of the system shall be done, signed, and stamped by a structural professional engineer in the state where the Project is located.
- 2. To insure Structural calculations are accurate for approved dimensions, Submittal may be submitted for dimensional approval prior to structural calculations and PE Stamp.

H. Commissioning submittals:

- 1. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756 - Commissioning.
- 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

- I. Video of factory test run on DVD or uploaded to FTP or Dropbox site.

- J. Submit warranty indicating liner and/or screw shall be replaced, along with labor to install said equipment, if either component fails within 15,000 hours or 3 years of equipment start-up, whichever occurs first.

1.06 QUALITY ASSURANCE

- A. Conveyor Manufacturer Qualifications:
1. Minimum 10 years' experience in construction and manufacturing of shaftless screw conveyor systems substantially similar to the specified equipment for the municipal wastewater treatment industry. The installation or reselling of shaftless screw conveyors shall not qualify as construction or manufacturing experience and will not be considered towards meeting the experience requirements.
 2. Installation List: Submit evidence of satisfactory operation of equipment similar to the specified equipment in at least 20 separate facilities in North America in accordance with the following requirements:
 - a. All equipment on the submitted installation list shall:
 - 1) Be in municipal wastewater industry application.
 - 2) Have the same spiral manufacturer and screw conveyor system manufacturer as proposed for this project.
 - 3) Have a minimum spiral diameter of 10 inches.
 - 4) Have a minimum spiral length of 30 feet.
 - 5) Be a conveyor separate from a compactor unit.
 - b. At least 3 of the installations shall also satisfy the following requirements:
 - 1) Years in Service: Minimum 3 years.
 - 2) Service: Dewatered municipal waste activated sludge.
 - 3) Incline: Between 20 degrees and 60 degrees.
 - 4) Spiral Length: Minimum 40 feet.
 - 5) Spiral Diameter: Minimum 10 inches.
 - c. Multiple equipment units at a plant shall be considered as one installation toward meeting the experience requirements.
 3. Manufacturer shall carry a current, valid certificate of ISO-Certification.
 4. Manufacturer shall be a current member of the Conveyor Equipment Manufacturer's Association.
 5. Manufacturer must carry an engineering staff of at least 10 degreed mechanical engineers.
 6. Manufacturer must fabricate at least 75 percent of the conveyor parts by weight and fully assemble & test the conveyors at the same facility where the engineering design staff is located. Manufacturers who subcontract the fabrication or assembly or procure the 75 percent parts from offsite are unacceptable to meet the desired standards for quality and design.
- B. Fulfillment of the specified experience requirements shall be a condition of acceptance.
- C. The gear reducer/motor drive unit shall be manufactured in the U.S.
- D. Manufacturer's shop welds, welding procedures, and welders: Qualified and certified in accordance with the requirements of ANSI/AWS D1.1, or ASME Boiler and Pressure Vessel Code Section IX. Welding shall be by the metal-arc method or gas-shield arc method described in the American Welding Society's Welding Handbook as supplemented by other AWS standards. Qualifications of welders shall comply with AWS Standard AWS D1.198. The equipment must be inspected by AWS certified welding inspectors and instructors.

- E. Screw Conveyor System: Shop inspected, assembled, adjusted and tested for proper fit before shipping.
- F. Manufacturer's not listed in this specification shall provide a formal request to the Owner 25 days before the opening of the bids and provide all of the above information (Section 1.06 A through D) to the Owner for approval along with the formal request. Additionally Manufacturer shall also clearly state all exceptions taken to this specification in the submittal. Owner reserves the right to accept or reject the bids for no reason. Owner may require manufacturer to submit additional information to be considered as "approved equal".

1.07 DELIVERY, STORAGE AND HANDLING

- A. MANUFACTURER shall coordinate delivery, shipping and handling, field dimensions and coordination with the installing Contractor and Owner. The MANUFACTURER shall deliver all conveyors at agreed upon dates with the installing Contractor and Owner. MANUFACTURER shall request the construction schedule from the Installing Contractor after the Contractor receives the Notice-to-Proceed (NTP) from the OWNER for the construction of dewatering system improvements. MANUFACTURER shall request the equipment delivery schedule confirmation at a minimum 60 days in advance and another at a minimum 15 days in advance of shipping the unit(s). MANUFACTURER shall provide the installing Contractor all necessary information to proper handling of the delivery and storage of the equipment and any assembly required on-site as necessary before installation.
- B. Shaftless Screw Conveyor System:
 - 1. Factory assembled before shipment to ensure proper fit of all components.
 - 2. Ship equipment in the minimum practical number of pieces for field assembly by the Contractor.
 - 3. Refer to Section 01600 for additional requirements.

1.08 WARRANTY

- A. MANUFACTURER shall warrant conveyor equipment (delivered under this solicitation) free of defects in material and workmanship for a period of 3 years from the date of Operational Acceptance or date of first beneficial use of the equipment by the Owner (or 42 months from shipment, whichever comes first). Cover parts and labor except for normal wear of the trough liner. The shaftless spiral must carry a warranty of 5 years beneficial use guarantee before replacement is needed.
- B. Manufacturer's warranty shall be issued in the Owner's name.

1.09 MAINTENANCE

- A. Spare Parts: Furnish the following spare part packed and labeled for warehouse storage:

Item	Quantity
1. Trough Liners	1 set for the longest conveyor of each size
2. Motor for Drive Unit	1 each size
3. Shaft Seals	1 set of all shaft seals for each shaft size
4. Rotation Sensor	1 set of rotation sensor
5. Emergency Stop Switch	1 set without enclosure

- B. Special Tools: Furnish any special tools required for maintenance and disassembly of furnished equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Shaftless screw conveyor: One of the following or approved equal:
1. Spirac.
 2. Keystone.
 3. KWS Manufacturing Company.
 4. Custom Conveyor Corporation.
- B. For manufacturers to be considered as "Approved Equal", submit all documentation to the Owner as per Specification 01600, Section 1.05.E.

2.02 MATERIALS

- A. Shaftless screw conveyor: The shaftless screw conveyor shall be new and of current manufacture, and shall be designed to transfer municipal dewatered sludge as specified and shall be constructed in accordance with CEMA 350 standards.
- B. Trough: AISI Type 316 stainless steel.
- C. Drive and End Plates: AISI Type 316 stainless steel.
- D. Covers: AISI Type 316 stainless steel.
- E. Spiral Flights (certified by manufacturer): Cold-formed chrome alloy steel, Brinell 225 hardness (minimum), 80,000 psi yield strength (minimum), with inner and outer spirals.
- F. Wear Liner: Ultra high molecular weight polyethylene (UHMWPE) impregnated with a lubricating agent for increased anti-wearing:
1. Density: 59 pounds per cubic foot, minimum.
 2. Hardness: 62 Shore D, minimum.
- G. Chutes, Hoppers: AISI Type 316L stainless steel.
- H. Supports: AISI Type 316L stainless steel.
- I. Hardware, Fasteners, Lifting Lugs: Type 18-8 stainless steel.

- J. Drive Shaft: AISI 1045. Shafts to be complete with flanged ends and mating bolt holes to match the conveyor spiral flanged end plates. Shaft to be integral with the shaft flange as a single-piece. Shafts welded to a flange are not acceptable.
- K. Conveyor support system structural elements, including but not limited to anchor bolts, support framing, and structural connection bolts: As specified in Section 05120 - Structural Steel.
- L. Conveyor system welded elements: Materials as specified in Section 05120 - Structural Steel.
- M. Fabrication:
 - 1. All welds shall be continuous unless otherwise specified.
 - 2. Facing surfaces of bolted joints shall be shop primed.
 - 3. Passivate or bead blast stainless steel welds.
 - 4. Facing surfaces of field welded components shall be beveled and match marked.
- N. Edge grinding: Sharp corners of all cut and sheared edges shall be made smooth.

2.03 SPIRAL FLIGHTING

- A. Design spiral lighting to convey material without a center shaft and designed with the stability to prevent distortion and jumping in the trough.
- B. Form spiral lighting in sections from 1 continuous flat hot-rolled spring steel bar:
 - 1. Material shall be corrosion-resistant micro-alloy steel bar and be concentric to within 1/16 inch.
 - 2. Spirals formed from cut plate are not permitted.
- C. The spiral shall be cold formed into the final diameter and pitched in 2 separate forming stages to reduce spiral neck-down and eliminate spiral cracking.
- D. The spiral shall be rolled in such a way as to limit "neck-down" of the outside edge of the cold-rolled spiral to 10 percent of the thickness of the inside edge of the spiral:
 - 1. The spiral edges shall be smooth in the as-rolled condition and not show cracks or grinding marks when tested with a dye penetrant.
- E. Connect spiral lighting to the drive shaft by welding the spirals to a 3/4-inch minimum circular torque plate properly reinforced with a gusset 180 degrees of the coupling disk:
 - 1. A separate connection plate shall be bored with a hole equal to the shaft, and the drive shaft shall be concentrically welded to the plate to effectively transmit torque and bolted to the torque plate.
 - 2. All welded connections on the spiral including drive plate, gusset and spiral splices should be mag flux tested to ensure there are no defects in the welds.
- F. Spiral connections shall be AWS requalified full penetration welds:
 - 1. Flights shall be welded in a jig to assure true alignment.

- G. All spirals shall have a welded insert to increase strength and decrease fall back.
- H. Spirals shall be manufactured by the conveyor manufacturer, since the spiral is integral with successful operation of the unit, spirals purchased from third party vendors will not be allowed.

2.04 TROUGH AND COVER

- A. Trough shall meet the dimensional standards of CEMA 350. Trough size, thickness, and material shall be as specified herein.
- B. Trough shall be U-shaped with stiffeners across the top, fastened to both sides of the trough to maintain trough shape and act as a face seal for each cover section. At filling openings, provide a trough stiffener on each side of opening.
- C. Apply a full-face continuous neoprene gasket to the entire top face of the trough top flange and stiffeners.
- D. Trough sections shall be joined using bolted flanged connections and neoprene gaskets.
- E. Equip each trough with filling and/or discharge openings as indicated in the Drawings. Each filling and discharge opening shall be flanged, suitable for connection to other devices such as slide gates, chutes, and hoppers:
 - 1. Discharge openings from conveyors shall have a length not less than 1.5 times the spiral pitch nor less than the dimension indicated on the Drawings.
 - 2. Discharge openings from conveyors shall have a width equal to the full width of the U-trough.
- F. Flare the trough immediately above top of liner at the locations of filling chutes where indicated on the Drawings.
- G. Provide each transport conveyor with two 3-inch flanged drain outlet located at each end plate as shown on the Drawings.
- H. The portion of each trough that is not covered by a filling chute shall be covered by a bolted cover of a material identical to the trough.
- I. Cover sections shall be 5-foot length, maximum.
- J. Holddown provisions - Holddown provisions shall be provided as recommended by the manufacturer to secure spiral flighting in trough bottom. Holddowns shall be bolted to trough and design shall not impede material flow. As a minimum, holddown shall be provided every 10 pitches of spiral length and each holddown shall span 1.5 pitches as a minimum. Holddown provisions shall not require regular maintenance and any wear component shall have a life greater than or equal to the life of the trough liner.
- K. Covers shall be bolted at 24-inch spacing maximum. To prevent unsafe access to the conveyors, quick opening covers will not be accepted.

- L. Provide covers with stainless steel hinged observation hatches at suitable locations. At each hatch location, provide the cover with a stainless steel mesh guard to block access to the spiral.
- M. Provide each conveyor with two 6-inch flanged connections to connect to odor control ductwork as indicated on the drawings. Only one connection may be used. The other connection shall then be closed with a blind flange.

2.05 TROUGH LINER

- A. Provide the conveyor trough with a wear liner fabricated of ultra high molecular weight polyethylene (UHMWPE) impregnated with a lubricating agent.
- B. Wear liner thickness shall be as specified herein.
- C. The liner shall be provided with a visual indication (using colors) of excess wear.
- D. Wear liner coefficient of thermal expansion shall match that of the trough material.
- E. Wear liner shall be the following type, or approved equal:
 - 1. Wear-Alert UHMW by KWS Mfg.
 - 2. DURAFLO SPX by SPIRAC, Inc.
 - 3. POLYSTONE M by Custom Conveyor Corporation.
- F. The wear liner shall be furnished in maximum 4-foot long sections. Shorter liner sections will be required at some locations to provide liner joints at specific locations indicated on the Drawings.
- G. Each liner section shall be held in place with a minimum of four Type 316L retainer bars permanently welded to the trough at 180 degrees along the trough. Fasteners that penetrate the trough will not be accepted.

2.06 SUPPORTS

- A. Provide conveyor supports fabricated of Type 316L stainless steel structural members. The support types and configurations shall be as shown on the Drawings. The conveyor manufacturer shall be responsible for sizing the support structural members and anchors and shall include all required bracing to meet the application and Specifications requirements. For support design, assume the conveyor trough is 100 percent full with material weighing 60 lb/cf.
- B. All structural supporting members shall be designed such that the ratio of the unbraced length to least radius of gyration (slenderness ratio) shall not exceed 120 for any compression member and shall not exceed 240 for any tension member (of angles about Z axis).
- C. All structural members and connections shall be designed so that the unit stresses will not exceed the American Institute of Steel Construction (AISC) allowable stresses by more than 1/3 when subject to loading of twice the maximum design operating torque of the spiral conveyor drive motors.

- D. At a minimum, each conveyor shall be provided with supports at each end, with intermediate supports as shown on the Drawings. If required, provide additional supports as determined by the calculations.
- E. Design the supports to avoid interference with other equipment or equipment supports.
- F. Conveyor support spacing shall not exceed 12 feet.
- G. Supports shall be shop fabricated, assembled, fitted to the conveyor, and match marked with the associated conveyor segments prior to shipment to the job site.
- H. All shop welding shall conform to the latest standards of the American Welding Society (AWS).
- I. Adjustable packing gland seal shall be provided where the drive shaft projects through conveyor end plate. Seals shall utilize a split follower to facilitate the changing of the packing material and to be complete with not less than three (3) ½ inch square packing rings per stuffing box. Provide grease fitting with lantern ring to lubricate the packing rings.

2.07 CHUTES AND HOPPERS

- A. The chutes and hoppers shall be sized to accommodate the entire discharge end from the specified belt filter press per Section 11362. Conveyor manufacturer shall coordinate with BFP Manufacturer for system responsibility for sizing. Any chutes and hopper of inadequate dimensions shall be changed out at no cost to the Owner.
- B. Fabricated from the same material as the conveyor trough.
- C. Construct of 3/16-inch wall thickness with 3/8-inch flanges for connection to the cake pump(s) one end. Provide chutes with external body reinforcing stiffeners as required.
- D. Provide neoprene gaskets at flanged connections.
- E. Where indicated on the Drawings, provide chutes with stainless steel hinged observation hatches. At each hatch location, provide a stainless steel mesh guard to block access to the spiral.
- F. Provide each chute section with handles and lifting lugs for easy handling for sections weighing over 100 lbs.
- G. Provide chutes with flexible neoprene sections where applicable. Attach neoprene chute section to stainless steel chute using stainless steel clamps.
- H. Provide chutes with supports as required. Include chute support calculations with submittal for review by the Engineer.

2.08 DRIVE UNITS

- A. Each spiral conveyor shall be driven by a constant-speed integral gear reducer/motor drive unit mounted to an adapter flange, which is in turn mounted to the end plate of the conveyor.
- B. The adapter flange shall allow the leakage of any material from the conveyor trough to atmosphere rather than into the gear reducer/motor drive unit. Direct coupling of the gear reducer/motor drive unit to the end flange of the conveyor will not be accepted.
- C. The drive unit shall be rigidly supported so there is no visible "wobble" movement under any operating condition.
- D. The drive system shall be designed, at a minimum, to start the conveyor from a dead stop with the trough filled throughout its entire cross sectional area and length with partially dried and hardened dewatered material.
- E. The drive unit shall be a hollow shaft mounted drive.
- F. Gear Reducers:
 - 1. All gears shall be AGMA Class II, single, double, or triple reduction, helical gear units with high capacity roller bearings.
 - 2. Bearings shall be designed for the thrust loads from the fully loaded startup condition and shall have an AFBMA B10 life of 30,000 hours minimum.
 - 3. V-belt driven speed reducers or chain driven reducers will not be accepted.
 - 4. The reducer shall be the standard air-cooled unit with no auxiliary cooling required.
 - 5. The gear reducer shall be sized with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate, at the driven shaft speed, whichever is greater.
- G. Motor:
 - 1. Motor shall be as specified in Division 16 except as modified herein.
 - 2. Motor horsepower for each conveyor shall be as specified herein.
 - 3. Constant speed, 460 V, 60 Hz, 3 phase.
 - 4. Maximum speed: 1750 rpm.
 - 5. Ambient temperature (degrees C): 40.
 - 6. Service factor: 1.15.
 - 7. Insulation: Class F.
 - 8. Temperature rise under full load: Not to exceed that for Class B insulation.
 - 9. Enclosure: TEFC.
 - 10. Design B speed/torque characteristics.
- H. Drive unit shall be manufactured by Nord, SEW Eurodrive; or approved equal.

2.09 CONTROLS AND ACCESSORIES (FURNISHED BY THE CONVEYOR MANUFACTURER)

- A. A NEMA 4X 316 SST conveyor control panel shall be furnished to accommodate both the horizontal and inclined conveyors to be installed in this contract and the additional horizontal and inclined conveyors which are planned for future installation as shown in the Drawings. Only one horizontal and one inclined conveyor will be

installed but the control panel shall be provided with all wiring, starters, etc. for two horizontal and two inclined conveyor systems. The conveyor control panel (LCP-CCP) shall house NEMA non-reversing starters associated with two horizontal and two inclined conveyors and control associated with those conveyors. The power supply for the LCP-CCP shall be 480V, 3-phase, 60-Hz. The LCP-CCP shall be provide with main breaker with external handle. Furnish and install SPD for incoming 480V power in the LCP-CCP. Provide each starter of conveyor to have "Hand-Off-Remote" selector switch for manual and automatic control, "running", "failed" LED indication lights, reset push button, etc. and shall be mounted on the dead front of the control panel. Provide step-down transformer and other power supplies as required for control power of the LCP-CCP. Furnish and install all necessary terminal blocks, wireways, breakers, fuses, relays, timers, etc. as needed for a complete and functional conveyor control system in place. See Divisions 16 and 17 for additional information on controls. Refer to Instrumentation drawings for additional requirements and provide accordingly.

- B. A NEMA 4X 316 SST truck loading conveyor control panel shall be furnished for truck loading conveyor and six truck loading motorized gates. The truck loading conveyor control panel (LCP-TLCCP) shall house NEMA reversing starter associated with truck loading conveyor. The power supply for the LCP-TLCCP shall be 480V, 3-phase, 60-Hz. The LCP-TLCCP shall be provide with main breaker with external handle. Furnish and install SPD for incoming 480V power in the LCP-TLCCP. Provide starter of truck loading conveyor to have "Local-Off-Remote" and "Left-Right" selector switches for manual and automatic control, "running left", "running right", "failed" LED indication lights, reset push button, etc. and shall be mounted on the dead front of the control panel. Provide step-down transformer and other power supplies as required for control power of the TLCCP. LCP-TLCCP shall also have "Local-Remote" and "Open-Close" selector switches for each motorized gate and "Gate Open" and "Gate Closed" LED indication light for each motorized gate. Furnish and install all necessary terminal blocks, wireways, breakers, fuses, relays, timers, etc. as needed for a complete and functional tuck loading conveyor and gate control system in place. See Divisions 16 and 17 for additional information on controls. Refer to Instrumentation drawings for additional requirements and provide accordingly.
- C. A NEMA 4X 316 SST truck loading remote control panel (LCP-TLRCP) shall be furnished by the Conveyor MANUFACTURER and Installing Contractor shall install remote control panel near the truck loading station. LCP-TLRCP shall have a minimum of "OFF-ON" selector switch for truck loading conveyor, "Running", and "Failed" LED indication light.
- D. Emergency stop cables:
 - 1. Provide emergency stop cables on both sides of the conveyor with 2 switches per 50 feet minimum length of cable.
 - 2. Cable shall be orange plastic coated safety cable mounted through eyebolt spaced no more than 10 feet.
- E. Non-contacting-type zero-motion switches shall be provided and installed so they stop the operation of the drive motor when conveyor motion is not detected.

2.10 FINISHES

- A. Surface preparation, factory prime, field prime and finish coats as specified in Section 09960.
- B. Stainless steel components: Chemically clean all exterior welds to remove discoloration and glass-blast all exterior stainless steel surfaces only to a uniform finish.
- C. Spiral: Shop primer coating following sandblasting.
- D. Torque bracket: Epoxy coating.
- E. Drive shaft: Zinc Plate Shaft (Rust inhibitor coating).

PART 3 EXECUTION

3.01 EXAMINATION

- A. MANUFACTURER shall coordinate with installing Contractor and field verify the actual dimensions required to construct the equipment prior to fabrication.

3.02 INSTALLATION

- A. Installing Contractor shall install screw conveyors in accordance with manufacturer's recommendations:
 - 1. All field welds shall be chemically cleaned to remove discoloration by Contractor.
- B. Prior to start-up, the equipment shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance.

3.03 SHOP TESTING

- A. Conveyors, in their entire length, shall be inspected and operated in the shop with the actual drive unit for the project:
 - 1. Unit shall be fully assembled with tack welds at the factory and test run for 15 minutes to check for equipment tolerances and proper operation.
 - 2. Conveyors shall be corrected as necessary.
 - 3. Prior to shipment, the tack welds will be broken apart and conveyors suitably prepared for shipment.
 - 4. A recorded video of the test shall be submitted to the Engineer for record purposes.

3.04 FIELD QUALITY CONTROL

- A. Testing: Perform operational and functional testing as specified in Section 01756 and Section 15958.
- B. Field check-out: Before field-testing and start-up, provide services of factory-trained field service representative to certify the equipment has been installed, aligned, and checked in accordance with the manufacturer's instructions and the Specifications.

- C. Manufacturer's representative:
1. Testing: Provide services of factory-trained representative to observe and advise the Contractor during field quality control testing.
 2. Field service:
 - a. The manufacturer shall include in the cost of the equipment 1 trip of 2 days to the site.
 - b. A qualified field-service engineer shall spend 8 hours at the site each trip.
 - c. The field service engineer shall be responsible for checking the installation and equipment start-up.
 3. Conveyor manufacturer shall provide four hours of training on the operation and maintenance of the conveyors.

END OF SECTION

SECTION 15050

COMMON WORK RESULTS FOR MECHANICAL EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Basic design and performance requirements for building mechanical equipment and process mechanical equipment.

1.02 REFERENCES

- A. American Gear Manufacturer's Association (AGMA) Standards:
 - 1. 6001-E08 - Design and Selection of Components for Enclosed Gear Drives.
- B. American Bearing Manufacturers Association (ABMA) Standards:
 - 1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. American Petroleum Institute (API):
 - 1. 682 - Shaft Sealing Systems for Centrifugal and Rotary Pumps.
- D. ASTM International (ASTM):
 - 1. A36 - Standard Specification for Carbon Structural Steel.
 - 2. A48 - Standard Specification for Gray Iron Castings.
 - 3. A125 - Standard Specification for Steel Springs, Helical, Heat-Treated.
 - 4. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - 5. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 6. A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
 - 7. A536 - Standard Specification for Ductile Iron Castings.
 - 8. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 9. B61 - Standard Specification for Steam or Valve Bronze Castings.
 - 10. B62 - Standard specification for Composition Bronze or Ounce Metal Castings.
 - 11. B505 - Standard Specification for Copper Alloy Continuous Castings.
 - 12. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 - 13. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 14. F594 - Standard Specification for Stainless Steel Nuts.
- E. Hydraulic Institute (HI).
- F. Occupational Safety and Health Administration (OSHA).
- G. Unified Numbering System (UNS).

1.03 DEFINITIONS

- A. Resonant frequency: That frequency at which a small driving force produces an ever-larger vibration if no dampening exists.
- B. Rotational frequency: The revolutions per unit of time usually expressed as revolutions per minute.
- C. Critical frequency: Same as resonant frequency for the rotating elements or the installed machine and base.
- D. Peak vibration velocity: The root mean square average of the peak velocity of the vibrational movement times the square root of 2 in inches per second.
- E. Rotational speed: Same as rotational frequency.
- F. Maximum excitation frequency: The excitation frequency with the highest vibration velocity of several excitation frequencies that are a function of the design of a particular machine.
- G. Critical speed: Same as critical frequency.
- H. Free field noise level: Noise measured without any reflective surfaces (an idealized situation); sound pressure levels at 3 feet from the source unless specified otherwise.
- I. Operating weight: The weight of unit plus weight of fluids or solids normally contained in unit during operation.

1.04 DESIGN REQUIREMENTS

- A. General:
 - 1. Product requirements as specified in Section 01600 - Product Requirements.
 - 2. Project conditions as specified in Section 01610 - Project Design Criteria.
 - 3. Provisions specified under each technical equipment specification prevail over and supersede conflicting provisions specified in this Section.
 - 4. Equipment manufacturer's responsibility extends to selection and mounting of gear drive units, motors or other prime movers, accessories, and auxiliaries required for proper operation.
 - 5. Vibration considerations:
 - a. Resonant frequency:
 - 1) For single-speed equipment, ensure there are no natural resonant frequencies within 25 percent above or below the operating rotational frequencies or multiples of the operating rotational frequencies that may be excited by the equipment design.
 - 2) For variable-speed equipment, ensure there are no natural resonant frequencies within 25 percent above or below the range of operating frequencies.
 - b. Design, balance, and align equipment to meet the vibration criteria specified in Section 15958 - Mechanical Equipment Testing.
 - 6. Equipment units weighing 50 pounds or more: Provide with lifting lugs or eyes to allow removal with hoist or other lifting device.

- B. Power transmission systems:
 - 1. V-belts, sheaves, shaft couplings, chains, sprockets, mechanical variable-speed drives, variable frequency drives, gear reducers, open and enclosed gearing, clutches, brakes, intermediate shafting, intermediate bearings, and U-joints are to be rated for 24 hour-a-day continuous service or frequent stops-and-starts intermittent service, whichever is most severe, and sized with a service factor of 1.5 or greater in accordance with manufacturer recommendations:
 - a. Apply service factor to nameplate horsepower and torque of prime source of power and not to actual equipment loading.
 - b. Apply service factors in accordance with AGMA 6001-E08, other applicable AGMA standards, or other applicable referenced standards.
- C. Equipment mounting and anchoring:
 - 1. Mount equipment on cast-iron or welded-steel bases with structural steel support frames:
 - a. Utilize continuous welds to seal seams and contact edges between steel members.
 - b. Grind welds smooth.
 - 2. Provide bases and supports with machined support pads, dowels for alignment of mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits.
 - 3. Provide jacking screws in bases and supports for equipment weighing over 1,000 pounds.
 - 4. Design equipment anchorage, supports, and connections for dead load, running loads, loads during start-up, and other loads as required for proper operation of equipment:
 - a. For equipment with an operating weight of 400 pounds or greater and all equipment that is supported higher than 4 feet above the floor, provide calculations for:
 - 1) The operating weight and location of the centroid of mass for the equipment.
 - 2) Forces and overturning moments.
 - 3) Shear and tension forces in equipment anchorages, supports, and connections.
 - 4) The design of equipment anchorage, supports, and connections based on calculated shear and tension forces.
 - 5. Anchorage of equipment to concrete or masonry:
 - a. Perform calculations and determine number, size, type, strength, and location of anchor bolts or other connections.
 - b. Unless otherwise indicated on the Drawings, select and provide anchors from the types specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
 - c. Provide bolt sleeves around cast-in anchor bolts for 400 pounds or greater equipment:
 - 1) Adjust bolts to final location and secure the sleeve.
 - 6. Anchorage of equipment to metal supports:
 - a. Perform calculations and determine number, size, type, strength, and location of bolts used to connect equipment to metal supports.
 - 7. Unless otherwise indicated on the Drawings, install equipment supported on concrete over non-shrink grout pads as specified in this Section.

1.05 SUBMITTALS

- A. As specified in Section 01600 - Product Requirements.
- B. Product data:
 - 1. For each item of equipment:
 - a. Design features.
 - b. Load capacities.
 - c. Efficiency ratings.
 - d. Material designations by UNS alloy number or ASTM Specification and Grade.
 - e. Data needed to verify compliance with the Specifications.
 - f. Catalog data.
 - g. Nameplate data.
 - h. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.
 - 2. Gear reduction units:
 - a. Engineering information in accordance with applicable AGMA standards.
 - b. Gear mesh frequencies.
- C. Shop drawings:
 - 1. Drawings for equipment:
 - a. Drawings that include cut-away drawings, parts lists, material specification lists, and other information required to substantiate that proposed equipment complies with specified requirements.
 - 2. Outline drawings showing equipment, driver, driven equipment, pumps, seal, motor(s) or other specified drivers, variable frequency drive, shafting, U-joints, couplings, drive arrangement, gears, base plate or support dimensions, anchor bolt sizes and locations, bearings, and other furnished components.
 - 3. Installation instructions including leveling and alignment tolerances, grouting, lubrication requirements, and initial Installation Testing procedures.
 - 4. Wiring, control schematics, control logic diagrams and ladder logic or similar for computer-based controls.
 - 5. Recommended or normal operating parameters such as temperatures and pressures.
 - 6. Alarm and shutdown setpoints for all controls furnished.
- D. Calculations:
 - 1. Mechanical:
 - a. ABMA 9 or ABMA 11 L10 life for bearings calculation methods for drivers, pumps, gears, shafts, motors, and other driveline components with bearings.
 - b. Substantiate that operating rotational frequencies meet the requirements of this Section.
 - c. Torsional analysis of power transmission systems: When torsional analysis specified in the equipment sections, provide:
 - 1) Sketch of system components identifying physical characteristics including mass, diameter, thickness, and stiffness.
 - 2) Results of analysis including first and second critical frequencies of system components and complete system.
 - d. Calculations shall be signed and stamped by a licensed engineer.

2. Drinking water:
 - a. If applicable, conform to the requirements of Section 01600 - Product Requirements for materials in contact with drinking water.
- E. Operation and maintenance manuals:
 1. As specified in Section 01782 - Operating and Maintenance Data.
 2. Equipment with bearings:
 - a. Include manufacturer and model number of every bearing.
 - b. Include calculated ball pass frequencies of the installed equipment for both the inner and outer raceways.
- F. Commissioning submittals: As specified in Section 01756 - Commissioning.
- G. Project closeout documents: As specified in Section 01770 - Closeout Procedures.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials as specified in Section 01600 - Product Requirements including special requirements for materials in contact with drinking water.
- B. Ferrous materials:
 1. Steel for members used in fabrication of assemblies: ASTM A36.
 2. Iron castings: ASTM A48, tough, close-grained gray iron, free from blowholes, flaws, and other imperfections.
 3. Ductile iron castings: ASTM A536, Grade 65-45-12, free from flaws and imperfections.
 4. Galvanized steel sheet: ASTM A653, minimum 0.0635-inch (16-gauge).
 5. Expanded metal: ASTM A36, 13-gauge, 1/2-inch flat pattern expanded metal.
 6. Stainless steel:
 - a. As specified in Section 05120 - Structural Steel.
 - b. In contact or within 36 inches of water: Type 316 or 316L.
 - c. Other locations: Type 316 or 316L.
 - d. Source cleaning and passivation as specified in Section 05120 - Structural Steel.
- C. Non-ferrous materials:
 1. Bronze in contact with drinking water: Composition of not more than 2 percent aluminum nor more than 6 percent zinc; UNS Alloy C89833, C89520, or C92200 in accordance with ASTM B61, B62, B505, or B584, when not specified otherwise.
 2. Bronze in contact with wastewater: Composition of not more than 2 percent aluminum nor more than 6 percent zinc; UNS Alloy C83600, C89833, C89520, C92200, or C93700 in accordance with ASTM B61, B62, B505, or B584, when not specified otherwise.
 3. Aluminum: As specified in Section 05140 - Structural Aluminum.

- D. Dielectric materials for separation of dissimilar metals:
 - 1. Neoprene, bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other materials as specified.
- E. Non-shrink grout and epoxy non-shrink grout.

2.02 ANCHORS AND FASTENERS

- A. Mechanical anchoring to concrete and masonry:
 - 1. As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry:
 - a. Type 316 stainless steel.
- B. High-strength fasteners:
 - 1. As specified in Section 05120 - Structural Steel.
- C. Mechanical assembly fasteners:
 - 1. Stainless steel:
 - a. High-temperature service or high-pressure service:
 - 1) Bolts: Grade B8M (Type 316), Class 1, heavy hex.
 - 2) Nuts: ASTM A194, Grade 8, heavy hex.
 - 3) Washers: Alloy group matching bolts and nuts.
 - b. Low-temperature service:
 - 1) Bolts: Grade B8M (Type 316), Class 1, heavy hex.
 - 2) Nuts: Grade B8M (Type 316), heavy hex.
 - 3) Washers: Alloy group matching bolts and nuts.
 - c. General service including all areas on the first floor (dewatering press area):
 - 1) Bolts: ASTM F593, Alloy Group 2 (Type 316).
 - 2) Nuts: ASTM F594, Alloy Group 2 (Type 316).
 - 3) Washers: Alloy group matching bolts and nuts.

2.03 SHAFT COUPLINGS

- A. General:
 - 1. Type and ratings: Provide non-lubricated type, designed for not less than 50,000 hours of operating life.
 - 2. Sizes: Provide as recommended by manufacturer for specific application, considering horsepower, speed of rotation, and type of service.
- B. Shaft couplings for close-coupled electric-motor-driven equipment:
 - 1. Use for:
 - a. Equipment 1/2 horsepower or larger.
 - b. Reversing equipment.
 - c. Equipment subject to sudden torque reversals or shock loading:
 - d. Examples:
 - 1) Reciprocating pumps, blowers, and compressors.
 - 2) Conveyor belts.
 - 2. Manufacturers: One of the following or equal:
 - a. Lovejoy.
 - b. T.B. Woods.
 - 3. Provide flexible couplings designed to accommodate angular misalignment, parallel misalignment, and end float.

4. Manufacture flexible component of coupling from synthetic rubber or urethane.
 5. Provide service factor of 2.5 for electric motor drives and 3.5 for engine drives.
 6. Do not allow metal-to-metal contact between driver and driven equipment.
- C. Shaft couplings for direct-connected electric-motor-driven equipment:
1. Use for 1/2 horsepower or larger and subject to normal torque, non-reversing applications.
 2. Manufacturers: One of the following or equal:
 - a. Rexnord.
 - b. T.B. Woods.
 3. Provide flexible couplings designed to accommodate shock loading, vibration, and shaft misalignment or offset.
 4. Provide flexible connecting element of rubber and reinforcement fibers.
 5. Provide service factor of 2.0.
 6. Connect stub shafts through collars or round flanges, firmly keyed to their shafts with neoprene cylinders held to individual flanges by through pins.
- D. Spacer couplings: Where cartridge-type mechanical seals or non-split seals are specified, provide a spacer-type coupling of sufficient length to remove the seal without disturbing the driver or driven equipment unless noted otherwise in the individual equipment specifications.
- E. Specialized couplings: Where requirements of equipment dictate specialized features, supply coupling recommended for service by manufacturer:
1. Includes any engine-driven equipment.

2.04 STUFFING BOX, SEAL CHAMBER, AND SHAFT SEALS

- A. General:
1. Unless otherwise noted in the equipment section, provide cartridge-type, double mechanical shaft seals for pumps.
 2. Provide a stuffing box large enough for a double mechanical seal.
 3. Where packing is specified, provide stuffing box large enough to receive a double mechanical seal.
 4. Provide seal or packing flush connections, (3/4-inch size unless another size is indicated on the Drawings).
 5. Provide and route leakage drain line to nearest equipment floor drain indicated on the Drawings.
 6. For pumps with packing, design packing gland to allow adjustment and repacking without dismantling pump except to open up packing box.
 7. Seal or packing flush requirements shall be in accordance with API Standard 682 requirements. Unless otherwise indicated, specified or required by the equipment and seal manufacturers, the following API flushing Plan arrangements shall be utilized as appropriate for the application:
 - a. Single seal, clean water applications: Plan 11 (Discharge bypass to seal).
 - b. Single seal, vertical pump applications: Plan 13 (Seal bypass to suction).
 - c. Single seal, clean hot water (greater than 180 degrees Fahrenheit) applications: Plan 23 (Seal cooler and pumping ring).
 - d. Single seal, solids, or contaminants containing water applications: Plan 32 (External seal water).
 - e. Double seal applications: Plan 54 (External seal water).

- B. Packing: When specified in the equipment section of the specifications, provide the following type of packing:
1. Wastewater, water, and sludge applications:
 - a. Asbestos free.
 - b. PTFE (Teflon) free.
 - c. Braided graphite.
 - d. Manufacturers: One of the following or equal:
 - 1) Chesterton, 1400.
 - 2) John Crane, equivalent product.
- C. Mechanical seals: Provide seal types specified in the equipment sections and as specified:
1. Provide seal types meeting the following requirements:
 - a. Balanced hydraulically.
 - b. Spring: Stationary, out of pumping fluid, Hastelloy C; Type Elgiloy or 17-7 PH stainless steel for split seals.
 - c. O-ring: Viton 747.
 - d. Gland: Type 316L stainless steel.
 - e. Set screws: Type 316L stainless steel.
 - f. Faces: Reaction bonded, silicon carbide.
 - g. Seal designed to withstand 300 pounds per square inch gauge minimum differential pressures in either direction; no requirement for seal buffer pressure to be maintained when pump is not operational even though process suction head may be present in pump.
 2. Cartridge-type single mechanical:
 - a. Manufacturers: One of the following or equal:
 - 1) Chesterton, S10.
 - 2) John Crane, 5610 Series.
 3. Cartridge-type double mechanical: Manufacturers:
 - a. One of the following or equal:
 - 1) Chesterton, S20.
 - 2) John Crane, 5620 Series.
 4. Split-face single mechanical: Manufacturers:
 - a. One of the following or equal:
 - 1) Chesterton, 442.
 - 2) John Crane, 3740.
 5. Cartridge-type flushless mechanical:
 - a. Manufacturers: One of the following or equal:
 - 1) Chesterton, 156.
 - 2) John Crane, 5870.

2.05 GEAR REDUCTION UNITS

- A. Type: Helical or herringbone, unless otherwise specified.
- B. Design:
1. Made of alloys treated for hardness and for severe service.
 2. AGMA Class II service:
 - a. Use more severe service condition when such is recommended by unit's manufacturer.
 3. Cast-iron housing with gears running in oil.
 4. Anti-friction bearings.

5. Thermal horsepower rating based on maximum horsepower rating of prime mover, not actual load.
 6. Manufactured in accordance with applicable AGMA standards.
- C. Planetary gear units are not to be used.

2.06 BELT DRIVES

- A. Sheaves:
1. Separately mounted on bushings by means of at least 3 pull-up bolts or cap tightening screws.
 2. When 2 sheave sizes are specified, provide separate belts sized for each set of sheaves.
 3. Statically balanced for all; dynamically balanced for sheaves that operate at a peripheral speed of more than 5,500 feet per minute.
 4. Key bushings to drive shaft.
- B. Belts: Anti-static type when explosion-proof equipment or environment is specified:
1. When spare belts are specified, furnish 1 spare belt for every different type and size of belt-driven unit:
 - a. Where 2 or more belts are involved, furnish matched sets.
 - b. Identify as to equipment, design, horsepower, speed, length, sheave size, and use.
 - c. Package in boxes labeled with identification of contents.
- C. Manufacturers: One of the following or equal:
1. Dodge, Dyna-V belts with matching Dyna-V sheaves and Taper-Lock bushings.
 2. T.B. Woods, Ultra-V belts with matching Sure-Grip sheaves and Sure-Grip bushings.

2.07 BEARINGS

- A. Type: Oil or grease lubricated, ball or roller antifriction type, of standard manufacture.
- B. Oil-lubricated bearings: Provide either pressure lubricating system or separate oil reservoir splash-type system:
1. Size oil-lubrication systems to safely absorb heat energy generated in bearings when equipment is operating under normal conditions and with the temperature 15 degrees Fahrenheit above the maximum design temperature as specified in Section 01610 - Project Design Criteria.
 2. Provide an external oil cooler when required to satisfy the specified operating conditions:
 - a. Provide air-cooled system if a water-cooling source is not indicated on the Drawings.
 - b. Equip oil cooler with a filler pipe and external level gauge.
- C. Grease lubricated bearings, except those specified to be factory sealed: Fit with easily accessible grease supply, flush, drain, and relief fittings:
1. Lubrication lines and fittings:
 - a. Lines: Minimum 1/4-inch diameter stainless steel tubing.

- b. Multiple fitting assemblies: Mount fittings together in easily accessible location.
 - c. Use standard hydraulic-type grease supply fittings:
 - 1) Manufacturers: One of the following or equal:
 - a) Alenite.
 - b) Zerk.
- D. Ratings: Rated in accordance with ABMA 9 or ABMA 11 L10 life for bearings rating life of not less than 50,000 hours.

2.08 MOTORS

- A. As specified in Section 16405.

2.09 GEAR MOTORS

- A. Motors as specified in Section 16405.
- B. Helical gearing for parallel shaft drives and worm gearing for right-angle drives.
- C. Manufactures: One of the following or equal:
 - 1. Baldor Electric Company.
 - 2. Bodine Electric Company.

2.10 VENDOR CONTROL PANELS

- A. As specified in Division 17.

2.11 EQUIPMENT SUPPORT FRAMES

- A. Bolt holes shall not exceed bolt diameter by more than 25 percent, up to a limiting maximum diameter oversize of 1/4-inch.

2.12 SAFETY EQUIPMENT

- A. Safety guards:
 - 1. Provide guards that protect personnel from rotating shafts or components within 7.5 feet of floors or operating platforms.
 - 2. Requirements:
 - a. Allow visual inspection of moving parts without removal.
 - b. Allow access to lubrication fittings.
 - c. Prevent entrance of rain or dripping water for outdoor locations.
 - d. Size belt and sheave guards to allow for installation of sheaves 15 percent larger and addition of 1 belt.
 - 3. Materials:
 - a. Sheet metal: Carbon steel, 12-gauge minimum thickness, hot-dip galvanized after fabrication.
 - b. Fasteners: Type 316 stainless steel.

- B. Insulation:
 - 1. Insulate all surfaces with normal operating temperatures above 120 degrees Fahrenheit when surface is within 7.5 feet height from any operating floor or level.
 - 2. Insulation thickness such that temperature is below 120 degrees Fahrenheit.
- C. Warning signs:
 - 1. Provide warning signs in accordance with OSHA requirements for equipment that starts automatically or remotely.
 - 2. Mount warning signs with stainless steel fasteners at equipment.

2.13 SPRING VIBRATION ISOLATORS

- A. Design requirements:
 - 1. Telescopic top and bottom housing with vertical stabilizers to resist lateral and vertical forces.
 - 2. Use steel coil springs.
- B. Performance requirements: Minimum spring deflection of 1-inch under static load and capable of limiting transmissibility to 10 percent maximum at design operating load.
- C. Manufacturers: One of the following or equal:
 - 1. California Dynamics Corporation, Type RJSD.
 - 2. Mason Industries, equivalent product.
- D. Materials:
 - 1. Fabricate isolators using welded-steel or shatterproof ductile iron in accordance with ASTM A536 Grade CS-45-12.
 - 2. Spring steel: ASTM A125.

2.14 NAMEPLATES

- A. Fastened to equipment at factory in an accessible and visible location.
- B. Stainless steel sheet engraved or stamped with text, holes drilled or punched for fasteners.
- C. Fasteners: Number 4 or larger oval head stainless steel screws or drive pins.
- D. Text:
 - 1. Manufacturer's name, equipment model number and serial number, motor horsepower when appropriate, and identification tag number.
 - 2. Indicate the following additional information as applicable:
 - a. Maximum and normal rotating speed.
 - b. Service class per applicable standards.
 - 3. Include for pumps:
 - a. Rated total dynamic head in feet of fluid.
 - b. Rated flow in gallons per minute.
 - c. Impeller, gear, screw, diaphragm, or piston size.
 - 4. Include for gear reduction units:
 - a. AGMA class of service.

- b. Service factor.
- c. Input and output speeds.

2.15 SHOP FINISHES

- A. Provide appropriate factory coatings as specified in Section 09960 - High-Performance Coatings:
 - 1. Motors and gear reducers: Shop finish paint with manufacturer's standard coating, unless otherwise specified in the individual equipment specification.

2.16 SPECIAL TOOLS

- A. Supply 1 set of special tools as specified in Section 01600 - Product Requirements.

2.17 SOURCE TESTING

- A. Testing requirements unless specified otherwise in the individual equipment specifications:
 - 1. Mechanical equipment: Level 1 General Equipment Performance Test as specified in Section 15958 - Mechanical Equipment Testing.
 - 2. Motors: As specified in Section 16405.
 - 3. Vendor control panels: As specified in Division 17.

2.18 SHIPPING

- A. As specified in Section 01600 - Product Requirements.
- B. Prior to shipment of equipment:
 - 1. Bearings (and similar items):
 - a. Pack separately or provide other protection during transport.
 - b. Greased and lubricated.
 - 2. Gear boxes:
 - a. Oil filled or sprayed with rust preventive protective coating.
 - 3. Fasteners:
 - a. Inspect for proper torques and tightness.

PART 3 EXECUTION

3.01 DELIVERY, HANDLING, STORAGE, AND PROTECTION

- A. As specified in Section 01600 - Product Requirements.
- B. Inspect fasteners for proper torques and tightness.
- C. Storage:
 - 1. Bearings:
 - a. Rotate units at least once per month or more often as recommended by the manufacturer to protect rotating elements and bearings.
 - 2. Gear boxes:
 - a. Inspect to verify integrity of protection from rust.

D. Protection:

1. Equipment Log shall include description of rotation performed as part of maintenance activities.

3.02 INSTALLATION (NOT USED)

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Functional testing requirements unless specified otherwise in the individual equipment specifications:

1. Mechanical equipment: Level 1 tests as specified in Section 15958 - Mechanical Equipment Testing.
2. Motors: As specified in Sections 16405.
3. Vendor control panels: As specified in Division 17.

END OF SECTION

SECTION 15075

EQUIPMENT IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Equipment nameplates.
 - 2. Special items.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents:
 - a. Section 01330 - Submittal Procedures.
 - b. Section 01600 - Product Requirements.
 - c. Section 01770 - Closeout Procedures.
 - d. Section 09960 - High-Performance Coatings.

1.02 SUBMITTAL

- A. Submit as specified in Section 01330.
- B. Submit following:
 - 1. Product data.
 - 2. Samples.
 - 3. Manufacturer's installation instructions.
 - 4. Submit following as specified in Section 01770:
 - a. Warranty.

PART 2 PRODUCTS

2.01 EQUIPMENT NAMEPLATES

- A. Material and fabrication:
 - 1. Stainless steel sheet engraved or stamped with text, holes drilled, or punch for fasteners.
- B. Fasteners:
 - 1. Number 4 or larger oval head stainless steel screws or drive pins.

- C. Text:
 - 1. Manufacturer's name, equipment model number and serial number, identification tag number; and when appropriate, drive speed, motor horsepower with rated capacity, pump rated total dynamic head, and impeller size.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify satisfactory conditions of substrate for applying identification.
- B. Verify that conditions are satisfactory for installation and application of products as specified in Section 01600.

3.02 PREPARATION

- A. Prepare and coat surfaces as specified in Section 09960.
- B. Prepare surface in accordance with product manufacturer's instructions.

END OF SECTION

SECTION 15958

MECHANICAL EQUIPMENT TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Testing of mechanical equipment and systems.
- B. Related sections:
 - 1. Section 01756 - Testing, Training, and Facility Start-up.
 - 2. Division 16.
 - 3. Division 17.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI S1.4 Specification for Sound Level Meters.
- B. American National Standards Institute/Hydraulic Institute (ANSI/HI):
 - 1. ANSI/HI 1.1-1.5 Standard for Centrifugal Pumps for Nomenclature, Definitions, Application, and Operation.
 - 2. ANSI/HI 1.6 Standard for Centrifugal Pump Tests.
 - 3. ANSI/HI 2.1-2.5 Standard for Vertical Pumps for Nomenclature, Definitions, Application, and Operation.
 - 4. ANSI/HI 2.6 Standard for Vertical Pump Tests.
 - 5. ANSI/HI 3.1-3.5 Standard for Rotary Pumps for Nomenclature, Definitions, Application, and Operation.
 - 6. ANSI/HI 3.6 Standard for Rotary Pump Tests.
 - 7. ANSI/HI 4.1-4.6 Standard for Sealless Rotary Pumps for Nomenclature, Definitions, Application, Operation, and Test.
 - 8. ANSI/HI 5.1-5.6 Standard for Sealless Centrifugal Pumps for Nomenclature, Definitions, Application, Operation, and Test.
 - 9. ANSI/HI 6.1-6.5 Standard for Reciprocating Power Pumps for Nomenclature, Definitions, Application, and Operation.
 - 10. ANSI/HI 6.6 Standard for Reciprocating Pump Tests.
 - 11. ANSI/HI 7.1-7.5 Standard for Controlled Volume Pumps for Nomenclature, Definitions, Application, and Operation.
 - 12. ANSI/HI 8.1-8.5 Standard for Direct Acting for Steam Pumps for Nomenclature, Definitions, Application, and Operation.
 - 13. ANSI/HI 9.1-9.5 Standard for Pumps - General Guidelines for Types, Definitions, Application, and Sound Measurement.

1.03 SUBMITTALS

- A. Schedule of factory tests and field tests as specified in Section 01756 and this Section.
- B. Test instrumentation calibration data.

- C. Start-up plan as specified in Section 01756.
- D. Test Plan specified in this Section.
- E. Test result reports.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 QUALITY CONTROL TESTING AND REPORTING

- A. Scheduling and Notification:
 - 1. Witnessed Source Quality Control Tests: Schedule test date and notify ENGINEER at least 30 days prior to start of test.
 - 2. Field Quality Control Tests: Schedule test date and notify ENGINEER at least 7 days prior to start of test.
- B. Testing Levels:
 - 1. Test equipment based on test levels specified in the equipment section of the Specifications.
 - 2. Requirements for Test Levels 1 to 4 are defined below.
 - 3. Test levels apply for both Source (Factory) Quality Control Tests and Field Quality Control Tests as specified in the individual equipment sections of the Specifications.
 - 4. If testing is not specified in the equipment section, provide Level 1 testing.
 - 5. Requirements of Section 01756 apply to Test Levels.
- C. Witnessing: Source Quality Control Tests not witnessed unless specified otherwise in the equipment specification section or Section 01756 - Field Quality Control Tests shall be witnessed.
- D. Instrumentation: Provide necessary test instrumentation, which has been calibrated within one year from date of test to recognized test standards traceable to the National Institute of Standards and Technology, Washington, D.C. or approved source. Properly calibrated field instrumentation permanently installed as a part of the Work may be utilized for Field Quality Control Tests.
- E. Temporary Facilities and Labor: Provide necessary fluids, utilities, temporary piping, temporary supports, temporary access platforms or access means and other temporary facilities and labor necessary to safely operate the equipment and accomplish the specified testing. With OWNER's permission, some utilities may be provided by fully tested permanently installed utilities that are part of the Work.
- F. Test Fluids:
 - 1. Factory Tests: Use water or air as appropriate at ambient conditions unless specified otherwise in the equipment section.
 - 2. Field Tests: Use specified process fluid at available conditions.

- G. Pressure Testing: Hydrostatically pressure test pressure containing parts in the factory at the appropriate standard or code required level above the equipment component specified design pressure or operating pressure, whichever is higher. Submit pressure test reports before shipping.
- H. Test Measurement and Result Accuracy:
 - 1. Use test instruments with accuracies as recommended in the appropriate referenced standards. When no accuracy is recommended in the referenced standard, use 1 percent or better accuracy test instruments. Improved (lower error tolerance) accuracies specified elsewhere prevail over this general requirement.
 - 2. Do not adjust results of tests for instrumentation accuracy. Measured values and values directly calculated from measured values shall be the basis for comparing actual equipment performance to specified requirements.
- I. Field Testing:
 - 1. Submit test plan as specified in Section 01756 and this Section. Indicate test start time and duration, equipment to be tested, other equipment involved or required; temporary facilities required, number and skill or trade of personnel involved; safety issues and planned safety contingencies; anticipated effect on OWNER's existing equipment and other information relevant to the test. Provide locations of all instruments to be used for testing. Provide calibration records for all instrumentation.
 - 2. Perform general start-up and testing procedures as specified in Section 01756.
 - 3. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.
- J. Reports: Submit reports for Source and Field testing. Submit Source Quality Control Test result reports before shipping equipment to the field. Report features:
 - 1. Report results in a bound document in generally accepted engineering format with title page, written summary of results compared to specified requirements, and appropriate curves or plots of significant variables in English units.
 - 2. Include appendix with a copy of raw, unmodified test data sheets indicating test value, date and time of reading, and initials of person taking the data.
 - 3. Include appendix with sample calculations for adjustments to raw test data and for calculated results.
 - 4. Include appendix with the make, model, and last calibration date of instrumentation used for test measurements.
 - 5. Include in body of report a drawing or sketch of the test system layout showing location and orientation of the test instruments relative to the tested equipment features.

3.02 EQUIPMENT TESTING, GENERAL

- A. Tests for Pumps, All Levels of Testing:
 - 1. Test in accordance with applicable Hydraulic Institute Standards in addition to the requirements in this and other sections.
 - 2. Test Tolerances: In accordance with appropriate Hydraulic Institute Standards, except the following modified tolerances apply:
 - a. From 0 to plus 5 percent of head at the specified flows.
 - b. 0 to plus 5 percent of flow at the rated design point head.

- c. No negative tolerance for the efficiency at the specified flows.
 - d. No positive tolerance for vibration limits. Vibration limits and test methods in Hydraulic Institute Standards do not apply, use limits, and methods specified in this or other sections of the specifications.
- B. Tests for Drivers: Test motors as specified in Division 16. Test other drivers as specified in the driver equipment section.

3.03 REQUIREMENTS FOR VIBRATION TESTING

- A. Definitions:
- 1. Peak to Peak Displacement: The root mean squared average of the peak to peak displacement multiplied by the square root of 2.
 - 2. Peak Velocity: The root mean squared average of the peak velocity multiplied by the square root of 2.
 - 3. Peak Acceleration: The root mean squared average of the peak acceleration multiplied by the square root of 2.
 - 4. High Frequency Enveloping: A process to extract very low amplitude time domain signals associated with impact or impulse events such as bearing or gear tooth defects and display them in a frequency spectra of acceleration versus frequency. Manufacturers: One of the following or equal:
 - a. Rockwell Automation, Entek Group, "Spike Energy" analysis.
 - b. CSI, "PeakVue."
 - 5. Low Speed Equipment: Equipment or components of equipment rotating at less than 600 revolutions per minute.
 - 6. High Speed Equipment: Equipment and equipment components operating at or above 600 revolutions per minute.
- B. Vibration Instrumentation Requirements:
- 1. Analyzers: Use digital type analyzers or data collectors with anti-aliasing filter, 12 bit A/D converter, fast fourier transform circuitry, phase measurement capability, time wave form data storage, high frequency enveloping capabilities, 35 frequency ranges from 21 to 1,500,000 cycles per minute, adjustable fast fourier transform resolution from 400 to 6400 lines, storage for up to one hundred 3200 line frequency spectra, RS232C data output port, circuitry for integration of acceleration data to velocity or double integration to displacement. Manufacturers: One of the following or equal:
 - a. Entek-IRD, Division of Rockwell Automation, Enpac 1200 with applicable data analysis software or Entek Model 838 analyzer with built in printer.
 - b. Computational Systems Inc., (CSI) Division of Emerson Electric, Model 2120A, Data Collector/analyzer with applicable analysis software.
 - 2. Analyzer Settings:
 - a. Units: English, inches/second, mils and g's.
 - b. Fast Fourier Transform Lines: Most equipment 1600 minimum; for motors, enough lines as required to distinguish motor current frequencies from rotational frequencies, use 3200 lines for motors with a nominal speed of 3600 rpm; 3200 lines minimum for High Frequency Enveloping; 1600 lines minimum for low speed equipment.
 - c. Sample Averages: 4 minimum.
 - d. Maximum Frequency (Fmax): 40 times rotational frequency for rolling element bearings, 10 times rotational frequency for sleeve bearings.

- e. Amplitude Range: Auto select but full scale not more than twice the acceptance criteria or the highest peak, whichever is lower.
 - f. Fast Fourier Transform Windowing: Hanning Window.
 - g. High Pass Filter: Minus 3 dB at 120 cycles per minute for high speed equipment. Minus 3 dB at 21 cycles per minute for low speed equipment.
3. Accelerometers:
- a. For Low Speed Equipment: Low frequency, shear mode accelerometer, 500 millivolts per g sensitivity, 10 g range, plus/minus 5 percent frequency response from 0.5 hertz to 850 hertz, magnetic mount. Manufacturers: One of the following or equal:
 - 1) Wilcoxon Research, Model 797L.
 - 2) PCB, Model 393C.
 - b. For High Speed Equipment: General purpose accelerometer, 100 millivolts per g sensitivity, 50 g range, plus/minus 3dB frequency response range from 2 hertz to 12,000 hertz when stud mounted, with magnetic mount holder. Manufacturers: One of the following or equal:
 - 1) Wilcoxon Research, Model 793.
 - 2) Entek-IRD Model 943.
- C. Accelerometer Mounting:
- 1. Use magnetic mounting or stud mounting.
 - 2. Mount on bearing housing in location with best available direct path to bearing and shaft vibration.
 - 3. Remove paint and mount transducer on flat metal surface or epoxy mount for High Frequency Enveloping measurements.
- D. Vibration Testing Results Presentation:
- 1. Provide equipment drawing with location and orientation of measurement points indicated.
 - 2. For each vibration measurement take and include appropriate data on equipment operating conditions at the time vibration data is taken; for pumps, compressors, and blowers record suction pressure, discharge pressure, and flow.
 - 3. When Vibration Spectra Data Required:
 - a. Plot peak vibration velocity versus frequency in cycles per minute.
 - b. Label plots showing actual shaft or part rotation frequency, bearing inner and outer race ball pass frequencies, gear mesh frequencies and relevant equipment excitation frequencies on the plot; label probable cause of vibration peaks whether in excess of specification limits or not.
 - c. Label plots with equipment identification and operating conditions such as tag number, capacity, pressure, driver horsepower, and point of vibration measurement.
 - d. Plot motor spectra on a log amplitude scale versus frequency.
 - 4. For low speed equipment, plot peak vibration displacement versus frequency as well as velocity versus frequency.
 - 5. Provide name of manufacturer and model number of the vibration instrumentation used, including analyzer and accelerometer used together with mounting type.

3.04 TESTING LEVELS

A. Level 1 Quality Control Tests:

1. Level 1 General Equipment Performance Test:
 - a. For equipment, operate, rotate, or otherwise functionally test for 15 minutes minimum after components reach normal operating temperatures.
 - b. Operate at rated design load conditions.
 - c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
2. Level 1 Pump Performance Test:
 - a. Measure flow and head while operating at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
 - b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Division 16 or the applicable equipment section. Use actual driver for field tests.
 - c. Record measured flow, suction pressure, discharge pressure, and make observations on bearing temperatures and noise levels.
3. Level 1 Vibration Test:
 - a. Test Requirement: Measure filtered vibration spectra for peak velocity and peak to peak displacement versus frequency in three perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; one plane of measurement to be parallel to the axis of rotation of the component.
 - b. Equipment Operating Condition: Test at specified maximum speed.
4. Level 1 Noise Test:
 - a. Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.

B. Level 2 Quality Control Tests:

1. Level 2 General Performance Test:
 - a. For equipment, operate, rotate, or otherwise functionally test for at least 2 hours after components reach normal operating temperatures.
 - b. Operate at rated design load conditions.
 - c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
2. Level 2 Pump Performance Test:
 - a. Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at a reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.

- b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Division 16. Use actual driver for field tests.
 - c. Test for flow and head at two additional conditions; one at 25 percent below the rated flow and one at 10 percent above the rated flow.
 - d. Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.
3. Level 2 Vibration Test:
- a. Test Requirement: Measure filtered vibration spectra for peak velocity, peak to peak displacement versus frequency and measure vibration phase in three perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; one plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.
 - b. Equipment Operating Condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.
 - c. Natural Frequency Test of Field Installed Equipment:
 - 1) Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears and supports.
 - 2) Perform test at each bearing housing and at each support pedestal and for pumps on the suction and discharge piping.
 - 3) Perform with equipment and attached piping full of intended service or process fluid.
4. Level 2 Noise Test:
- a. Measure filtered A-weighted overall sound pressure level in dBA for each of 8 octave band mid-points beginning at 63 hertz measured at three feet horizontally from the surface of the equipment at mid-point height of the noise source.

C. Level 3 Quality Control Tests:

- 1. Level 3 General Equipment Performance Tests:
 - a. For equipment, operate, rotate, or otherwise functionally test for at least 4 hours after components reach normal operating temperatures.
 - b. Operate at rated design load conditions for one half the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.
 - c. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration, or temperatures are observed.
 - d. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure, and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.
 - e. Bearing Temperatures: During maximum speed or capacity performance testing, measure and record the exterior surface temperature of each bearing versus time.

2. Level 3 Pump Performance Test:
 - a. Test four hours minimum for flow and head at or near the rated condition; for factory testing, testing may be at a reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
 - b. Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Division 16. Use actual driver for field tests.
 - c. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 15 minutes; for factory testing, test at other speeds may be omitted if test driver at reduced speeds is used for rated condition testing.
 - d. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices are not required by the equipment specification) and record observations on noise levels.
 3. Level 3 Vibration Test:
 - a. Requirements: Same as Level 2 vibration test except data taken at each operating condition tested and with additional requirements below.
 - b. Perform High Frequency Enveloping Analysis for gears and bearings:
 - 1) Measure bearing element vibration directly on each bearing cap in a location close as possible to the bearing load zone that provides a smooth surface and direct path to the bearing to detect bearing defects.
 - 2) Report results in units of acceleration versus frequency in cycles per minute.
 - c. Perform Time Wave Form analysis for gears, low speed equipment and reciprocating equipment; plot true peak amplitude velocity and displacement versus time and label the period between peaks with the likely cause of the periodic peaks (relate the period to a cause).
 - d. Plot vibration spectra on three different plots; peak displacement versus frequency, peak acceleration versus frequency and peak velocity versus frequency.
 4. Level 3 Noise Test: Measure filtered, un-weighted overall sound pressure level in dB at 3 feet horizontally from the surface of the equipment at mid-point height and at four locations approximately 90 degrees apart in plan view; report results for each of 8 octave band mid-points beginning at 63 hertz.
- D. Level 4 Quality Control Tests:
1. Level 4 General Equipment Performance Test:
 - a. For equipment, operate, rotate, or otherwise functionally test for at least 8 hours after components reach normal operating temperatures.
 - b. Operate at rated design load conditions for one half the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.
 - c. Confirm that equipment is properly assembled, equipment rotates in the proper direction, shafting and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual noise, vibration, or temperatures are observed.

- d. Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure, and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.
 - e. Bearing Temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.
2. Level 4 Pump Performance Test:
- a. Test 8 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field testing, test with furnished motor at full speed.
 - b. Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 20 minutes or longer as necessary to measure required performance, vibration, and noise data at each test condition.
 - c. Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices not required by the equipment specification) and record observations on noise levels.
 - d. Bearing Temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.
 - e. Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate ANSI/HI standard and as follows:
 - 1) Perform NPSHr testing at maximum rated design speed, head and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.
 - 2) Perform efficiency testing with test fluids at maximum rated speed.
 - 3) Perform priming time testing with test fluids at maximum rated speed.
3. Level 4 Vibration Test: Same as Level 3 vibration test.
4. Level 4 Noise Test: Same as Level 3 Noise Test except with data taken at each operating condition tested.

3.05 SOURCE QUALITY CONTROL

- A. Test equipment as specified for each type of test at the test levels specified in individual equipment sections. Prepare and submit test reports as specified.
- B. Inspection and Balancing:
 - 1. Statically and dynamically balance each of the individual rotating parts as required to achieve the required field vibration limits. Statically and dynamically balance the completed equipment rotating assembly and drive shaft components.
 - 2. Furnish copies of material and component inspection reports including balancing reports for equipment system components and for the completed rotating assembly.

- C. Critical Speed of Rotating Equipment: Satisfy the following:
1. First critical speed of the constant, variable, and 2-speed driven equipment is to be at least 25 percent above the maximum operating speed or 25 percent below the minimum operating speed.
 2. Second critical speed of any 2-speed or the variable speed equipment is to be at least 25 percent above or below the maximum operating speed or 25 percent below the minimum operating speed.

3.06 FIELD QUALITY CONTROL

- A. Test equipment as specified for each type of test at the test levels specified in individual equipment sections. Prepare and submit test reports as specified. Comply with latest version of applicable standards.
- B. For variable speed equipment, conduct test to establish performance over the entire speed range and at the average operating condition. Establish performance curves for:
1. The speed corresponding to the rated maximum capacity.
 2. The speed corresponding to the minimum capacity.
 3. The speed corresponding to the average operating conditions.

3.07 VIBRATION ACCEPTANCE CRITERIA

- A. Testing of Rotating Mechanical Equipment: Tests are to be performed by an experienced, factory trained, and independent authorized vibration analysis expert.
- B. Vibration Displacement Limits: Unless otherwise specified, equipment is not to exhibit unfiltered readings in excess of following:

Operating Speed (revolutions per minute)	Centrifugal Blowers	Unfiltered (Overall) Peak-to-Peak Amplitude (mils)		
		Other Rotating Equipment	Non-Clog Mixed Flow Pumps	Clean Fluid Pumps
0 - 300	N/A	5.0	6.0	6.0
301 - 600	N/A	4.0	5.0	5.0
601 - 900	N/A	3.0	4.0	3.0
901 - 1,200	N/A	2.0	5.7	2.0
1,201 - 1,500	N/A	1.8	3.0	1.8
1,501 - 1,900	N/A	1.5	2.5	1.5
1,801 - 2,400	N/A	1.0	2.0	1.0
2,401 - 3,000	N/A	0.8	1.5	0.8
3,001 - 3,600	1.25	0.7	1.3	0.7
Above 3,600	1.0	0.6	1.2	0.6
Note: For all equipment, axial shaft displacements not to exceed 50 percent of the maximum radial shaft displacements relative to the casing.				

- C. Vibration Velocity Limits: Unless otherwise specified, equipment is not to exceed the following peak velocity limits:

Item	Unfiltered Overall Limit (inches per second)	Any Filtered Peak Limit (inches per second)
Non-Clog or Mixed Flow Pumps	0.44	0.25
Clean Fluid Pumps	0.25	0.20
Motors and Steady Bearings	0.25	0.20
Gear Reducers, Radial	Not to exceed AGMA 6000-A88 limits	
Other Reducers, Axial	0.10	0.10
Centrifugal Blowers	0.15	0.10
Other Equipment, Radial	0.16	0.10
Other Equipment, Axial	0.10	0.10

- D. Equipment Operation: Measurements are to be obtained with equipment installed and operating within capacity ranges specified and without duplicate equipment running.
- E. Additional Criteria:
1. No narrow band spectral vibration amplitude components, whether subrotational, higher harmonic, or synchronous multiple of running speed, are to exceed 40 percent of synchronous vibration amplitude component without manufacturer's detailed verification of origin and ultimate effect of such excitation.
 2. The presence of discernable vibration amplitude peaks in Test Level 2 or 3 vibration spectra at bearing inner or outer race frequencies shall be cause for rejection of the equipment.
 3. For Motors, the Following Shall be Cause for Rejection:
 - a. Stator eccentricity evidenced by a spectral peak at 2 times electrical line frequency that are more than 40 percent of the peak at rotational frequency.
 - b. Rotor eccentricity evidenced by a spectral peak at 2 times electrical line frequency with spectra side bands at the pole pass frequency around the 2 times line frequency peak.
 - c. Other rotor problems evidenced by pole pass frequency side bands around operating speed harmonic peaks or 2 times line frequency side bands around rotor bar pass frequency or around two times the rotor bar pass frequency.
 - d. Phasing problems evidenced by one third line frequency side band spectral peaks around the 2 times electrical line frequency peak.

4. The presence of peaks in a High Frequency Enveloping spectra plot corresponding to bearing, gear or motor rotor bar frequencies or harmonics of these frequencies shall be cause for rejection of the equipment; since inadequate lubrication of some equipment may be a cause of these peaks, lubrication shall be checked, corrected as necessary and the high frequency envelope analysis repeated.

3.08 NOISE REQUIREMENTS AND CONTROL

- A. Make measurements in relation to reference pressure of 0.0002 microbar.
- B. Make measurements of emitted noise levels on sound level meter meeting or exceeding ANSI S1.4, Type II.
- C. Set sound level meter to slow response.
- D. Unless otherwise specified, maximum free field noise level not to exceed 88 dBA measured as sound pressure level at 5 feet from the equipment.

3.09 FUNCTIONAL AND OPERATIONAL TESTING OF EQUIPMENT

- A. Functional testing as specified in Section 01756 and this Section.
- B. General Check-out: Prior to operating equipment, inspect, test, and check supporting systems, including but not limited to power systems, control systems, piping systems, lubrication systems, and safety systems:
 1. Test and calibrate instrumentation and electrical devices as specified in Division 16 and 17.
 2. As a minimum for control systems associated with the equipment, perform the following:
 - a. Individual Loop Tests: Test from field device to intermediate terminations to controller and back to controlled element.
 - b. End to End Test: Simulate input at field device and observe control system response at the final field control element.
 3. Prior to testing, provide signed and dated certificates of calibration for test instrumentation and equipment.
- C. Operation of Related Existing Equipment: OWNER will operate related existing equipment or facilities necessary to accomplish the testing.
- D. Acceptable Tests: Demonstrate the equipment performance meets the requirements of this Section and the equipment section; when the equipment fails to meet the specified requirements, perform additional more detailed testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.
- E. Operational Testing: As specified in Section 01756.

END OF SECTION

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this Section:
1. American National Standards Institute (ANSI):
 - a. C55.1, Standard for Shunt Power Capacitors.
 - b. C62.11, Standard for Metal-Oxide Surge Arrestors for AC Circuits.
 - c. Z55.1, Gray Finishes for Industrial Apparatus and Equipment.
 2. American Society for Testing and Materials (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. A240, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
 - c. A570, Standard Specification for Steel, Sheet, and Strip, Carbon, Hot-Rolled, Structural Quality.
 3. Federal Specifications (FS):
 - a. W-C-596, Connector, Receptacle, Electrical.
 - b. W-S-896E, Switches, Toggle, Flush Mounted.
 4. National Electrical Contractor's Association, Inc. (NECA): 5055, Standard of Installation.
 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. AB 1, Molded Case Circuit Breakers and Molded Case Switches.
 - c. CP I, Shunt Capacitors.
 - d. ICS 2, Industrial Control Devices, Controllers, and Assemblies.
 - e. KS 1, Enclosed Switches.
 - f. LA I, Surge Arrestors.
 - g. PB 1, Panelboards.
 - h. ST 20, Dry-Type Transformers for General Applications.
 - i. WD I, General Requirements for Wiring Devices.
 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 7. Underwriters Laboratories, Inc. (UL):
 - a. 67, Standard for Panelboards.
 - b. 98, Standard for Enclosed and Dead-Front Switches.
 - c. 198C, Standard for Safety High-Interrupting-Capacity Fuses, Current-Limiting Types.
 - d. 198E, Standard for Class Q Fuses.
 - e. 486E, Standard for Equipment Wiring Terminals.
 - f. 489, Standard for Molded Case Circuit Breakers and Circuit Breaker Enclosures.
 - g. 508, Standard for Industrial Control Equipment.
 - h. 810, Standard for Capacitors.

- i. 943, Standard for Ground-Fault Circuit Interrupters.
- j. 1059, Standard for Terminal Blocks.
- k. 1561, Standard for Dry-Type General-Purpose and Power Transformers.

1.02 SUBMITTALS

- A. Shop Drawings, where applicable:
 - 1. Device boxes for use in hazardous areas.
 - 2. Junction and pull boxes used at, or below, grade.
 - 3. Hardware.
 - 4. Terminal junction boxes.
 - 5. Panelboards and circuit breaker data.
 - 6. Fuses.
 - 7. Contactors.
 - 8. Transformers.
 - 9. All other miscellaneous material part of this project.
 - 10. Wire pulling compound.
 - 11. Disconnects.

1.03 QUALITY ASSURANCE

- A. UL Compliance: Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.
- B. Hazardous Areas: Materials and devices shall be specifically approved for hazardous areas of the class, division, and group shown and of a construction that will ensure safe performance when properly used and maintained.

1.04 SPARE PARTS

- A. Furnish, tag, and box for shipment and storage the following spare parts:
 - 1. Fuses, 0 to 600 Volts: Three of each type and each current rating installed.

PART 2 PRODUCTS

2.01 OUTLET AND DEVICE BOXES

- A. Sheet Steel: One-piece drawn type, zinc- or cadmium-plated.
- B. Cast Aluminum:
 - 1. Material:
 - a. Box: Cast, copper-free aluminum.
 - b. Cover: Gasketed, weatherproof, cast copper-free aluminum with stainless steel screws.
 - 2. Hubs: Threaded.
 - 3. Lugs: Cast mounting.
 - 4. Manufacturers:
 - a. Crouse-Hinds; Type FS-SA or FD-SA.
 - b. Appleton; Type FS or FD.
 - c. Or approved equal.

- C. Nonmetallic:
 - 1. Box: PVC.
 - 2. Cover: PVC, weatherproof, with stainless steel screws.
 - 3. Manufacturer: Carlon; Type FS or FD, with Type E98 or E96 covers or approved equal.

2.02 JUNCTION AND PULL BOXES

- A. Outlet Boxes Used as Junction or Pull Box: As specified under Article OUTLET AND DEVICE BOXES.
- B. Large Sheet Steel Box: NEMA 250, Type 1:
 - 1. Box: Code-gauge, 316 stainless steel.
 - 2. Cover: Full access, screw type.
 - 3. Machine Screws: Corrosion-resistant.
- C. Large Stainless Steel Box: NEMA 250, Type 4X:
 - 1. Box: 14-gauge, ASTM A240, Type 316 stainless steel.
 - 2. Cover: Hinged with screws.
 - 3. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 4. Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Robroy Industries.
 - c. Or approved equal.
- D. Large Steel Box: NEMA 250, Type 4:
 - 1. Box: 12-gauge steel, with white enamel painted interior and gray primed exterior, over phosphated surfaces, with final ANSI Z55.1, No. 61 gray enamel on exterior surfaces.
 - 2. Cover: Hinged with screws.
 - 3. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 4. Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Robroy Industries.
 - c. Or approved equal.
- E. Large Nonmetallic Box (only for corrosive areas and where shown):
 - 1. NEMA 250, Type 4X, only used for location approved by engineers.
 - 2. Box: High-impact, fiberglass-reinforced polyester or engineered thermoplastic, with stability to high heat.
 - 3. Cover: Hinged with screws.
 - 4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 5. Conduit hubs and mounting lugs.
 - 6. Manufacturers:
 - a. Crouse-Hinds; Type NJB.
 - b. Carlon; Series N, C, or H.
 - c. Robroy Industries.

2.03 WIRING DEVICES

- A. Switches:
 - 1. NEMA WD I and FS W-S-896E.

2. Specification grade, totally-enclosed, ac type, with quiet tumbler switches and screw terminals.
 3. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
 4. Rating: 20 amps, 120/277 volts.
 5. Color:
 - a. Office Areas: Ivory.
 - b. Other Areas: Brown.
 6. Switches with Pilot Light: 125-volt, neon light with red jewel, or lighted toggle when switch is ON.
 7. Manufacturers:
 - a. Bryant.
 - b. Leviton.
 - c. Hubbell.
 - d. Pass and Seymour.
 - e. Arrow Hart.
- B. Receptacle, Single and Duplex:
1. NEMA WD 1 and FS W-C-596.
 2. Specification grade, two-pole, three-wire grounding type with screw type wire terminals suitable for No. 10 AWG.
 3. High strength, thermoplastic base color.
 4. Color:
 - a. Office Areas: Ivory.
 - b. Other Areas: Brown.
 5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
 6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
 7. Manufacturers:
 - a. Bryant.
 - b. Leviton.
 - c. Hubbell.
 - d. Pass and Seymour.
 - e. Sierra.
 - f. Arrow Hart.
- C. Receptacle, Ground Fault Circuit Interrupter: Duplex, specification grade, tripping at 5 mA:
1. Color: Ivory.
 2. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps, capable of interrupting 5,000 amps without damage.
 3. Size: For 2-inch by 4-inch outlet boxes.
 4. Standard Model: NEMA WD 1 with No. 12 AWG copper USE/RHH/RHW-XLPE insulated pigtails and provisions for testing.
 5. Feed-Through Model: NEMA WD 1, with No. 12 AWG copper USE/RHH/RHW-XLPE insulated pigtails and provisions for testing.
 6. Manufacturers:
 - a. Pass and Seymour.
 - b. Bryant.
 - c. Leviton.
 - d. Hubbell.
 - e. Arrow Hart.

- D. Receptacle, Special-Purpose:
 - 1. Rating and number of poles as indicated or required for anticipated purpose.
 - 2. Matching plug with cord-grip features for each special-purpose receptacle.
- E. Multioutlet Surface Raceway System: Three-wire grounding receptacles, spaced on 6-inch centers with insulated grounding conductor to each receptacle:
 - 1. Color: Gray with black receptacles.
 - 2. Manufacturers:
 - a. Plugmold; 2000.
 - b. Walker; Duct 2GW.
 - c. Or approved equal.

2.04 DEVICE PLATES

- A. General: Sectional type plates not permitted.
- B. Plastic:
 - 1. Material: Specification grade, 0.10-inch minimum thickness, noncombustible, thermosetting.
 - 2. Color: To match associated wiring device.
 - 3. Mounting Screw: Oval-head metal, color matched to plate.
- C. Metal:
 - 1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
 - 2. Finish: ASTM A167, Type 302/304, satin.
 - 3. Mounting Screw: Oval-head, finish matched to plate.
- D. Cast Metal:
 - 1. Material: Malleable ferrous metal, with gaskets.
 - 2. Screw: Oval-head stainless steel.
- E. Engraved:
 - 1. Character Height: 3/16 inch.
 - 2. Filler: Black.
- F. Weatherproof:
 - 1. For Receptacles: Gasketed, cast metal or stainless steel, with individual cap over each receptacle opening.
 - 2. Mounting Screw: Stainless steel:
 - a. Cap Spring: Stainless steel.
 - b. Manufacturers:
 - 1) General Electric.
 - 2) Bryant.
 - 3) Hubbell.
 - 4) Sierra.
 - 5) Pass and Seymour.
 - 6) Crouse-Hinds; Type WLRD or WLRS.
 - 7) Bell.
 - 8) Arrow Hart.

3. For Switches: Gasketed, cast metal incorporating external operator for internal switch:
 - a. Mounting Screw: Stainless steel.
 - b. Manufacturers:
 - 1) Crouse-Hinds; DS-181 or DS-185.
 - 2) Appleton; FSK-LVTS or FSK-IVS.
 - 3) Or approved equal.
- G. Raised Sheet Metal: 1/2-inch high zinc- or cadmium-plated steel designed for one-piece drawn type sheet steel boxes.

2.05 LIGHTING AND POWER DISTRIBUTION PANELBOARD

- A. NEMA PB I, NFPA 70, and UL 67, including panelboards installed in motor control equipment.
- B. Panelboards and Circuit Breakers: Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- C. Short-Circuit Current Equipment Rating: Fully rated; series connected unacceptable.
- D. Rating: If not otherwise shown in plans. Applicable to a system with available short-circuit current of 25,000 amperes rms symmetrical at 208Y/120 or 120/240 volts and 65,000 amperes rms symmetrical at 480Y/277 volts.
- E. Where ground fault interrupter circuit breakers are indicated or required by code: 5 mA trip, 10,000 amps interrupting capacity circuit breakers or as shown on plan.
- F. Cabinet: As shown on plans.
- G. Bus Bar:
 1. Material: Copper, full sized throughout length.
 2. Provide for mounting of future circuit breakers along full length of bus regardless of number of units and spaces shown. Machine, drill, and tap as required for current and future positions.
 3. Neutral: Insulated, rated 150 percent of phase bus bars with at least one terminal screw for each branch circuit.
 4. Ground: Copper, installed on panelboard frame, bonded to box with at least one terminal screw for each circuit.
 5. Lugs and Connection Points:
 - a. Suitable for either copper or aluminum conductors.
 - b. Solderless main lugs for main, neutral, and ground bus bars.
 - c. Subfeed or through-feed lugs as shown.
 6. Bolt together and rigidly support bus bars and connection straps on molded insulators.
- H. Circuit Breakers:
 1. NEMA AB 1 and UL 489.
 2. Thermal-magnetic, quick-make, quick-break, molded case, of the indicating type showing ON/OFF and TRIPPED positions of operating handle.
 3. Noninterchangeable, in accordance with NFPA 70.

4. Locking: Provisions for handle padlocking, unless otherwise shown.
 5. Type: Bolt-on circuit breakers in all panelboards.
 6. Multipole circuit breakers designed to automatically open all poles when an overload occurs on one pole.
 7. Do not substitute single-pole circuit breakers with handle ties for multipole breakers.
 8. Do not use tandem or dual circuit breakers in normal single-pole spaces.
 9. Ground Fault Interrupter:
 - a. Equip with conventional thermal-magnetic trip and ground fault sensor rated to trip in 0.025 second for a 5-milliampere ground fault (UL 943, Class A sensitivity).
 - b. Sensor with same rating as circuit breaker and a push-to-test button.
 10. All 480V, 3-phase panel shall have mechanism for lockable breakers.
- I. Manufacturers:
1. Square D.
 2. Eaton.
 3. Or approved equal.

2.06 CIRCUIT BREAKER, INDIVIDUAL, 0 TO 600 VOLTS

- A. NEMA AB I, UL 489 listed for use at location of installation.
- B. Minimum Interrupt Rating: As shown or as required.
- C. Thermal-magnetic, quick-make, quick-break, indicating type, showing ON/OFF and TRIPPED indicating positions of the operating handle.
- D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- E. Locking: Provisions for padlocking handle.
- F. Multipole breakers to automatically open all poles when an overload occurs on one-pole.
- G. Enclosure: NEMA 250, Type 12, Industrial Use, 4X - outdoors, wet locations and corrosive areas, unless otherwise shown.
- H. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position.
- I. Do not provide single-pole circuit breakers with handle ties where multipole circuit breakers are shown.

2.07 NONFUSED DISCONNECT SWITCH, INDIVIDUAL, 0 TO 600 VOLTS

- A. NEMA KS 1.
- B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- C. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

- D. Enclosure: NEMA 250, Type 12, industrial use, 4X- outdoors, wet locations and corrosive areas, unless otherwise shown.
- E. Interlock: Enclosure and switch to prevent opening cover with switch in the ON position.

2.08 FUSED DISCONNECT SWITCH, INDIVIDUAL, 0 TO 600 VOLTS

- A. UL 98 listed for use and location of installation.
- B. NEMA KS 1 and UL 98 Listed for application to system with available short circuit current of 22,000 amps rms symmetrical.
- C. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- E. Fuse mountings shall reject Class H fuses and accept only current-limiting fuses specified.
- F. Enclosure: NEMA 250, Type 12, Industrial Use, 4X - outdoors, wet locations and corrosive areas, unless otherwise shown.
- G. Interlock: Enclosure and switch to prevent opening cover with switch in the ON position.

2.09 FUSE, 0 TO 600 VOLTS

- A. Current-limiting, with 200,000-ampere rms interrupting rating.
- B. Provide to fit mountings specified with switches and features to reject Class H fuses.
- C. Motor and Transformer Circuits, 0- to 600-Volt:
 - 1. Amperage: 0 to 600.
 - 2. UL 198E, Class RK-1, dual element, with time delay.
 - 3. Manufacturers:
 - a. Bussmann; Type LPS-RK.
 - b. Littlefuse; Type LLS-RK.
 - c. Or approved equal.
- D. Motor and Transformer Circuits, 0- to 250-Volt:
 - 1. Amperage: 0 to 600.
 - 2. UL 198E, Class RK-1, dual element, with time delay.
 - 3. Manufacturers:
 - a. Bussmann; Type LPN-RK.
 - b. Littlefuse; Type LLN-RK.
 - c. Or approved equal.
- E. Feeder and Service Circuits, 0- to 600-Volt:
 - 1. Amperage: 0 to 600.
 - 2. UL 198E, Class RK-I, dual element, with time delay.

3. Manufacturers:
 - a. Bussmann; Type LPS-RK.
 - b. Littlefuse; Type LLS-RK.
 - c. Or approved equal.
- F. Feeder and Service Circuits, 0- to 250-Volt:
1. Amperage: 0 to 600.
 2. UL 198E, Class RK-I, dual element, with time delay.
 3. Manufacturers:
 - a. Bussmann; Type LPN-RK.
 - b. Littlefuse; Type LLN-RK.
 - c. Or approved equal.
- G. Feeder and Service Circuits, 0- to 600-Volt:
1. Amperage: 601 to 6,000.
 2. UL 198C, Class L, double O-rings and silver links.
 3. Manufacturers:
 - a. Bussmann; Type KRP-C.
 - b. Littlefuse; Type KLPC.
 - c. Or approved equal.

2.10 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCHES

- A. Contact Rating: NEMA ICS 2, Type A600.
- B. Selector Switch Operating Lever: Standard.
- C. Indicating Lights: LED type Push-to-test, minimum 22 mm diameter.
- D. Pushbutton: Only used for reset pushbutton.
- E. Selector switches lockable in the OFF position where indicated.
- F. Legend Plate:
1. Material: Aluminum.
 2. Engraving: 11 character/spaces on one line, 14 character/spaces on each of two lines, as required, indicating specific function.
 3. Letter Height: 7/64 inch.
- G. Manufacturers:
1. Heavy-Duty, Oiltight Type:
General Electric; Type CR 104P.
Square D; Type T.
Cutler-Hammer; Type 10250T.
 2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
Square D; Type SK.
General Electric; Type CR 104P.
Cutler-Hammer; Type E34.
Crouse-Hinds; Type NCS.

2.11 TERMINAL JUNCTION BOX

- A. Cover: Hinged, unless otherwise shown.
- B. Terminal Blocks: Provide separate connection point for each conductor entering or leaving box:
 - 1. Spare Terminal Points: 25 percent.
- C. Interior Finish: Paint with white enamel or lacquer.

2.12 TERMINAL BLOCK (0 TO 600 VOLTS)

- A. UL 486E and UL 1059.
- B. Size components to allow insertion of necessary wire sizes.
- C. Capable of termination of all control circuits entering or leaving equipment, panels, or boxes.
- D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between the compression screw and yoke.
- E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.
- F. Yoke shall guide all strands of wire into terminal.
- G. Current bar shall ensure vibration-proof connection.
- H. Terminals:
 - 1. Capable of wire connections without special preparation other than stripping.
 - 2. Capable of jumper installation with no loss of terminal or rail space.
 - 3. Individual, rail mounted.
- I. Marking system allowing use of preprinted or field-marked tags.
- J. Manufacturers:
 - 1. Weidmuller.
 - 2. Ideal.
 - 3. Electrovert.

2.13 MAGNETIC CONTROL RELAY

- A. NEMA ICS 2, Class A600 (600 volts, 10 amps continuous, 7,200VA make, 720VA break), industrial control with field convertible contacts.
- B. Time Delay Relay Attachment:
 - 1. Pneumatic type, timer adjustable from 0.2 to 60 seconds (minimum).
 - 2. Field convertible from ON delay to OFF delay and vice versa.
- C. Latching Attachment: Mechanical latch having unlatching coil and coil clearing contacts.

- D. Manufacturers:
 - 1. Cutler-Hammer; Type M-600.
 - 2. General Electric; Type CR120B.
 - 3. Or approved equal.

2.14 ELAPSED TIME METER

- A. Drive: Synchronous motor.
- B. Range: 0 to 99,999.9 hours, nonreset type.
- C. Mounting: Semiflush, panel.
- D. Manufacturers:
 - 1. General Electric; Type 240, 2-1/2-inch Big Look.
 - 2. Eagle Signal; Bulletin 705.
 - 3. Or approved equal.

2.15 MAGNETIC CONTACTOR

- A. NEMA ICS 2, UL 508.
- B. Electrically operated, electrically held.
- C. Main Contacts:
 - 1. Power driven in one direction with gravity dropout.
 - 2. Silver alloy with wiping action and arc quenchers.
 - 3. Continuous-duty, rated 30 amperes, 600-volt.
 - 4. Three-pole.
- D. Control: Two-wire.
- E. One normally open and one normally closed auxiliary contacts rated 10 amperes at 480-volt.
- F. Enclosure: NEMA 250, Type 12, unless otherwise shown.
- G. Manufacturers:
 - 1. Westinghouse; Class A211.
 - 2. General Electric; CR 353.
 - 3. Allen-Bradley; Bulletin 500 Line.

2.16 MAGNETIC LIGHTING CONTACTOR

- A. NEMA ICS 2, UL 508.
- B. Electrically operated by dual-acting, single coil mechanism.
- C. Inherently interlocked and electrically held in both OPEN and CLOSED position.
- D. Main Contacts:
 - 1. Power driven in both directions.

2. Double-break, continuous-duty, rated 20 amperes, 600 volts, withstand rating of 22,000 amps rms symmetrical at 250 volts.
 3. Marked for electric discharge lamps, tungsten, and general-purpose loads.
 4. Position not dependent on gravity, hooks, latches, or semi-permanent magnets.
 5. Capable of operating in any position.
 6. Visual indication for each contact.
- E. Auxiliary contact relay for three-wire control.
- F. One normally open and one normally closed auxiliary contacts rated 10 amperes at 480-volt.
- G. Fully rated neutral plate.
- H. Provision for remote pilot lamp with use of auxiliary contacts.
- I. Clamp type, self-rising terminal plates for solderless connections.
- J. Enclosure: NEMA 250, Type 12, Dust-Tight, Drip-Tight, Industrial Use, unless otherwise shown.
- K. Manufacturers:
1. ASCO.
 2. Westinghouse; Class A202.
 3. General Electric; Class 360.

2.17 DRY TYPE TRANSFORMER (0- TO 600-VOLT PRIMARY)

- A. UL 1561, NEMA ST 20, unless otherwise indicated.
- B. Self-cooled, two-winding, UL K-4 rated for nonlinear loads.
- C. Insulation Class and Temperature Rise: Manufacturer's standard.
- D. Core and Coil:
1. Encapsulated for single-phase units 1/2 to 25 kVA and for three-phase units 3 to 15 kVA.
 2. Thermosetting varnish impregnated for single-phase units 37.5 kVA and above, and for three-phase units 30 kVA and above.
- E. Enclosure:
1. Single-Phase, 3 to 25 kVA: NEMA 250, Type 3R, non-ventilated.
 2. Single-Phase, 37-1/2 kVA and Above: NEMA 250, Type 2, ventilated.
 3. Three-Phase, 3 to 15 kVA: NEMA 250, Type 3R, nonventilated.
 4. Three-Phase, 30 kVA and Above: NEMA 250, Type 2, ventilated.
 5. Outdoor or Wet location (process area) Transformers: NEMA 250, Type 3R.
- F. Wall Bracket: For single-phase units, 15 to 37-1/2 kVA, and for three-phase units, 15 to 30 kVA.

- G. Voltage Taps:
 - 1. Single-Phase, 3 to 10 kVA: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
 - 2. Single-Phase, 15 kVA and Above: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
 - 3. Three-Phase, 3 to 15 kVA: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
 - 4. Three-Phase, 30 kVA and Above: Four 2-1/2 percent, full capacity; two above and two below normal voltage rating.
- H. Impedance: 4.5 percent minimum on units 75 kVA and larger.
- I. Maximum Sound Level: NEMA ST 20:
 - 1. 40 decibels for 0 to 9 kVA.
 - 2. 45 decibels for 10 to 50 kVA.
 - 3. 50 decibels for 51 to 150 kVA.
 - 4. 55 decibels for 151 to 300 kVA.
 - 5. 60 decibels for 301 to 500 kVA.
- J. Vibration Isolators:
 - 1. Rated for transformer's weight.
 - 2. Isolation Efficiency: 99 percent, at fundamental frequency of sound emitted by transformer.
 - 3. Less Than 30 kVA: Isolate entire unit from structure with external vibration isolators.
 - 4. 30 kVA and Above: Isolate core and coil assembly from transformer enclosure with integral vibration isolator.
- K. Manufacturers:
 - 1. Eaton Electrical.
 - 2. Square D.
 - 3. GE.
 - 4. Or approved equal.

2.18 LOW VOLTAGE, SECONDARY SURGE PROTECTIVE EQUIPMENT

- A. NEMA LA1, ANSI C62. 11.
- B. Surge Capacitor:
 - 1. Impregnated with non-PCB, biodegradable dielectric fluid.
 - 2. Integral discharge resistor which will drain residual voltage to 50 volts crest in less than 1 minute after disconnection from circuit.
- C. Arrestor: High strength metal oxide valve elements enclosed in high strength, corrosion resistant, molded resin housing.
- D. Equip capacitor and arrestor with mounting nipple, flat washer, and nut suitable for knockout or bracket mounting.

2.19 SUPPORT AND FRAMING CHANNELS

- A. Material:
 - 1. Dry indoors - galvanized.
 - 2. All Other Areas: ASTM A167, Type 316 stainless steel or fiber-reinforced epoxy, as required. Fiber-reinforced epoxy shall be only used where shown on drawings.
- B. Finish:
 - 1. Dry indoors - galvanized.
 - 2. All Other Areas: ASTM A167, Type 316 stainless steel or fiber-reinforced epoxy, as required. Fiber-reinforced epoxy shall be only used where shown on drawings.
- C. Inserts: Continuous.
- D. Beam Clamps: 316 stainless steel. All hinges and hardware shall be 316 stainless steel.
- E. Manufacturers:
 - 1. B-Line.
 - 2. Unistrut.

2.20 NAMEPLATES

- A. Material: Laminated plastic.
- B. Attachment Screws: Stainless steel.
- C. Color: White, engraved to a black core.
- D. Engraving:
 - 1. Pushbuttons/Selector Switches: Name of drive controlled on one, two, or three lines, as required.
 - 2. Panelboards: Panelboard designation, service voltage, and phases.
- E. Letter Height:
 - 1. Pushbuttons/Selector Switches: 1/8 inch.
 - 2. Panelboards: 1/4 inch.

2.21 SURGE PROTECTIVE DEVICES

- A. This Section describes the material and installation requirements for surge protection devices (SPD) in switchboards, panelboards, and motor control centers for the protection of all AC electrical circuits.
- B. SPD's shall be listed and component recognized in accordance with UL 1449 3rd addition Type 1 SPD and UL 1283.
- C. SPD's shall be installed and warranted by and shipped from the electrical distribution equipment manufacturer's factory.

- D. SPD's shall provide surge current diversion paths for all modes of protection; L-L, L-N, L-G, N-G in WYE systems, and L-L, L-G in DELTA systems.
- E. SPD's shall be modular in design. Each module shall be fused with a surge rated fuse.
- F. A UL approved disconnect switch shall be provided as a means of disconnect in the switchboard device only.
- G. SPD's shall meet or exceed the following criteria:
 - 1. Maximum surge current capability (single pulse rated) shall be:
 - a. Service entrance switchboard 300kA per phase, non-service entrance rated switchboard: 240kA per phase.
 - b. Branch panelboards 150kA per phase.
 - c. Motor control centers 80kA per phase.
 - 2. UL 1449 3rd edition Listed and Recognized Component Voltage Protection Ratings shall not exceed the following:

Voltage	L-N	L-G	N-G
208Y/120	600V	600V	600V
480Y/277	1000V	1000V	1000V

- H. SPD's shall have a minimum EMI/RFI filtering of -44dB at 100kHz with an insertion ration of 50:1 using MIL STD. 220A methodology.
- I. SPD's shall be provided with 1 set of NO/NC dry contacts.
- J. SPD's shall have a warranty for a period of five years, incorporating unlimited replacements of suppressor parts if transients destroy them during the warranty period. Warranty will be the responsibility of the electrical distribution equipment manufacturer.
- K. Approve manufactures are:
 - 1. Cutler Hammer.
 - 2. General Electric.
 - 3. Siemens.
 - 4. Square D Company.
 - 5. Current Technology.
 - 6. Allen-Bradley.
 - 7. Or Owner approved equal.

2.22 POWER METER

- A. Solid-state device with LED displays.
- B. Direct voltage input up to 600 volts ac.
- C. Current input via current transformer with 5-ampere secondary.
- D. Programmable current and potential transformer ratios.
- E. Programmable limits to activate up to four alarms.

- F. Selectable voltage measurements; line-to-line or line-to-neutral, and wye or delta.
- G. Simultaneous Display:
 - 1. Volts, three-phase.
 - 2. Amperes, three-phase.
 - 3. Kilowatts.
 - 4. Kilowatt-hours.
 - 5. Power factor.
 - 6. Frequency.
 - 7. kW demand, with programmable period intervals.
 - 8. kVA, kVAR, kVARh.
 - 9. Ground leakage mA.
 - 10. THD.
 - 11. 1K-factor.
- H. Voltage Rating: 95 to 135 volts, ac.
- I. Individual voltage, current, and kW 4-20 mA output. KYZ pulse output representing units of energy.
- J. Power meter shall communicate over EtherNet communications protocol.
- K. Manufacturers:
 - 1. Cutler-Hammer.
 - 2. GE.
 - 3. Square D.
 - 4. Or Owner/Engineer Approved Equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Install equipment in accordance with NECA 5055.

3.02 OUTLET AND DEVICE BOXES

- A. Install suitable for conditions encountered at each outlet or device in the wiring or raceway system, sized to meet NFPA 70 requirements.
- B. Size:
 - 1. Depth: Minimum 2 inches, unless otherwise required by structural conditions.
Box extensions not permitted:
 - a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
 - 2. Ceiling Outlet: Minimum 4-inch octagonal sheet steel device box, unless otherwise required for installed fixture.
 - 3. Switch and Receptacle: Minimum 2-inch by 4-inch sheet steel device box.
- C. Locations:
 - 1. Drawing locations are approximate.

2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by ENGINEER.
 3. Light Switch: Install on lock side of doors.
 4. Light Fixture: Install in symmetrical pattern according to room layout unless otherwise shown.
- D. Mounting Height:
1. General:
 - a. Measured to centerline of box.
 - b. Where specified heights do not suit building construction or finish, mount as directed by ENGINEER.
 2. Light Switch: 48 inches above floor.
 3. Thermostat: 54 inches above floor.
 4. Telephone Outlet: 6 inches above counter tops or 15 inches above floor.
 5. Wall Mounted Telephone Outlet: 52 inches above floor.
 6. Convenience Receptacle:
 - a. General Interior Areas: 15 inches above floor.
 - b. General Interior Areas (Counter Tops): Install device plate bottom or side flush with top of splashback, or 6 inches above countertops without splashback.
 - c. Industrial Areas, Workshops: 48 inches above floor.
 - d. Outdoor, All Areas: 24 inches above finished grade.
 7. Special-Purpose Receptacle: 54 inches above floor or as shown.
- E. Install plumb and level.
- F. Flush Mounted:
1. Install with concealed conduit.
 2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
 3. Holes in surrounding surface shall be no larger than required to receive box.
- G. Support boxes independently of conduit by attachment to building structure or structural member.
- H. Install bar hangers in frame construction, or fasten boxes directly with wood screws on wood, bolts and expansion shields on concrete or brick, toggle bolts on hollow masonry units, and machine screws threaded into steelwork.
- I. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
- J. Provide plaster rings where necessary.
- K. Boxes embedded in concrete or masonry need not be additionally supported.
- L. Install stainless steel mounting hardware in industrial areas.
- M. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

- N. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.
- O. Box Type (Steel Raceway System):
 - 1. Exterior Locations:
 - a. Exposed Raceways: Cast metal.
 - b. Concealed Raceways: Cast metal.
 - c. Concrete Encased Raceways: Cast metal.
 - d. Class I, II, or III Hazardous Areas: Cast metal.
 - 2. Interior Dry Locations:
 - a. Exposed Rigid Conduit: Cast metal.
 - b. Exposed EMT: Sheet steel.
 - c. Concealed Raceways: Sheet steel.
 - d. Concrete Encased Raceways: Cast metal.
 - e. Lighting Circuits, Ceiling: Sheet steel.
 - f. Class I, II, or III Hazardous Areas: Cast metal.
 - 3. Interior Wet Locations:
 - a. Exposed Raceways: Cast metal.
 - b. Concealed Raceways: Cast metal.
 - c. Concrete Encased Raceways: Cast metal.
 - d. Lighting Circuits, Ceiling: Sheet steel.
 - e. Class I, II, or III Hazardous Areas: Cast metal.
 - 4. Cast-In-Place Concrete Slabs: Sheet steel.
- P. Box Type (Rigid Aluminum Raceway System): Cast aluminum.
- Q. Box Type (Nonmetallic Raceway System):
 - 1. Corrosive Locations: Nonmetallic.
 - 2. Exposed Raceways: Nonmetallic.
 - 3. Concealed Raceways: Nonmetallic.
 - 4. Concrete Encased Raceways: Nonmetallic.

3.03 JUNCTION AND PULL BOXES

- A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
- B. Install pull boxes where necessary in raceway system to facilitate conductor installation.
- C. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.
- D. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
- E. Installed boxes shall be accessible.
- F. Do not install on finished surfaces.
- G. Install plumb and level.

- H. Support boxes independently of conduit by attachment to building structure or structural member.
- I. Install bar hangers in frame construction, or fasten boxes directly with wood screws on wood, bolts and expansion shields on concrete or brick, toggle bolts on hollow masonry units, and machine screws or welded threaded studs on steelwork.
- J. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
- K. Boxes embedded in concrete or masonry need not be additionally supported.
- L. Above Grade:
 - 1. Install above grade pullbox on concrete pad as shown on details. All mounting hardware shall be 316 stainless steel.
- M. Flush Mounted:
 - 1. Install with concealed conduit.
 - 2. Holes in surrounding surface shall be no larger than required to receive box.
 - 3. Make edges of boxes flush with final surface.
- N. N. Mounting Hardware:
 - 1. Noncorrosive Interior Areas: Galvanize.
 - 2. All Other Areas: Stainless steel.
- O. O. Location/Type:
 - 1. Finished, Indoor, Dry: NEMA 250, Type 1.
 - 2. Unfinished, Indoor, Dry: NEMA 250, Type 12.
 - 3. Unfinished, Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X.
 - 4. Unfinished, Indoor and Outdoor, Wet, Dust, or Oil: NEMA 250, Type 13.
 - 5. Unfinished, Indoor and Outdoor, Hazardous: NEMA 250, Type 7 and Type 9, where indicated.
 - 6. Underground Conduit: Concrete Encased.
 - 7. Corrosive Locations: Nonmetallic.

3.04 WIRING DEVICES

- A. Switches:
 - 1. Mounting Height: See Paragraph OUTLET AND DEVICE BOXES.
 - 2. Install with switch operation in vertical position.
 - 3. Install single-pole, two-way switches such that toggle is in up position when switch is on.
- B. Receptacles:
 - 1. Install with grounding slot down except where horizontal mounting is shown, in which case install with neutral slot up.
 - 2. Ground receptacles to boxes with grounding wire only.
 - 3. Weatherproof Receptacles:
 - a. Install in cast metal box.
 - b. Install such that hinge for protective cover is above receptacle opening.

4. Ground Fault Interrupter: Install feed-through model at locations where ground fault protection is specified for "downstream" conventional receptacles.
 5. Special-Purpose Receptacles: Install in accordance with manufacturer's instructions.
- C. Multioutlet Surface Raceway System:
1. Install in accordance with manufacturer's instructions.
 2. Wire alternate outlets to each circuit where two-circuit, three-wire supply is shown.

3.05 DEVICE PLATES

- A. Securely fasten to wiring device; ensure a tight fit to the box.
- B. Flush Mounted: Install with all four edges in continuous contact with finished wall surfaces without use of mats or similar materials. Plaster fillings will not be an acceptable.
- C. Surface Mounted: Plate shall not extend beyond sides of box unless plates have no sharp corners or edges.
- D. Install with alignment tolerance to box of 1/16 inch.
- E. Engrave with designated titles.
- F. Types (Unless Otherwise Shown):
1. Office: Stainless Steel.
 2. Exterior: Weatherproof.
 3. Interior:
 - a. Flush Mounted Boxes: Stainless Steel.
 - b. Surface Mounted, Cast Metal Boxes: Cast metal.
 - c. Surface Mounted, Sheet Steel Boxes: Stainless Steel.
 - d. Surface Mounted, Nonmetallic Boxes: Plastic.

3.06 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Heavy-Duty, Oiltight Type: Locations (Unless Otherwise Shown): Nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations.
- B. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
1. Locations (Unless Otherwise Shown): Nonhazardous, outdoor, or normally wet areas.
 2. Mounting: NEMA 250, Type 4X enclosure.

3.07 TERMINAL JUNCTION BOX

- A. Install in accordance with Paragraph JUNCTION AND PULL BOXES.
- B. Label each block and terminal with permanently attached, nondestructible tag.
- C. Do not install on finished outdoor surfaces.

- D. Location:
 - 1. Finished, Indoor, Dry: NEMA 250, Type 1.
 - 2. Unfinished, Indoor, Dry: NEMA 250, Type 12.
 - 3. Unfinished, Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X.
 - 4. Unfinished, Indoor and Outdoor, Wet, Dust, or Oil: NEMA 250, Type 13.

3.08 LIGHTING AND POWER DISTRIBUTION PANELBOARD

- A. Install securely, plumb, in-line and square with walls.
- B. Install top of cabinet 6 feet above floor unless otherwise shown.
- C. Provide typewritten circuit directory for each panelboard.

3.09 SUPPORT AND FRAMING CHANNEL

- A. Furnish zinc-rich primer; paint cut ends prior to installation, where applicable.
- B. Install where required for mounting and supporting electrical equipment and raceway systems.

3.10 3.10 MOTOR SURGE PROTECTION

- A. Ground in accordance with NFPA 70.
- B. Low Voltage: Ground terminals to equipment bus.

END OF SECTION

SECTION 16405

ELECTRIC MOTORS

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. This Section applies only when referenced by a motor-driven equipment specification. Application, horsepower, enclosure type, mounting, shaft type, synchronous speed, and any deviations from this Section will be listed in the equipment specification. Where such deviations occur, they shall take precedence over this Section.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this Section:
 - 1. Anti-Friction Bearing Manufacturers' Association (AFBMA):
 - a. 9, Load Ratings and Fatigue Life for Ball Bearings.
 - b. 11, Load Rating and Fatigue Life for Roller Bearings.
 - 2. American National Standards Institute (ANSI): C50.41, Polyphase Induction Motors for Power Generating Stations.
 - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 85, Test Procedure for Airborne Sound Measurements on Rotating Machines.
 - b. 112, Standard Test Procedures for Polyphase Induction Motors and Generators.
 - c. 114, Standard Test Procedures for Single-Phase Induction Motors.
 - d. 620, Guide for Construction and Interpretation of Thermal Limit Curves for Squirrel-Cage Motors Over 500 Horsepower.
 - e. 841, Recommended Practice for Chemical Industry Severe-Duty Squirrel-Cage Induction Motors, 600V and Below.
 - 4. National Electrical Manufacturers Association (NEMA):
 - a. MG 1, Motors and Generators.
 - b. MG 13, Frame Assignments for Alternating Current Integral Horsepower Induction Motors.
 - c. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - 5. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).
 - 6. Underwriters Laboratories (UL):
 - a. 547, Thermal Protectors for Electric Motors.
 - b. 674, Electric Motors and Generators Used in Hazardous (Classified) Locations.

1.03 DEFINITIONS

- A. CISD-TEFC: Chemical industry, severe-duty enclosure.
- B. DIP: Dust-ignition-proof enclosure.

- C. EXP: Explosion-proof enclosure.
- D. ODP: Open drip-proof enclosure.
- E. TEFC: Totally enclosed, fan cooled enclosure.
- F. TENV: Totally enclosed, non-ventilated enclosure.
- G. WPI: Open weather protected enclosure, Type I.
- H. WPII: Open weather protected enclosure, Type II.
- I. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Descriptive information.
 - 2. Nameplate data in accordance with NEMA MG 1.
 - 3. Additional Rating Information:
 - a. Service factor.
 - b. Locked rotor current.
 - c. No load current.
 - d. Safe stall time for motors 200 horsepower and larger.
 - e. Multispeed load classification (e.g., variable torque).
 - f. Adjustable frequency drive motor load classification (e.g., variable torque) and minimum allowable motor speed for that load classification.
 - 4. Enclosure type and mounting (e.g., horizontal, vertical).
 - 5. Dimensions and total weight.
 - 6. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.
 - 7. Bearing type.
 - 8. Bearing lubrication.
 - 9. Bearing life.
 - 10. Space heater voltage and watts.
 - 11. Description and rating of motor thermal protection.
 - 12. Motor sound power level in accordance with NEMA MG 1.
 - 13. Maximum brake horsepower required by the equipment driven by the motor.
 - 14. Description and rating of submersible motor moisture-sensing system.
- B. Quality Control Submittals:
 - 1. Factory test reports, certified.
 - 2. Manufacturer's Certificate of Proper Installation, 100 horsepower and larger.
 - 3. Operation and Maintenance Manual.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. General Electric Water.
- B. Reliance.
- C. Teco-Westinghouse.
- D. U.S. Motors.
- E. Or approved equal.

2.02 GENERAL

- A. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.
- B. In order to obtain single source responsibility, use a single supplier to provide a drive motor, its driven equipment, and specified motor accessories.
- C. Meet requirements of NEMA MG 1.
- D. Frame assignments in accordance with NEMA MG 13.
- E. Provide motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.
- F. Motors shall be specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.
- G. Lifting lugs on all motors weighing 100 pounds or more.
- H. Operating Conditions:
 - 1. Maximum ambient temperature not greater than 50 degrees C.
 - 2. Motors shall be suitable for operating conditions without any reduction being required in the nameplate rated horsepower or exceeding the rated temperature rise.
 - 3. Overspeed in either direction in accordance with NEMA MG 1.

2.03 HORSEPOWER RATING

- A. As designated in motor-driven equipment specifications.
- B. Constant Speed Applications: Brake horsepower of the driven equipment at any head capacity point on the pump curve not to exceed motor nameplate horsepower rating, excluding any service factor.
- C. Adjustable Frequency, Adjustable Speed Applications: Driven equipment brake horsepower at any head capacity point on the pump curve not to exceed motor nameplate horsepower rating, excluding any service factor.

2.04 SERVICE FACTOR

- A. 1.15 minimum at rated ambient temperature, unless otherwise indicated.

2.05 VOLTAGE AND FREQUENCY RATING

- A. System Frequency: 60-Hz.
- B. Voltage Rating: Unless otherwise indicated in motor-driven equipment specifications:

Size	Voltage	Phases
1/2 hp and smaller	115	1
3/4 hp through 400 hp	460	3
450 hp and larger	4,000	3

- C. Suitable for full voltage starting.
- D. One hundred horsepower and larger also suitable for reduced voltage starting with 65 or 80 percent voltage tap settings on reduced inrush motor starters.
- E. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.
- F. Motor for Variable Frequency Drive (VFD) shall meet the requirement of this specification Section 2.16.B.

2.06 EFFICIENCY AND POWER FACTOR

- A. For all motors except single-phase, under 1 horsepower, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:
1. Efficiency:
 - a. Tested in accordance with NEMA MG 1, paragraph 12.54.1. All motors shall be premium efficiency.
 - b. Guaranteed minimum at full load in accordance with Table 1 or as indicated in motor-driven equipment specifications.
 2. Power Factor: Guaranteed minimum at full load in accordance with Table 1 or as indicated in motor-driven equipment specifications.

2.07 LOCKED ROTOR RATINGS

- A. Locked rotor kVA Code F or lower if motor horsepower not covered by NEMA MG 1 tables.
- B. Safe stall time 15 seconds or greater.

2.08 INSULATION SYSTEMS

- A. Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system.

- B. Motors Rated Over 600 Volts: Sealed windings in accordance with NEMA MG 1.
- C. Three-Phase and Integral Horsepower Motors, Unless Otherwise Indicated in Motor-Driven Equipment Specifications: Class F with Class B rise at nameplate horsepower and designated operating conditions, except EXP and DIP motors which must be Class B with Class B rise. Insulation shall be chemical and humidity resistant.

2.09 ENCLOSURES

- A. All enclosures to conform to NEMA MG 1.
- B. Unless otherwise noted, all motors shall be TEFC and shall be furnished with a drain hole with porous drain/weather plug.
- C. Explosion-Proof (EXP):
 - 1. TEFC listed to meet UL 674 and NFPA 70 requirements for Class 1, Division 1, Group C and D hazardous locations.
 - 2. Drain holes with drain and breather fittings.
 - 3. Integral thermostat opening on excessive motor temperature in accordance with UL 547 and NFPA 70.
 - 4. Thermostat leads to terminate in a terminal box separate from main terminal box.
- D. Dust-Ignition-Proof (DIP):
 - 1. TEFC listed to meet UL 674 and NFPA 70 requirements for Class II, Division 1, Group E, F, G.
 - 2. Integral thermostat opening on excessive motor temperature in accordance with UL 547 and NFPA 70.
 - 3. Thermostat leads to terminate in a terminal box separate from main terminal box.
- E. Chemical Industry, Severe-Duty (CISD-TEFC): In accordance with Paragraph SPECIAL MOTORS.

2.10 TERMINAL (CONDUIT) BOXES

- A. Oversize main terminal boxes for all motors.
- B. Diagonally split, rotatable to each of four 90-degree positions. Threaded hubs for conduit attachment.
- C. Except ODP, furnish gaskets between box halves and between box and motor frame.

- D. Minimum usable volume in percentage of that specified in NEMA MG 1-11.06 and 20.62 and NFPA 70, Article 430:

Voltage		Horsepower	Percentage
Below 600		15 thru 125	500
Below 600		150 thru 300	275
Below 600		350 thru 600	225
Above 600		All Sizes	200

- E. Terminal for connection of equipment grounding wire in each terminal box.

2.11 BEARINGS AND LUBRICATION

- A. Horizontal Motors:
1. 3/4 horsepower and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
 2. 1 Through 400 horsepower: Regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
 3. Above 400 horsepower: Regreasable antifriction bearings in labyrinth sealed end bells with removable grease relief plugs.
 4. Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in AFBMA 9 and 11.
- B. Vertical Motors:
1. Thrust Bearings:
 - a. Antifriction bearing.
 - b. Manufacturer's standard lubrication 100 horsepower and smaller.
 - c. Oil lubricated 125 horsepower and larger.
 - d. Minimum 100,000 hours L-10 bearing life.
 2. Guide Bearings:
 - a. Manufacturer's standard bearing type.
 - b. Manufacturer's standard lubrication 100 horsepower and smaller.
 - c. Oil lubricated 125 horsepower and larger.
 - d. Minimum 100,000 hours L-10 bearing life.
- C. Regreasable Antifriction Bearings:
1. Readily accessible, grease injection fittings.
 2. Readily accessible, removable grease relief plugs.
- D. Oil Lubrication Systems:
1. Oil reservoirs with sight level gauge.
 2. Oil fill and drain openings with opening plugs.
 3. Provisions for necessary oil circulation and cooling.

2.12 NOISE

- A. Measured in accordance with IEEE 85 and NEMA MG 1 and be less than levels in 12.53.3 at no load.
- B. Motors controlled by adjustable frequency drive systems shall not exceed sound levels of 3 dBA higher than NEMA MG 1.

2.13 BALANCE AND VIBRATION CONTROL

- A. In accordance with NEMA MG 1-12.06 and 1-12.07.

2.14 EQUIPMENT FINISH

- A. External Finish: Prime and finish coat manufacturer's standard. Field painting in accordance with Section 09900 - Painting and Protective Coatings.
- B. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

2.15 SPECIAL FEATURES AND ACCESSORIES

- A. Screen over Air Openings: Stainless steel on motors with ODP, WPI, and WPFI enclosures meeting requirements for Guarded Machine in NEMA MG 1.
- B. Winding Thermal Protection:
 - 1. Thermostats:
 - a. Motors for constant speed and adjustable speed application 50 and larger.
 - b. Bi-metal disk or rod type thermostats embedded in stator windings (normally closed contact). Automatic reset contacts rated 120 volts ac, 5 amps minimum, opening on excessive temperature. (Manual reset will be provided at motor controller).
 - 2. Motor Space Heaters: All motors 50 horsepower and larger except if otherwise noted, shall be furnished with 120V ac space heaters. The rating of the space heaters shall be determined in accordance with the motor manufacturer's standard for particular frame size and type. Coordinate the power requirements of the space heater with the manufacturer of motor starters or adjustable frequency drive for sizing of the control transformer. Space heater wire leads shall be brought out in the conduit box on the motor and clearly identified.

2.16 SPECIAL MOTORS

- A. Requirements in this article take precedence over conflicting features specified elsewhere in this Section.
- B. Motors for Variable Frequency Drives (VFD's): These motors shall be specially designed inverter duty motors and comply with NEMA MG 1.31. Motor insulation shall withstand high voltages caused by fast rise time voltage pulses associated with PWM type inverters. Motor design shall take into account motor heating caused by harmonics in the drive output. Each motor for VFD application shall have a label certifying that the motor is suitable for inverter duty. Coordinate the motor

full load current data with the drive manufacturer. Inverter-duty rated motor shall be provided with AEGIS SGR split grounding ring and mounted on the motor. Select SGR split grounding ring size based on the actual shaft diameter of the motor supplied.

2.17 FACTORY TESTING

A. Tests:

1. In accordance with IEEE 112 for polyphase motors and IEEE 114 for single-phase motors.
2. Routine (production) tests on all motors in accordance with NEMA MG 1, plus no load power at rated voltage and polyphase, rated voltage measurement of locked rotor current. Test multispeed motors at all speeds.
3. For energy efficient motors, test efficiency at 50, 75, and 100 percent of rated horsepower:
 - a. In accordance with IEEE 112, Test Method B, and NEMA MG 1, paragraphs 12.54 and 12.57.
 - b. For motors 500 horsepower and larger where facilities are not available to test by dynamometer (Test Method B), determine efficiency by IEEE 112, Test Method F.
4. Power factor:
 - a. Speed.
 - b. Current at rated horsepower.
 - c. kW input at rated horsepower.
 - d. On motors of 100 horsepower and smaller, furnish a certified copy of a motor efficiency test report on an identical motor.

B. Test Report Forms:

1. Routine Tests: IEEE 112, Form A-1.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In accordance with manufacturer's instructions and recommendations.
- B. Align motor carefully and properly with driven equipment.
- C. Secure equipment to mounting surface with anchor bolts. Provide anchor bolts meeting manufacturer's recommendations and of sufficient size and number for the specified seismic conditions.

3.02 FIELD QUALITY CONTROL

- A. Refer to Section 16950 - Electrical Testing.

3.03 MANUFACTURER'S SERVICES

- A. Manufacturer's Certificate of Proper Installation.

3.04 SUPPLEMENTS

- A. Table supplements, following "END OF SECTION," are a part of this Specification.

END OF SECTION

TABLE 1									
MOTOR PERFORMANCE REQUIREMENTS									
hp	Nom.Speed rpm	% Guar. Min. Full Load Efficiency				%Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
		Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
1	1800	80.0	81.5			Mfr.'s Std.	Mfr.'s Std.		
	1200	78.5	79.3			Mfr.'s Std.	Mfr.'s Std.		
1.5	3600	79.3	81.5			Mfr.'s Std.	Mfr.'s Std.		
	1800	79.3	82.0			Mfr.'s Std.	Mfr.'s Std.		
	1200	82.5	84.0		82.0	Mfr.'s Std.	Mfr.'s Std.		Mfr.'s Std.
2	3600	82.0	84.0			Mfr.'s Std.	Mfr.'s Std.		
	1800	81.5	83.7			Mfr.'s Std.	Mfr.'s Std.		
	1200	85.5	85.5	83.7	83.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	82.9	82.5	82.9	81.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
3	3600	82.0	84.0	82.0	82.0	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	84.8	86.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	87.5	88.1	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	84.1	82.9	84.1	82.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
5	3600	84.8	86.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	86.5	86.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	87.5	88.1	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	87.5	86.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.

TABLE 1									
MOTOR PERFORMANCE REQUIREMENTS									
hp	Nom.Speed rpm	% Guar. Min. Full Load Efficiency				%Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
		Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
7.5	3600	86.5	88.1	84.8	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	89.3	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	88.5	88.5	88.4	87.5	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	87.5	86.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
10	3600	89.3	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	89.3	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	89.5	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	89.3	88.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
15	3600	88.5	89.8	88.4	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	91.0	91.0	90.9	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	90.2	90.2	90.2	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	89.3	88.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
20	3600	91.0	90.6	90.9	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	91.7	91.7	91.7	90.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	91.0	90.6	90.2	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	90.2	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
25	3600	91.7	91.0	91.7	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	92.4	92.4	92.4	91.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	91.7	91.0	90.9	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.

TABLE 1									
MOTOR PERFORMANCE REQUIREMENTS									
hp	Nom.Speed rpm	% Guar. Min. Full Load Efficiency				%Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
		Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
	900	90.2	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
30	3600	91.7	91.4	89.5	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1800	92.4	92.4	92.4	91.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1200	91.7	91.0	91.7	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	91.7	91.7	90.9	90.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
40	3600	91.7	91.7	90.2	89.3	86.6	86.1	87.0	89.0
	1800	93.6	93.0	92.8	91.7	78.2	78.2	83.0	84.5
	1200	92.4	92.4	91.7	90.9	81.5	81.5	81.5	81.5
	900	91.7	91.0	90.9	90.2	70.0	70.5	70.0	70.5
50	3600	92.0	92.0	90.2	89.3	85.1	86.7	89.0	89.0
	1800	93.6	93.0	92.8	91.7	79.5	79.4	82.5	82.5
	1200	92.4	92.4	91.7	90.9	81.5	81.5	81.5	81.5
	900	91.7	91.7	90.9	90.9	78.5	72.9	78.5	80.0
60	3600	92.7	93.0	91.7	90.9	85.8	88.3	87.5	89.0
	1800	93.6	94.1	93.5	92.8	80.5	79.9	80.5	80.5
	1200	93.0	93.0	92.8	91.7	81.5	81.5	81.5	81.5
	900	92.4	91.7	91.7	90.9	79.5	73.2	79.5	79.5

TABLE 1									
MOTOR PERFORMANCE REQUIREMENTS									
hp	Nom.Speed rpm	% Guar. Min. Full Load Efficiency				%Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
		Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
70	3600	93.6	93.6	91.7	91.7	87.1	88.5	88.5	88.5
	1800	94.5	94.5	93.5	93.5	81.0	81.5	81.0	81.5
	1200	93.6	93.5	93.5	92.8	82.0	82.0	82.0	82.0
	900	92.8	92.4	92.8	91.7	80.5	74.5	80.5	81.0
100	3600	93.6	93.3	91.7	90.7	87.0	88.2	87.0	88.5
	1800	95.1	94.5	94.0	93.5	81.0	81.0	81.0	81.0
	1200	93.6	93.6	92.8	92.8	82.1	81.7	85.5	85.5
	900	93.5	92.4	92.8	91.7	77.0	77.3	77.0	80.0
125	3600	93.6	93.7	91.7	91.7	86.4	89.1	87.0	90.5
	1800	94.5	94.7	93.5	92.8	85.4	85.5	87.5	86.0
	1200	93.6	94.1	93.5	92.8	82.7	82.3	85.5	85.5
	900	93.5	93.0	92.8	92.4	78.5	78.5	78.5	78.5
150	3600	93.6	93.7	92.4	91.7	86.5	90.0	86.5	90.5
	1800	95.0	95.2	94.5	94.0	82.5	85.0	84.5	85.0
	1200	94.5	94.5	93.5	94.0	81.5	81.5	81.5	81.5
	900	93.5	93.0	92.8	92.4	78.0	78.5	78.0	78.5
200	3600	94.3	94.3	92.4	93.0	87.8	89.4	91.0	91.0
	1800	95.0	95.2	94.0	94.0	85.2	86.5	87.0	87.0
	1200	94.5	94.5	93.5	93.5	79.0	82.5	79.0	82.5

TABLE 1									
MOTOR PERFORMANCE REQUIREMENTS									
hp	Nom.Speed rpm	% Guar. Min. Full Load Efficiency				%Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
		Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
250	3600	94.3	94.7	91.7	92.4	85.0	86.5	85.0	96.5
	1800	85.4	95.4	94.5	94.5	79.0	79.0	79.0	79.0
	1200	95.0	94.5	94.5	93.5	82.0	82.0	82.0	82.0
300	3600	93.7	94.3			89.8	89.9		
	1800	95.4	95.2	94.5	94.0	80.0	80.0	80.0	80.0
	1200	93.7	93.7			84.5	90.1		
350	3600	94.3	94.7			89.4	85.9		
	1800	94.7	94.7			85.9	85.9		
400	3600	94.3				88.4			
	1800	94.37				86.8			
450	3600	94.7				89.1			
500	3600	94.7				88.3			

SECTION 16485

VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment and incidentals required, and install, place in operation and field test variable frequency drive(s) (VFD's).
- B. The variable frequency drive shall be a space vector Pulse-Width Modulated (PWM) design. Modulation methods which incorporate "gear-changing" techniques are not acceptable. The final responsibility of distributor or packager modifications to a third-party standard product will reside with the VFD manufacturer. The VFD manufacturer shall have overall responsibility for the drives. All drives shall be supplied by one manufacturer. The VFD shall be manufactured within the United States of America to alleviate concerns of future serviceability and parts availability.
- C. VFD's shall be 18 pulse drives with output filter for motor 150HP and above. For motor below 30HP shall be 6-pulse drives with input line reactor and output filter. External phase shifting transformers will not be accepted. VFD shall have Ethernet communication to communicate with the PLC system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Pumps, General.
- B. Division 11 - Equipment.
- C. Section 16405 - Electric Motors.
- D. Division 17 - Instrumentation.

1.03 QUALITY ASSURANCE

- A. The entire VFD system as described in Section 2.01B shall be factory assembled and system tested by the VFD manufacturer to assure a properly coordinated system.
- B. Codes: Provide equipment in full accordance with the latest applicable rules, regulations, and standards of:
 - 1. Local Laws and Ordinances.
 - 2. State and Federal Laws.
 - 3. National Electric Code (NEC).
 - 4. Underwriters Laboratories (UL).
 - 5. American National Standards Institute (ANSI).
 - 6. National Electrical Manufacturers Association (NEMA).
 - 7. Institute of Electrical and Electronics Engineers (IEEE).

- C. The complete drive system shall be UL listed.
- D. Acceptable Manufacturers:
 - 1. ABB.
 - 2. Square D.
 - 3. Or Owner/Engineer approved equal.

1.04 SUBMITTALS

- A. Submittals shall conform in all respects to Section 01330.
- B. Submittals shall be custom prepared by the VFD manufacturer for this specific application.
- C. Submittal information shall include, but not be limited to:
 - 1. Equipment dimensions, including stub-up locations, shipping splits and shipping weights.
 - 2. Catalog cuts of major components.
 - 3. Spare parts list, per Paragraph 3.03.
 - 4. Certifications, including:
 - a. Warranty, per Section 1.05.
 - b. Efficiencies, per Section 2.02.A.1.

1.05 WARRANTY

- A. All equipment furnished under this Section shall be warranted for on site parts and labor by the contractor and the equipment manufacturers for a period of five years after successful completion of VFD system startup and acceptance. The warranty shall cover all Drive failures including line anomalies – including lightning strikes, load anomalies, accidental exposure to moisture or corrosives and accidental collision of other physical damage; product misapplications, vandalism and chronic problems due to the misapplication are not covered. The cost of the warranty shall be included in the bid.

PART 2 PRODUCTS

2.01 MATERIAL AND EQUIPMENT

- A. Any modifications to a standard product required to meet this specification shall be performed by the VFD manufacturer only. Distributor or system integrator changes to the VFD manufacturer's product are specifically disallowed.
- B. The VFD system shall consist of an input line reactor, 6 pulse converter section, output inverter and control logic section, and output filter.
- C. Input circuit breaker, interlocked with the enclosure door, with through-the-door handle to provide positive disconnect of incoming AC power and shall be capable of being locked in the open position.
- D. VFD system shall maintain a 0.95 minimum true power factor throughout the entire speed range.

2.02 VARIABLE FREQUENCY DRIVES

A. Ratings:

1. The drive system shall be 96 percent efficient at full load and full speed and 95.5 percent efficient at 51 percent load and 80 percent speed. Losses to be utilized in drive system efficiency calculation shall include input transformer, harmonic filter and power factor correction if applicable, VFD converter and output filter if applicable. Auxiliary controls, such as internal VFD control boards, cooling fans or pumps, shall be included in all loss calculations. The VFD shall be heavy duty rated and shall have a rating as describes in this specification 2.02.A.2.9.
2. Rated Input Power: 460 Volts 60 Hz, +10 percent, -5 percent at rated load, 3-phase:
 - a. Voltage Dip Ride-Through: VFD shall be capable of sustaining continued operation with a 40 percent dip in nominal line voltage. Output speed may decline only if current limit rating of VFD is exceeded.
 - b. Power Loss Ride-through: VFD shall be capable of a minimum 3 cycle power loss ride-through without fault activation.
3. Output Power: As required by motors supplied. The VFD drive rating shall meet or exceed the motor horsepower rating and 110 percent of the motor nameplate rated full-load current.
4. Ambient Temperature Range: 0 to 40°C.
5. Elevation: Up to 3300 feet (1000 meters) above MSL without derating.
6. Atmosphere: Non-condensing relative humidity to 95 percent.
7. AC Line Frequency Variation: +/- 3 Hertz.
8. Power Unit Rating Basis: 110 percent rated current continuous, 150 percent rated current for one minute, at rated temperature.
9. VFD Unit Rating shall be minimum 110 percent of the motor full load current nameplate rating. If the 110 percent does not match the standard horsepower or current rating of the VFD, provide the larger size VFD unit.

B. Construction:

1. The controller shall produce an adjustable AC voltage/frequency output. It shall have an output voltage regulator to maintain correct output V/Hz ratio despite incoming voltage variations.
2. The controller shall have a continuous output current rating of 100 percent of motor nameplate current.
3. The converter section shall be 6 pulse minimum utilizing diodes.
4. The inverter output shall be generated by IGBTs. Pulse Width Modulation strategy will be of the space vector type implemented to generate a sine-coded output voltage. The VFD shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation. The inverters shall be able to sustain 1600 volt surges.
5. The controller(s) shall be suitable for use with any standard NEMA-B squirrel-cage induction motor(s) having a 1.15 Service Factor or with existing standard NEMA-B squirrel-cage induction motor(s) with nameplate data as shown on the plans. Provide drives with dV/dT output filters manufactured by Trans-Coil type KLC, MTE, or equal. At any time in the future, it shall be possible to substitute any standard motor (equivalent horsepower, voltage, and RPM) in the field.

6. The control logic section shall be fully digital and not require analog adjustment pots or fixed selector resistors. A power failure will not necessitate a reload of any drive parameter or configuration.
7. Minimum Starting Speed: When called to operate, the VFD shall immediately ramp to a minimum speed. The minimum speed shall be adjustable but initially set at 40 percent of maximum speed. The 4-20 MA speed signal from the PLC and potentiometer on the front of the drive shall modulate the signal between the minimum speed setpoint and the maximum output speed of the drive; i.e., at the 4 MA signal, the VFD shall run at the minimum speed. At the 20 MA signal, the VFD shall run at full speed. The potentiometer shall also adjust speed between the minimum speed setpoint and the maximum running speed. Below the minimum speed setpoint, the potentiometer shall have no effect.
8. All 6-pulse VFD's shall be provided with 5 percent input line reactors.

C. Basic Features:

1. The door of each power unit shall include: a keypad with a manual speed device, "LOCAL / OFF / REMOTE" mode selector switch, "VFD FAIL" light, VFD "RUNNING" light, "Motor Heater On" light, "Motor Over temperature" light, elapsed time meter, fault reset pushbutton, START and STOP pushbuttons. All lights shall be push-to-test LED type.
2. The VFD shall include a customer selectable automatic restart feature. When enabled, the VFD shall automatically attempt to restart after a trip condition resulting from instantaneous overcurrent, overvoltage, out of saturation or overload. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function (programmable for up to 3 attempts) is not successful within a customer programmable time period. Auto-Restart shall be programmable to allow for individual fault selection.
3. A door-mounted membrane keypad with integral 2-line minimum, 24-character LCD display shall be furnished, capable of controlling the VFD and setting drive parameters. The keypad shall include the following features:
 - a. The digital display must present all diagnostic message and parameter values in English engineering units when accessed, without the use of codes.
 - b. The digital keypad shall allow the operator to enter exact numerical settings in English engineering units. A user menu written in plain English (rather than codes) shall be provided in software in nonvolatile memory as a guide to parameter setting and resettable in the field through the keypad. Multiple levels of password security shall be available to protect drive parameters from unauthorized personnel. The drive set up parameters must be able to be transferred to new boards to reprogram spare boards.
 - c. The following digital door-mounted keypad indications may be selectively displayed:
 - 1) Speed demand in percent.
 - 2) Output current in amperes.
 - 3) Output Frequency in hertz.
 - 4) Input voltage.
 - 5) Output voltage.
 - 6) Total 3-phase KW.
 - 7) Kilowatt hour meter
 - 8) Elapsed time running meter.

- 9) RPM.
- 10) DC bus voltage.
- d. VFD parameters, fault log and diagnostic log shall be downloadable via the RS-232, RS-422, or RS-485 port.
- e. VFD shall have Ethernet communication card for future communicate with PLC system via Ethernet. VFD shall have hard-wired control and alarm signals as shown on Electrical Drawings.

D. Enclosure:

- 1. Maximum enclosure dimensions for various VFD sizes shall be as follows:
 - a. 200HP VFD (18-pulse): 42"W x 24.5"D x 94.65"H

E. Protective Features and Circuits: The controller shall include the following alarms and protective features:

- 1. Instantaneous overcurrent and overvoltage trip.
- 2. Undervoltage and power loss protection.
- 3. Power unit overtemperature alarm and protection. Upon sensing an overtemperature condition, the VFD is to automatically trip.
- 4. Electronic motor inverse time overload protection.
- 5. Responsive action to motor winding temperature detectors or thermostatic switches. A dry contact (NC) input to the VFD is required.
- 6. When power is restored after a complete power outage, the VFD shall be capable of catching the motor while it is still spinning and restoring it to proper operating speed without the use of an encoder.
- 7. The VFD shall be protected from damage due to the following, without requiring an output contactor:
 - a. Three-phase short circuit on VFD output terminals.
 - b. Loss of input power due to opening of VFD input disconnecting device or utility power failure during VFD operation.
 - c. Loss of one (1) phase of input power.
- 8. The VFD shall continue to operate at a reduced capacity under a single-phase fault condition.
- 9. The VFD shall be able to withstand the following fault conditions without damage to the power circuit components:
 - a. Failure to connect a motor to the VFD output.
 - b. VFD output open circuit that may occur during operation.
 - c. VFD output short circuit that may occur during operation.
- 10. Provide input line reactors (5 percent impedance) when no 12 or 18 pulse transformers are supplied or required.
- 11. Three phase lightning and surge protection across the line input at each VFD. Lea Dynatec TVSS #GB-100, or equal.
- 12. Provide 120V motor heater power, if shown on drawings, that is active when the motor is off and is off when the motor is active if motor space heater is provided with the motor.

F. Parameter Settings:

- 1. The following system configuring settings shall be provided and field adjustable, without exception, through the keypad/display unit. Except for Motor Nameplate Data, all parameters must be adjustable while the processor is on-line and the drive is running:
 - a. Motor Nameplate Data:
 - 1) Motor frequency.

- 2) Number of poles.
- 3) Full load speed.
- 4) Motor volts.
- 5) Motor full load amps.
- 6) Motor HP.
- 7) Current limit, max.
- b. VFD Configuration Parameters:
 - 1) Independent accelerate/decelerate rates.
 - 2) Max/Min speed (frequency).
 - 3) Catch-a spinning load selection.
 - 4) No load boost.
 - 5) Full load boost.
 - 6) Volts/Hertz ratio.
 - 7) Overspeed trip.
 - 8) Overload trip curve selection.
 - 9) Overload trip time selection.
- c. Automatic VFD Control:
 - 1) PID utilizing an internal or external setpoint.
 - 2) Three selectable critical speed avoidance bands with programmable bandwidths.
 - 3) Auto start functions: On/Off, Delay On/Off. Operable from a 4-20mA signal or from the PID output, command, or feedback signal.
 - 4) Speed Profile: Programmable entry and exit points.
 - 5) Programmable loss of signal control: Stop, maintain last speed, or default to preselected setpoint.
2. All drive setting adjustments and operation parameters shall be stored in a parameter log which lists allowable maximum and minimum points as well as the present set values. This parameter log shall be accessible via a RS-232, RS-422, or RS-485 serial port as well as on the keypad display.
3. VFD shall have Ethernet protocol for communication. If factory default protocol is not Ethernet protocol, VFD manufacturer shall use converter to translate factory default protocol to Ethernet protocol. Using a remote I/O rack with converting hard-wired I/O points to Ethernet protocol is not acceptable.
- G. Input/Output Features thru Ethernet communication. VFD shall be provided with hard-wired controls as shown on Electrical drawings as well as Ethernet communication protocol:
 1. Two programmable analog inputs: – VFD speed in, spare.
 2. Two programmable analog outputs: – VFD speed output, spare.
 3. Two programmable digital inputs: – Start/Stop, spare.
 4. Four programmable digital outputs: – VFD fault, VFD running, VFD in remote, spare.
 5. One Pot input (three wire control, +10 V, wiper and common) or speed adjustable from LCD screen.
 6. VFD shall also have additional analog inputs – VFD speed in, analog output – VFD speed output, digital inputs – Start/Stop, and digital outputs – VFD fault, VFD running, VFD in remote, VFD output current low, etc. in Ethernet.
- H. System Program providing built-in drive control or application specific configuration capability.

- I. Diagnostic Features and Fault Handling:
 1. The VFD shall include a comprehensive microprocessor based digital diagnostic system that monitors its own control functions and displays faults and operating conditions.
 2. A "Fault Log" shall be accessible via a RS-232, RS-422, or RS-485 serial link as well as line-by-line on the keypad display and via Ethernet. The "FAULT LOG" shall record, store, display and output to a serial port upon demand, the following for the 64 most recent events:
 - a. Date and time of day.
 - b. Type of fault.
 - c. All faults and events shall be stored and displayed in English, not fault codes.
 3. A "HISTORIC LOG" shall record, store, and output to a RS-232, RS-422, or RS-485 serial link port upon demand, the following selectable control variables at 1 msec. intervals for the 58 intervals immediately preceding and the 20 intervals immediately following a fault trip:
 - a. Torque demand.
 - b. Torque command.
 - c. Torque feedback.
 - d. Torque error.
 - e. Torque maximum.
 - f. Current demand.
 - g. Peak current.
 - h. Motor current.
 - i. DC bus voltage.
 - j. Line voltage.
 - k. Velocity demand.
 - l. Velocity reference.
 - m. PI min/max limit.
 - n. Boost.
 - o. VFD mode (Auto/Manual).

PART 3 EXECUTION

3.01 PRE-DELIVERY TESTING COORDINATION

- A. The VFD manufacturer shall fully test each VFD unit before shipping to the job site. Certified test reports shall be submitted to the Engineer/Owner as part of the equipment shipment.

3.02 STARTUP AND TRAINING

- A. A trained technician shall be provided for startup assistance and training.
- B. Services of a qualified technical representative who shall adequately supervise the installation and testing of and start up of all equipment furnished under this Contract and instruct the installation personnel and the Owner's operating personnel in its maintenance and operation as outlined in the General Conditions.

3.03 SPARE PARTS

- A. The following spare parts shall be furnished:
 - 1. One keypad assembly.
 - 2. One spare VFD NEMA 1 VFD drive, same model as supplied.

3.04 FIELD QUALITY CONTROL

- A. Functional Test:
 - 1. Conduct on each VFD.
 - 2. Inspect controller for electrical supply termination connections, interconnections, proper installation, and quiet operation.
 - 3. Vibration Test: Complete assembly, consisting of motor, load, and flexible shafting, connected and in normal operation, shall not develop amplitudes of vibration exceeding limits recommended by current edition of Hydraulic Institute Standards. Where pumps and motors are separated by intermediate flexible shafting, measure vibration both at top motor bearing and at two points on top pump bearing, 90 degrees apart.
 - 4. Record test data for report.
- B. Performance Test:
 - 1. Conduct on each VFD.
 - 2. Perform under actual or approved simulated operating conditions.
 - 3. Test for continuous 48-hour period without malfunction.
 - 4. VFD technician shall adjust the carrier frequency as needed to balance between the noise and motor winding heating, if applicable for the VFD supplied.
 - 5. Demonstrate performance by operating the continuous period while varying the application load, as the input conditions allow, in order to verify system performance.
 - 6. Record test data for report.

END OF SECTION

SECTION 17000

INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

- A. The Instrumentation and Control (I&C) Contractor/ the Installing Contractor shall furnish, install, and place into service operating process instrumentation, control systems, and panels including accessories, related to this facility, all as shown on plans and specified herein:
1. Existing plant systems must remain operational during construction. Nighttime and/or other off hours work may be required to support plant operations and shall be included in the Installing contractor's bid.
 2. The installing instrumentation contractor is responsible to "As-Build" all existing control panels and to provide all demolition and modification as necessary for the installation of the new I/O in the existing local control panels.
 3. Equipment rendered obsolete by this construction must be removed from the existing panels. Equipment previously abandoned must also be removed from the panels. Functioning equipment present in these panels must remain functional and will be included on the instrument contractor's "As-Built" drawings. No existing equipment, with the exception of the field wires and panel, may be reused as part of the new control system. New power supplies, surge suppressors, terminal strips, etc. for all I/O to be connected to the new control system must be provided new. The installing instrumentation contractor is responsible to provide completed panels that are clean, functional and present a professional workman-like appearance.
 4. All wires in control panels must be permanently tagged and shown on the as-built drawings. This includes all spare and abandoned wires and cables. Spare and abandoned cables are to be taped and left coiled in the panels for future use. Cable and wire numbers are to be assigned by the installing contractor, documented, and controlled to prevent duplicate numbers. The installing contractor shall turn over to the owner, at the project conclusion, a cable and wire list showing assigned numbers and their physical location in the plant.
 5. See electrical drawings and specifications for additional work required of the installing instrumentation contractor as part of this project to supply demolition instructions, relocation and modification instructions for equipment not necessarily shown on the instrument drawings.
 6. Furnish and install new RIO panel as shown on drawings and as per this specification complete in place.
 7. Furnish and install new instruments as shown on drawings and as per this specification.
 8. Perform loop check for the Belt Filter Press Control panel and conveyor control panels supplied by packaged system suppliers.
- B. Work Includes: Engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and OWNER training for a complete Instrumentation and Control System.

1. Major parts are:
 - a. Modification of existing PCP-2A remote I/O panel at Dewatering Building – 1st floor to add fiber optic patch panel and fiber optic connection as shown on drawings.
 - b. New PLC panel (PCP-DW) at Dewatering Building – 1st floor Electrical Room as shown on drawings and as describes in this specification. New PLC panel shall consist a minimum of a Allen-Bradley Compactlogix 5370 L3 controller (Model:1769-L33ER) with associated I/O system, power supply, fiber optic patch panel, panelview plus touch screen, ethernet switch, patch cables, relays, terminal blocks, etc. as required for a complete and working PLC system in place.
 - c. Coordinate with packaged belt filter press supplier for interfacing with plant PLC and SCADA system. Provide new fiber optic cables with appropriate connectors as shown on drawings and as required.
 - d. Installing Contractor shall program the plant SCADA system, including SCADA server, Historian server, etc.
 - e. New PLC and touchscreen HMI programming is part of Installing Instrumentation Contractor's scope as well as Belt Filter Press Supplier's scope as describes in this specification and in specification 11362. Belt Filter Press Supplier shall program the PLC for each Belt Filter Press system control, including conveyor systems and polymer system, and the Installing Contractor shall program the remaining control strategy such as Sludge Feed Pumps, sludge flow meter totalization, wash water valve control, etc. Coordinate with Belt Filter Press Supplier to identify the control strategy of any items not part of the Belt Filter Press Supplier's scope and shall be included in the Installing Contractor's scope.
 - f. Perform loop check for all signals and control points.
 - g. Acceptance Testing, including acceptance test.
- C. Instrument and Control (I&C) Supplier work scope:
 1. For I&C equipment and ancillaries provide the following:
 - a. Completing detail design.
 - b. Required Submittals.
 - c. Equipment and ancillaries.
 - d. Instructions, details, and recommendations to, and coordination with, Installing Contractor for proper installation.
 - e. Verify readiness for operation.
 - f. Verify the correctness of final power and signal connections.
 - g. Adjusting and calibrating.
 - h. Starting up.
 - i. Testing and coordination of testing.
 - j. Training.
 2. Verify following work not by I&C Supplier is provided:
 - a. Correct type, size, and number of signal wires with their raceways.
 - b. Correct electrical power circuits and raceways.
 - c. Correct size, type, and number of I&C related pipes, valves, fittings, and tubes.
 - d. Correct size, type, materials, and connection of process mechanical piping for in-line primary elements.

3. For equipment not provided under I&C Supplier, but directly connected to equipment required by I&C Supplier:
 - a. Coordinate with other installing discipline Contractor or obtain from other installing discipline Contractor, manufacturer's information on installation, interface, function, and adjustment.
 - b. Coordinate with Installing Contractor to allow required interface and operation with I&C System.
 - c. For operation and control, verify that installations, interfacing signal terminations, and adjustments have been completed with manufacturer's recommendations.
 - d. Test to demonstrate required interface and operation with I&C System.
 - e. Examples of items in this category, but not limited to the following:
 - 1) Valve operators, position switches, and controls.
 - 2) Chemical feed pump and feeder speed/stroke controls.
 - 3) Automatic samplers.
 - 4) Motor control centers.
 - 5) Adjustable speed drive systems.
 - f. Examples of items not in this category:
 - 1) Internal portions of equipment provided under Division 16, Electrical, that are not directly connected to equipment under I&C System.
 - 2) Internal portions of I&C Systems provided as part of package systems and that are not directly connected to equipment provided under I&C System.
4. Wiring external to equipment provided by I&C Supplier:
5. Special control and communications cable: Provided by I&C Supplier.
- D. Software Engineering work scope: PLC and SCADA programming shall be performed by the I&C Contractor's software programmer. HMI touchscreen (part of the new control panel) programming shall also be performed by the Installing Contractor's software programmer.

1.02 SINGLE INSTRUMENT SUPPLIER

- A. The Installing Contractor shall assign to the Single Instrument and Control (I&C) supplier full responsibility for the functional operation of all new instrumentation systems. The Installing Contractor shall have said supplier perform all engineering necessary in order to select, to furnish, to program, to supervise installation, connection, to calibrate, to place into operation of all sensors, instruments, alarm equipment, control panels, accessories, and all other equipment as specified herein. The I&C supplier shall have a maintenance office within a 150 mile radius of the project.
- B. The single instrument and controls supplier shall demonstrate his ability to successfully complete projects of similar sizes and nature. Provide references (including phone number and contact name) for at least three projects successfully completed in which the following tasks were performed, if requested by the Owner: system engineering, documentation including panel assembly, schematics and wiring diagram, field testing, calibration and start-up, operator instruction and maintenance training:
 1. The foregoing shall enable the Installing Contractor and the Owner to be assured that the full responsibility for the requirements of this Section shall reside in an organization which is qualified and experienced in the water management field and its process technology on a functional systems basis.

2. The single I&C supplier shall have a UL approved shop and shall build all panels according to UL 508A.
 3. Instrumentation and Controls supplier shall be Blackburn Controls, Curry Controls, Commerce Controls, Inc., Rocha Controls, and Revere Controls, CEC Controls or Owner approved equal.
- C. The single software engineering supplier shall demonstrate his ability to successfully complete projects of similar sizes and nature. Provide references (including phone number and contact name) for at least three projects successfully completed in which the following tasks were performed: ladder logic programming, computer based SCADA system configuration, documentation, field testing, start-up, and operator instruction.

1.03 INSTALLATION WORK

- A. Nothing in this part of the Specifications shall be construed as requiring the Installing Contractor to utilize personnel supplied by his assigned instrument manufacturer's organization, or any division thereof, to accomplish the physical installation of any elements, instruments, accessories or assemblies specified herein. However, the Installing Contractor shall employ installers who are skilled and experienced in the installation and connection of all elements, instruments, accessories and assemblies; portions of their work shall be supervised or checked as specified in Part 3, herein.

1.04 PREPARATION OF SUBMITTAL OF DRAWINGS AND DATA

- A. It is incumbent upon the Installing Contractor to coordinate the work specified in these Sections so that a complete I&C system for the facility shall be provided and shall be supported by accurate Shop and record Drawings. As a part of the responsibility as assigned by the Installing Contractor, the Single I&C supplier shall prepare and submit through the Installing Contractor, complete organized Shop Drawings, as specified in Part 2.02, herein. Interface between instruments, motor starters, etc. shall be included in his Shop Drawing submittal.
- B. During the period of preparation of this submittal, the Installing Contractor shall authorize direct, informal liaison between his Single I&C supplier and the Engineer for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as specified may be authorized informally by the Engineer, but these shall not alter the scope of work or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the Engineer shall be construed to give formal approval of any component or method, nor shall any statement be construed to grant formal exception to, or variation from these Specifications.

1.05 ADDITIONAL TECHNICAL SERVICES

- A. At no separate additional cost to the Owner, the Installing Contractor shall provide the following services of qualified technical representatives of the Single I&C supplier (See Part 3, herein):
1. To supervise installation and connection of all instruments, elements, and components of every system, including connection of instrument signals to primary measurement elements and to final control elements such as pumps, valves, and chemical feeders.

2. To make all necessary adjustments, calibrations and tests; and to instruct plant operating and maintenance personnel on instrumentation. This time shall be in addition to whatever time is required for other facets of work at the site, and shall be during the Owner's normal working days and hours.
3. To terminate and test all fiber optic cable and effected devices.

1.06 GUARANTEE

- A. The Installing Contractor shall guarantee all equipment and installation, as specified herein, for a period of one (1) year following the date of completion of the work. To fulfill this obligation, the Installing Contractor shall utilize technical service personnel designated by the Single I&C supplier to which the Installing Contractor originally assigned project responsibility for instrumentation. Services shall be performed within two (2) calendar days after notification by the Owner.

1.07 ADDITIONAL PROVISIONS

- A. The applicable provisions of the following sections under Electrical Work shall apply to work and equipment specified herein, the same as if stated in full, herein:
 1. Codes and Standards.
 2. Equipment, Materials and Workmanship.
 3. Testing.
 4. Grounding.
 5. Equipment Anchoring.
 6. Conductor and Equipment Identification.
 7. Terminal Cabinets and Control Compartments.
 8. Process Control Devices.

1.08 NEWEST MODEL COMPONENTS

- A. All meters, instruments, and other components shall be the most recent field proven models marketed by their manufacturers at the time of submittal of Shop Drawings unless otherwise specified to match existing equipment. All technical data publications included with submittals shall be the most recent issue.

1.09 INSPECTION OF THE SITE AND EXISTING CONDITIONS

- A. The instrumentation drawings were developed from past record drawings and information supplied by the Owner.
- B. Before submitting a bid, visit the site and determine conditions at the site and at all existing structures in order to become familiar with all existing conditions and instrumentation and control systems which will, in any way or manner, affect the work required under this Contract. No subsequent increase in Contract cost will be allowed for additional work required because of the Installing Contractor's failure to fulfill this requirement.

1.10 RELATED WORK

- A. Division 16 - Electrical.
- B. Division 11 - Equipment.

PART 2 PRODUCTS

2.01 INSTRUMENTATION CRITERIA

- A. Designation of Components:
 - 1. In these Specifications and on the Drawings, all systems, meters, instruments, and other elements are represented schematically, and are designated by numbers, as derived from criteria in Instrument Society of American Standard ANSI/ISA S5.1-1973. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout Shop Drawings, data sheets, and similar materials. Any other symbols, designations, and nomenclature unique to the manufacturer's standard methods shall not replace these prescribed above, used, herein and on the Drawings.
- B. Signal Characteristics:
 - 1. Signals shall be electrical, as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted. Electrical signals outside control panel(s) shall be 4 to 20 milliamperes DC, except as noted. Signals within enclosures may be 1-5 volts DC.
- C. Matching Style, Appearance, And Type:
 - 1. All instruments to be panel mounted at the control panels shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be of one (1) manufacturer.
- D. Accuracy And Repeatability:
 - 1. The overall accuracy of each instrumentation system or loop shall be as prescribed in the Specifications for that system or loop. Each system's accuracy shall be determined as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracy s" of certain designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual electronic instrument shall have a minimum accuracy of ± 0.7 percent of full scale and a minimum repeatability of ± 0.4 percent of full scale unless otherwise specified. Instruments which do not conform to or improve upon these criteria are not acceptable.
- E. Signal Isolators, Converters, and Power Supplies:
 - 1. Signal isolators shall be furnished and installed in each measurement and control loop, wherever required, to insure adjacent component impedance match or where feedback paths may be generated. Signal converters shall be included where required to resolve any signal level incompatibilities. Signal power supplies shall be included, as required by the manufacturer's instrument load characteristics, to insure sufficient power to each loop component.
- F. Alternative Equipment or Methods:
 - 1. Equipment or methods requiring redesign of any project details are not acceptable without prior approval of the Engineer. Any changes inherent to a proposal alternative shall be at no additional cost to the Owner. The required approval shall be obtained in writing by the I&C Subcontractor through the Installing Contractor prior to submittal of Shop Drawings and data. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage, and maintenance

enhancement over the equipment or method specified, or shall include evidence that a specified component is not available. Otherwise, alternative equipment (other than direct, equivalent substitutions) and alternative methods shall not be proposed.

2.02 SHOP DRAWINGS AND DATA

A. Content:

1. The Installing Contractor shall submit detailed Shop Drawings and data prepared and organized by the Single I&C supplier designated at the time of bidding. The quantity of submittal sets required shall be six (6). These Drawings and data shall be submitted as a complete bound package at one time within 80 calendar days after date of Notice to Proceed and shall include:
 - a. Drawings showing definite diagrams for every instrumentation loop system. These diagrams shall show and identify each component of each loop or system using legend and symbols from ISA Standard S5.4, each having the format of ISA Standard S5.1 as used on the Project Drawing. (Each system or loop diagram shall be drawn on a separate Drawing sheet.)
 - b. Data sheets for each component, together with a technical product brochure or bulletin. The data sheets shall show:
 - 1) Component function description used herein and on the Drawings.
 - 2) Manufacturer's model number or other product designation.
 - 3) Project tag number used herein and on the Drawings.
 - 4) Project system loop of which the component is a part.
 - 5) Project location or assembly at which the component is to be installed.
 - 6) Input and output characteristics.
 - 7) Scale range and units (if any) and multiplier (if any).
 - 8) Special requirements or features:
 - a) A complete index shall appear in the front of each bound submittal volume. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.
 - c. Drawings showing both schematic and wiring diagrams for control circuits. Complete details on the circuit interrelationship of all devices within and outside each control panel shall be submitted first, using schematic control diagrams. Subsequent to return of this first submittal by the Engineer, piping and wiring diagrams shall be prepared and submitted for review by the Engineer; the diagrams shall consist of component layout Drawings to scale, showing numbered terminals on components together with the unique number of the wire to be connected to each terminal. Piping and wiring diagrams shall show terminal assignments from all primary measurement devices, such as flow meters, and to all final control devices, such as samplers, pumps, valves, and chemical feeders. The Installing Contractor shall furnish all necessary equipment supplier's Shop

Drawings to facilitate inclusion of this information by the I&C system supplier.

- d. Schematic and wiring diagram criteria shall be followed as established in NEMA Standards Publication ANSI/NEMA 1CS-1-1978, "Industrial Control and Systems."
- e. Assembly and construction Drawings for each control panel and for other special enclosed assemblies for field installation. These Drawings shall include dimensions, identification of all components, surface preparation and finish data, nameplates, and the like. These Drawings also shall include enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly; a finish treatment sample shall be included.
- f. Installation, mounting and anchoring details for all components and assemblies to be field-mounted, including conduit connection or entry details.
- g. Complete and detailed bills of materials. A master Bill of Materials listing all field mounted devices, control panels, and other equipment that shall be shipped to the job site. A Bill of Materials for each control panel listing all devices within the panel.
- h. Modifications to existing equipment. A complete description of all proposed modifications to existing instrumentation equipment, control panels, control devices, cabinets, etc., shall be submitted with the Shop Drawings complete with detailed Drawings of the proposed modifications.

B. Organization and Binding:

- 1. The organization of initial Shop Drawing submittal required above shall be compatible to eventual inclusion with the Technical Manuals submittal and shall include final alterations reflecting "as built" conditions. Accordingly, the initial multiple copy Shop Drawing submittal shall be separately bound in 3-ring binders of the type specified under Part 2.03, herein, for the Technical Manuals.

2.03 TECHNICAL MANUALS

- A. Five (5) final sets of technical manuals shall be supplied for the Owner, and one (1) final set shall be supplied for the Engineer, as a condition of acceptance of the project. Each set shall consist of one (1) or more volumes, each of which shall be bound in a standard size, three-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 3.0 inches.
- B. Initially, two (2) sets of these manuals shall be submitted to the Engineer for favorable review after return of favorably reviewed Shop Drawings and data required under Part 3, herein. Following the Engineer's review, one (1) set shall be returned to the Installing Contractor with comments. The sets shall be revised and/or amended as required and the requisite final sets shall be submitted to the Engineer fifteen (15) days prior to start-up of systems. The Engineer shall distribute the copies. Final technical manuals shall include the electronic version on a CD, DVD, or SD drive.
- C. In addition to updated Shop Drawing information to reflect actual existing conditions, each set of technical manuals shall include installation, connection, operating, trouble-shooting, maintenance, and overhaul instructions in complete detail. This shall provide the Owner with comprehensive information on all systems and

components to enable operation, service, maintenance, and repair. Exploded or other detailed views of all instruments, assemblies, and accessory components shall be included together with complete parts lists and ordering instructions.

2.04 SPARE PARTS (NOT USED)

2.05 CONTROL PANELS

A. General:

1. New control panels shall be furnished and installed under this Contract. They shall house the instrumentation, control devices, indicating lights, PLC's, alarm chasses, displays, all necessary accessories, wiring and terminal blocks as necessary and as shown on the Drawings and as described herein. Control panel doors shall be equipped with a door latch kit or a fast operating clamp assembly as applicable. 120 volt AC control voltage in a control panel shall be supplied with a line noise suppressing transformer specified elsewhere in this Section. Each control panel shall be properly grounded and as such be provided with a ground terminal block. Control panels shall be properly sized for installation through new and existing entry ways and custom fit for locations as shown on the drawings. Each panel shall be provided with LED interior light that shall turn on when the control panel door is opened.

B. Construction:

1. Control Room:
 - a. Control room panels shall be NEMA 12. The enclosures shall be manufactured of 14 gauge or thicker aluminum.
2. Building:
 - a. Control panels inside a building (not in a control room) shall be NEMA 12, 304 stainless steel 14 gauge construction. Control panels in corrosive areas shall be construed to be outdoors.
3. Outdoor and Non-Air Conditioned Area:
 - a. All outdoor control panels shall be NEMA 4X with drip shield kit, 3 point latch mechanism and 316 stainless steel 14 gauge construction.
4. Cooling:
 - a. Control panels shall have sufficient cooling and/or ventilation not to exceed the maximum operating temperature of any of the internal components. Ambient temperature limits shall be 90 degrees F for indoor and 100 degrees F for outdoor control panels. Outdoor control panels with electronic equipment shall be furnished with sun shields around and on top of the control panels.
5. UPS:
 - a. UPS: PLC and RIO Control Panels shall be furnished with a UPS to provide power to the PLC microprocessor and all PLC support, interface, and communication equipment for 10 minutes. UPS shall be manufactured by Best, model Ferrups or approved equal.

C. Signal and Control Circuit Wiring:

1. Wire TYPE and Sizes:
 - a. Conductors shall be flexible stranded copper wire; these shall be U.L. listed Type THHN and shall be rated 600 volts. Wire for control signal circuits and alarm input circuits shall be 16 AWG. All instrumentation cables shall be shielded No. 20 AWG minimum with a copper drain wire.

All special instrumentation cable such as between sensor and transmitter shall be supplied by the I&C supplier.

2. Wire INSULATION Colors:

- a. Conductors supplying 120 volt AC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120 volt AC control circuit conductors shall be red. All wires energized by a voltage source external to the control board(s) shall have yellow insulation. Insulation for all DC conductors shall be blue.

3. WIRING INSTALLATION:

- a. All wires shall be run in plastic wireways except (1) field wiring, (2) wiring run between mating blocks in adjacent sections, (3) wiring run from components on a swing-out panel to components on a part of the fixed structure, and (4) wiring run to panel mounted components. Wiring run from components on a swing-out panels to other components on a fixed panel shall be made up in tied bundles. These shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at terminals.
- b. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and secured to the inside face of the panel using adhesive mounts.
- c. Wiring to rear terminals on panel mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.
- d. Shields of shielded instrument cable shall only be grounded on one side of each cable run. The side to be grounded shall always be in the field as applicable.
- e. Care shall be exercised to properly insulate the ungrounded side, to prevent ground loops from occurring.
- f. Conformance to the above wiring installation requirements shall be reflected by details shown on the Shop Drawings for the Engineer's review.

4. Wire Marking:

- a. Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all Shop Drawings. These numbers shall be marked on all conductors at every terminal using permanently marked heat-shrink plastic. Instrument signal circuit conductors shall be tagged with unique multiple digit numbers. Black and white wires from the circuit breaker panelboard shall be tagged including the one (1) or two (2) digit number of the branch circuit breaker.

5. TERMINAL Blocks:

- a. Terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 15 amperes at 600 volts. White marking strips, fastened securely to the molded sections, shall be provided and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid. Terminal blocks shall be General Electric Type CR 151A1 with mounting rack, equivalent by Cinch-Jones or equal.

D. Painting:

1. Control panels shall be thoroughly cleaned and sandblasted per SSPC-SP-6 (Commercial Blast) after which surfaces shall receive a prime coat (Amercoat 185, Koppers 622HB, or equal) 3-mils dry, followed by two (2) or more finish coats (Amercoat 5401, Koppers 501, or equal) 3-mils dry, for a total thickness of the complete system of 6 mils. The finished color of the outside surfaces shall be selected by the Engineer. The inside surfaces shall have a white finish coat.
2. Exterior control panels shall be painted white on the exterior. A durable coating system with a five-year full replacement guarantee shall be used to coat the stainless steel panels. Defects in the coating systems include, but are not limited to, fading, color change, cracking peeling, or otherwise disbonding.

E. PLC Control Panel Requirements:

1. All input/output hardware and interface equipment shall be provided by the computer & PLC system supplier for all specified inputs and outputs. Input/output hardware shall be plug-in modules (or equivalent I/O assembly and associated printed circuit board) in associated I/O rack assemblies.
2. All analog and discrete inputs and outputs shall be optically or transformer isolated for voltage surge protection and shall meet peak common mode and 3 kV surge to ground withstand capability (SWC) test as specified by ANSI C37.90A-197A (IEEE Standard 472-1974).
3. In the event a standard manufacturers product does not satisfy the above surge requirements, additional protective circuitry to suppress contact bounce and to protect transients from being recognized as data. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms which are movable to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals.
4. Input/output modules shall have individual indicators that show the on/off status of each input or output device connected to it. Remote I/O system shall be Allen-Bradley Compactlogix family with Ethernet Communication module, unless otherwise noted:
 - a. Analog Input:
 - 1) The analog input subsystem shall accept 4-20 MA (1-5 volts across 250 ohms) signals which shall be multiplexed into one or more amplifiers and ADC's by one or more analog input multiplexers. The analog input multiplexers shall be of the solid state differential type and shall employ successive approximation or dual slope integration to digitize the sampled analog signals into a 12 bit binary value; with an accuracy of ± 0.05 percent of full scale. Input power supply shall be 24 volts DC from the I/O power supply subsystem where power is not supplied by the associated field instrument. Analog input cards shall match existing type and shall be Allen Bradley 1756-IF16.
 - b. Discrete Input:
 - 1) Dry Contact:
 - a) The input subsystem shall sense the open or closed status of contacts at each scan interval. Sensing power shall be 24 volts DC from the I/O power supply subsystem.
 - 2) Powered input:
 - a) The input subsystem shall sense the status of 120VAC inputs at each scan interval. Power for inputs is derived from the source

system or equipment. Discrete input cards shall match existing type and shall be Allen Bradley 1756-IB32.

- c. Analog Output:
 - 1) The analog output subsystem shall accept incremental signals from the process controller. A solid state digital to analog converter (DAC) shall be provided for each analog output. The incremental signals from the process controller shall increment or decrement the 4-20 MA output signal from each DAC. A 24 volt DC power supply shall be provided for analog outputs from the I/O power supply subsystem.
 - 2) The output of each DAC shall be continuously maintained and shall have a drift rate no greater than 2 percent in 24 hours. Each DAC shall have a 12 bit resolution and an accuracy of ± 0.05 percent full scale. Analog output cards shall match existing type and shall be Allen Bradley 1756-OF8I.
- d. Discrete Output:
 - 1) The discrete output subsystem shall be of the solid state type and shall generate maintained or momentary outputs as required to operate interposing relays provided in related circuitry. Diode protection (in addition to surge protection) shall be provided on all discrete outputs. The output contacts shall be rated 24 VDC/120 VAC, 5A SPDT. Discrete output cards shall match existing type and shall be Allen Bradley 1756-OB32.
- e. Power Supplies:
 - 1) Input/output (I/O) subsystem power supplies shall be provided for each PLC control panel and shall be sized to power all 2-wire and 4-wire discrete and analog DC circuits under full-load conditions including allowances for specified spares. The incoming power source to the I/O subsystem power supplies shall be 115 VAC from the associated panelboard. Transformation, rectification, and smoothing circuitry shall be furnished to provide a regulated 24 volt DC power supply. The DC power supply shall be converted to other DC voltage levels as required. Provide redundant 24VDC power supplies with diode protection and alarm (PLC input) in case of either power supply failure. Power supplier type shall match existing type and shall be Allen-Bradley 1756-PA72. If power consumption is more than PA72 model, supply larger power supply model.
- f. Programmable Controller/CPU:
 - 1) Programmable controllers shall have dual Ethernet ports with DLR capability, 2MB memory, 16 I/O module expansion capacity and 32 Ethernet IP nodes. Controllers shall be Allen-Bradley Compactlogix, unless otherwise noted. The PLC shall be backed by a CompactFlash or SD flash drive to be provided with the CPU.
- g. Uninterruptable Power Supplies:
 - 1) Provide UPS in each PLC control panel to provide uninterruptible power for the PLC, I/O, two wire instrument loops, all interposing relays, all PLC support, interface, and communication equipment for 10 minutes. UPS shall adhere to this Section.
- h. Ethernet Switch with POE (Power over Ethernet):
 - 1) Provide Allen-Bradley Stratix 5400 family Ethernet Managed Switch (model: 1783-HMS4T4E4CGN or Engineer approved equal) with a minimum of 4-fiber optic ports (multimode) and a minimum of 4-RJ45 ethernet (POE) ports, unless otherwise noted on drawings.

- i. Ethernet Switch without POE (Power over Ethernet):
 - 1) Provide Allen-Bradley Stratix 2000 family Ethernet Unmanaged Switch (model: 1783-US6T2F or Engineer approved equal) with a minimum of 2-fiber optic ports (multimode) and a minimum of 4-RJ45 ethernet ports, unless otherwise noted on drawings.
- j. Additional spare inputs and outputs:
 - 1) The PLC power supply shall have sufficient capability to handle the power requirements for all the PLC components and I/O points, and spare I/O points. For new PLC panel, provide additional 25 percent input/output active spare capacity, 25 percent input/output expansion capability for future use.

2.06 ACCESSORIES

- A. General purpose relays in the control panels shall be plug in type with contacts rated 10 amperes at 120 volts AC. The quantity and type of contacts shall be as shown on the Drawings. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover. Sockets for relays shall have screw type terminals. Relays shall be Potter and Brumfield Type KRP or KUP, Square-D Type K, or equal.
- B. Time delay relays shall be solid state on-delay or off-delay type with contacts rated 10 amperes at 120VAC. Units shall include adjustable dial with graduated scale covering the time range in each case. Time delay relays shall be Agastat Series 7000, Omron series H3, SSAC type TDM or approved equal.
- C. Additional slave relays shall be installed when the number or type of contacts shown exceeds the contact capacity of the specified relays and timers.
- D. Switches and indicating lights shall be round 30.5-mm configuration, heavy-duty and corrosion-resistant. Legend plate shall be standard size square style laminate with white field and black markings as shown.
- E. Indicating lights shall be LED type, unless otherwise noted. Lens color shall be as noted. All indicating lights shall be push-to-test type. Pushbuttons shall include full guard with flush button and selector switches shall include a black non-illuminated knob on switch, unless otherwise noted. Contact arrangement and configuration shall be as shown. Devices shall be by Cutler Hammer, General Electric, Square D, Allen-Bradley or approved equal.
- F. Selector switches shall be of the rotary type with the number of positions as shown on the Drawings. Color, escutcheon engravings, contact configurations and the like shall be as shown. Devices shall be Cutler Hammer Type E-24, General Electric Type CR104, or equal.
- G. Circuit breakers shall be single pole, 120 volt, 15 ampere rating or as required to protect wires and equipment and mounted inside the panels as shown.
- H. Nameplates shall be supplied for identification of all field mounted elements, including flow meters and their transmitters. These nameplates shall identify the instrument, or meter, descriptively, as to function and system. These nameplates shall be fabricated from black-face, white-center, laminated engraving plastic. A nameplate shall be provided for each signal transducer, signal converter, signal

isolator, each electronic trip, and the like, mounted inside the control panels. These shall be descriptive, to define the function and system of such element. Adhesives shall be acceptable for attaching nameplates. Painted surfaces must be prepared to allow permanent bonding of adhesives. Nameplates shall be provided for instruments, function titles for each group of instruments and other components mounted on the front of the control panels as shown. These nameplates and/or individual letters shall be fabricated from VI-LAM, Catalog No. 200, manufactured by N/P Company, or equivalent by Formica, or equal. Colors, lettering, style and sizes shall be as shown or as selected by the Engineer.

- I. Solenoid Valves if not otherwise noted shall be globe valve directly actuated by solenoid and not requiring minimum pressure differential for operation. Materials shall be brass globe valve bodies and Buna-N valve seats. The size shall be 1/4" normally closed. The coil shall be 115 VAC coil, NEMA 4 solenoid enclosure. Manufacturer shall be ASCO; Red Hat, or equal.
- J. Fiber Optic Cable and Fiber Optic Patch Panel: Fiber optic cable shall be loose tube with ripcords (62.5/125 microns graded index (GI) multimode, a minimum of 6 strands (color-coded), Gigabit Ethernet rated, 200/500MHz-km at 850/1300 nm bandwidth. Fiber optic cable shall be manufactured by Corning cable systems, Belden, Phoenix Digital, or Engineer approved equal. Fiber optic cable shall utilize mechanically spliced, field installable, SC, ST, or LC compatible connectors, or as shown on drawings. Fiber optic patch panel shall be cabinet mounted type and shall have sufficient ports for all fiber cables as shown on drawings. Fiber optic patch panel shall be manufactured by Corning cable systems, Black Box, or Engineer approved equal.

2.07 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS) PROTECTION

- A. General:
 - 1. TVSS protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. 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, and be maintenance free and self-restoring.
 - 2. Instruments shall be housed in a suitable case, properly grounded. Ground wires for all TVSS shall be connected to a good earth ground and where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4X junction box coupled to the enclosure.
- B. Power Supply:
 - 1. Protection of all 120 VAC instrument power supply lines shall be provided. Control panels shall be protected by line noise suppressing isolation transformers and TVSS. Field instruments shall be protected by TVSS. For control panels, the line noise suppressing isolation transformer shall be Topaz Series 30 Ultra isolators or approved equal. The suppressor shall be Edco HSP-121 or approved equal and U.L. 1449 compliant.
- C. Analog Signals:
 - 1. Protection of analog signal lines originating and terminating not in the same building shall be provided by TVSS. For analog signal lines, the TVSS shall be Edco PC-642. For field mounted two-wire instruments, the TVSS shall be

- encapsulated in stainless steel pipe nipples and shall be Edco SS64 series or approved equal, and U.L. 497B compliant.
2. For field-mounted four-wire 120VAC instruments, the TVSS shall be in a NEMA 4X polycarbonate enclosure, Edco SLAC series or approved equal.

2.08 INSTRUMENTATION AND CONTROL EQUIPMENT SPECIFICATIONS

A. Diaphragm Seal – Threaded:

1. Type:
 - a. Thread Attached.
 - b. Welded Metal Diaphragm.
 - c. Exposed Surfaces - 316 stainless steel.
2. Operation:
 - a. Purpose - To protect instruments or gauges from the process medium.
 - b. Operating Principal - A flexible diaphragm separates process medium and instrument element. Space on instrument side of diaphragm to be completely filled with a suitable silicone or instrument oil. The process pressure is transmitted by the liquid filled system to the instrument element.
3. Functional:
 - a. Filling Screw - Include on all units.
 - b. Pressure Limits - 1,000 psi.
 - c. Flushing Connection - Include on all units.
 - d. Capillary tubing as required.
4. Physical:
 - a. Top Housing - 316 Stainless Steel, Cadmium plated.
 - b. Bottom Housing - Compatible with the process.
 - c. Diaphragm - 316 ELC Stainless Steel.
 - d. Exposed Surfaces - 316 Stainless Steel.
 - e. Bolts, Nuts and Plugs - 18-8 stainless steel or 316 stain steel.
 - f. Capillary - 1/4-in stainless steel armor shielded.
5. Manufacturers:
 - a. Mansfield-Green.
 - b. Ashcroft.
 - c. Or approved equal.

B. Magnetic Flowmeter Element and Transmitter:

1. Flow Element:
 - a. Type: Pulsed DC electromagnetic induction type and shall provide a signal which is linear to the liquid flow rate.
 - b. Functional/Performance:
 - 1) Power requirements: Match to converter/transmitter.
 - 2) Accuracy: Plus or minus 1 percent of rate (including converter/transmitter) and an ambient of 65 degrees Celsius.
 - 3) RFI protection - Provide RFI protection.
 - c. Pressure rating - 240 PSI if 150 lb flanges are used, 700 PSI if 300 lb flanges are used.
 - d. Temperature rating: Suitable for process liquid temperature up to 70 degrees Celsius.
 - e. Additional - Meter shall be capable of running empty indefinitely without damage to any component.

- f. Physical:
 - 1) Metering Tube: Stainless steel unless otherwise indicated.
 - 2) Flanges: ANSI 150-lb, carbon steel unless otherwise indicated. Provide 316 stainless steel on all sludge applications. Flangeless wafer type may be used if compatible with adjacent piping.
 - 3) Liner –TFE.
 - 4) Electrodes - 316 stainless steel, bullet nosed or elliptical self cleaning type unless otherwise noted.
 - 5) Housing - Meters in below grade vaults, basements, etc., shall be designed for accidental submergence in 30-ft of water for 24 hours. Meters above grade shall be of splashproof/dripproof design unless otherwise noted. Where hazardous areas are indicated on the contract Drawings, the equipment shall be rated for that area.
 - 6) Mounting: Remote mounting with ANSI Class 150 flanges with alignment rings and hardware.
 - 7) Painting - All external surfaces shall be painted with a chemical and corrosion resistant epoxy finish.
 - g. Accessories/Options Required:
 - 1) Factory calibration - All meters shall be factory calibrated. A copy of the report shall be in the O&M manual.
 - 2) Grounding - Meter shall be grounded per the manufacturers recommendation. Provide ground ring, ground wires, gaskets, etc., as required or as otherwise noted. All materials shall be suitable for liquid being measured.
 - h. Manufacturers: Rosemount or Endress and Hauser or ABB or with remote transmitter or Owner approved equal.
2. Flow Converter/Transmitter:
 - a. Type: Match to flow element.
 - b. Functional/Performance:
 - 1) Power requirements: 120V AC plus or minus 10 percent.
 - 2) Accuracy: As defined for flow element.
 - 3) Temperature: minus 25 degrees C to plus 65 degrees C.
 - 4) Output: Isolated 4-20 ma into 0 to 1000 ohms.
 - 5) Physical: Housing - NEMA 4X wall mount.
 - c. Accessories/Options Required:
 - 1) Cable - Provide signal cable between magmeter and signal converter.
 - 2) Indicator – Provide remote transmitter/indicator with scale engraved 0 to 100 percent which indicates actual converter output signal.
 - 3) Totalizer - provide a seven digit, non-reset totalizer on the face of the enclosure and a scalable pulse output to drive the totalizer. The totalizer multiplier shall be a power of 10.
 - 4) Zero Return Unit - Where indicated on the instrument device schedule provide a zero return unit. The unit shall be powered from the converter/transmitter and may be mounted in a separate NEMA 4X enclosure, the device shall drive the magmeter output to 4 ma DC on no flow conditions.
 - 5) Mounting: 2 inch pipe stand. Mounting hardware shall be Type 316 stainless steel.
 - d. Manufacturer: (same as flow element): Rosemount or Endress and Hauser Promag or ABB Model WaterMaster or Owner approved equal.

C. Variable Area Flow Meter (Rotameter):

1. General:
 - a. Function: Indicate flow rate.
 - b. Type: Tapered tube and float.
2. Performance:
 - a. Range: As noted.
 - b. Accuracy: Plus or minus 2 percent of full scale, uncalibrated, over a 10 to 1 turndown ratio.
 - c. Repeatability: 1/4 percent of flow.
3. Features: Direct reading scale, nominally 10 inches long.
4. Service:
 - a. Fluid: Water, unless otherwise noted.
5. Physical Features:
 - a. Materials: Glass tube, 316 stainless steel float, 316 stainless end fittings, stainless steel side plates, stainless steel scale, and 1/4-inch laminated safety glass, unless otherwise noted.
 - b. Scale graduated in gpm.
 - c. Viton tube packing.
 - d. Buna O-ring seal for valve.
 - e. 316 stainless steel needle valve.
6. Process Connections:
 - a. Line Size: As noted.
 - b. Connection Type: Straight-through construction with vertical female NPT connections, unless otherwise noted.
 - c. Connection Material: 316 stainless steel, unless otherwise noted.
7. Manufacturers:
 - a. Brooks, Series 1358.
 - b. Approved Equal.

D. Pressure Gage:

1. Type:
 - a. Bourdon tube actuated pressure gauge.
 - b. Absolute, gauge or differential pressure operation, as indicated on the loop drawings.
2. Functional/Performance:
 - a. Accuracy - Plus or minus 1.0 percent of span or better.
3. Physical:
 - a. Case - Phenolic shock resistant or 316 stainless steel for surface/stem mounting with a pressure relieving back. The case shall be vented for temperature/atmospheric compensation. Gage shall be capable of being liquid filled in the field or at the factory.
 - b. Window - Clear acrylic or shatter proof glass.
 - c. Bourdon Tube - 316 stainless steel.
 - d. Connection - 1/4-in NPT.
 - e. Gage size - 4.0-in minimum.
 - f. Pointer travel - Not less than 200 degrees nor more than 270 degree arc.
 - g. Range - As indicated in the instrument device schedule.
4. Accessories/Options Required:
 - a. Shutoff valve - Each gage shall have a process shutoff valve which can also be used as an adjustable pressure snubber.

- b. Special scales - Engineer reserves the right to require special scales and/or calibration if the manufacturers standard is not suitable for the application.
 - c. Gauges listed as liquid filled or to be provided with a diaphragm seal in the instrument device schedule shall be Glycerin filled with appropriate sealing barrier to prevent the process fluid from entering the gage. The liquid filled gauges shall be glycerin filled at the factory and the entire assembly shall be shipped complete from the factory.
 - d. Test valve - Each gage shall have a test valve connected to a piping tee for testing of the unit when the process is isolated.
- 5. Manufacturers:
 - a. Ashcroft.
 - b. Or Owner approved equal.
- E. Sunshade/Rain Hood:
 - 1. Instrumentation suns shade shall be aluminum material for the application. Fiberglass sunshade is not acceptable. Furnish shade with appropriate 316 stainless steel mounting hardware as shown on Instrumentation Detail Drawing. Provide UV protective flexible sun shield in front of the transmitter display. Flexible sun shield cover shall be attached to the sunshade/ rain hood using door hinges and screws so that it can be easily flip over to read the instrument display.

2.09 CONTROL STRATEGY SCHEDULES

- A. The control strategies are written descriptions of the programming required to implement regulatory and sequential control of the unit processes. Control strategies shall fully reside in the memory of the designated PLC. Coefficients pertaining to control strategies shall be modifiable through the operator interface in the monitoring / control mode.
- B. Existing Sludge Feed Pumps Control: Existing sludge feed pumps and existing VSC (variable speed controller) will remain. Installing Contractor shall modify the existing sludge feed pump control strategy in the existing Plant PLC system as needed and as describes in this specification. Existing sludge feed pump VSC units have LOCAL/REMOTE control selection. If LOCAL control is selected at the VSC unit, the unit can be started/stopped from the local START/STOP selector switch near each VSC unit. If REMOTE control is selected at the VSC unit, the PLC program will control the start/stop of each sludge feed pump. In the PLC program, the "AUTO/MANUAL" control selection shall be available from the SCADA screen for operator to select. In MANUAL mode, the Operator can start/stop the desired sludge feed pump from the SCADA screen. In AUTO mode, the PLC logic shall start/stop the appropriate sludge feed pump based on the automatic pump selection logic.
- C. Sludge Feed Pump Automatic Pump Selection Logic: There are five existing sludge feed pumps and one sludge feed pump will be needed for one BFP. The PLC logic shall rotate pump based on the total runtime. The PLC logic shall have a pump rotating matrix and the operator can easily take any pump "out of service" to remove from the rotation.
- D. If available at the existing VSC unit of each sludge feed pump, "in remote", "running", and "fault" signals will be connected to the new RIO panel.

- E. Each Belt Filter Press (BFP) unit shall require a permissive of “Sludge Feed Pump Running” signal, appropriate motorized valve open signals.
- F. Each BFP unit shall also need the associated horizontal conveyor, incline conveyor, and truck loading conveyor running signal permissive to operate. For If associated conveyor running signals are removed, associated BFP unit shall shutdown. For example, Horizontal conveyor No.1, Inclined conveyor No.1, and Truck Loading conveyor shall be running to start the BFP No.2 unit. Horizontal conveyor No.2, Inclined conveyor No.2, and Truck Loading conveyor shall be running to start the BFP No.3 unit.
- G. No sludge flow alarm: If one sludge feed pump is running and no flow is registered at the associated flowmeter, PLC shall send a “No Sludge Flow Alarm” to the plant SCADA system.
- H. Individual BFP unit control will be programmed by the software programmer of the BFP’s supplier. Installing Contractor shall coordinate with the software programmer of the BFP’s supplier for programming in the same existing Plant PLC processor and avoiding duplicate address or tag, etc. Refer to specification 11362 for BFP Control Description.
- I. Miscellaneous Control and Monitoring: In addition to process monitoring and control shown on Instrumentation drawings, the reclaimed PLC shall control and/or monitor the following station attributes:
 - 1. Pump Ready: When pump is in Auto and no fault alarm, the PLC logic shall generate “pump ready” signal.
 - 2. Pump Failed to Start: When the pump is called to start and within a preset adjustable time (10 seconds), no running feedback is received, the PLC logic shall generate “pump failed to start” alarm.
 - 3. Total Run Time: The PLC program shall have a counter for total run time for each pump/aerator and display on SCADA/HMI screens.
 - 4. Analog Input (flow, pressure, etc.): The PLC program shall have the “Hi-Hi”, “High”, “Low”, and “Low-Low” alarms set point (adjustable) for all analog inputs and generates the “Hi-Hi”, “High”, “Low”, and “Low-Low” alarms if the condition occurs. All alarms shall be auto reset when alarm condition goes away.
 - 5. Auto-Manual Start-Stop scheme for all equipment (pump or valves) shall operate on the following way: Any equipment shall have Auto and Manual mode selectable from the HMI screen. In Auto mode the particular pump or valve shall follow the auto control strategy described above. In Manual mode, operator shall be able to Start, Stop, Open or Close pump/ Valve from the HMI screen. VFD pump or modulating valve shall have in addition the manual set point for speed/ position.
 - 6. The control system shall be designed to allow online calibration and repair of instruments used in the plant control scheme without disruption of the plant process or production rate. This shall be accomplished using operator selectable process hold values in conjunction with operator selectable hold timers and alarms to remind operators to reset the system to active inputs.
 - 7. All alarms that are generated by the PLC and have active role in PLC logic, shall be latched, and shall be resettable from the HMI screens, except the alarms that need to be reset on the field.
 - 8. All alarms generated by the PLC shall have selectable value in HMI for alarm set point, and selectable time delay.

9. All Set points for PID loops shall be enterable from the screen together with percentage that PLC shall use to calculate stage up and stage down set points. That calculation shall be one scan operation. After that one scan operation initiated by either entering the PID set point or percentage, operator shall be able to overwrite calculated values from the screen.
10. Each PLC or RIO panel shall have an internal power fail alarm generated by a relay internally wire to monitor the 120V power.

2.10 PROGRAMMING SOFTWARE

- A. No new PLC software license is needed as part of this project. Installing Contractor shall use own software to program the PLC system.

2.11 TOUCH SCREEN HUMAN-MACHINE INTERFACE (HMI)

- A. General:
 1. 1 Function: Allows operator to monitor and control at DPC/PLC level.
 - a. Type: Allen-Bradley Panelview Plus 1500 color touch screen, no equal.
 - b. Parts: Touch screen, power and communication cabling, communication module, accessories.
- B. Environmental:
 1. Operator Temperature: 0 to 55 degree C.
 2. Humidity: 5 to 95 percent (without condensation) @ 0 to 55 degree C.
 3. Storage Temperature: -25 to 70 degree C.
- C. Features:
 1. Display Type: TFT liquid crystal display (LCD), 256 colors.
 2. Display size: 12.0 x 9.0" (1024X768 pixels).
 3. Display Panel size; 15", unless otherwise noted.
 4. Application Memory: 7168K user memory; 5689K for options. Alarm Buffer. Provide memory flash card for storage for backup.
 5. Power Requirements: 85 to 264 Vac.
 6. Power Consumption: 200VA max.
 7. Certifications: UL approved.
 8. Vector graphic capable.
- D. Interfaces:
 1. Ethernet.
- E. Accessories:
 1. Configuration Software and Ancillaries:
 - a. Latest Version of Rockwell Automation RSView software – Factory Talk View Machine Edition. Provide software license for HMI touch screen. Software license shall be provided for City of Daytona Beach – Westside Regional Water Reclamation Facility and shall have full development license so that Owner can modify the screen in the future.
 - b. Full documentation.
 - c. Download cable.
 - d. Power Cords.
 2. Alarms: 4000 Alarms/32 classes.
 3. Up to 500 process screens.
 4. 2048 process tags.

5. Bar graphs/trend curves.
6. Screen blocks.
7. Recipes: up to 500 total.

PART 3 EXECUTION

3.01 INSTALLATION, CALIBRATION, TESTING, START-UP AND INSTRUCTION

A. General:

1. Under the supervision of the Single I&C supplier, all systems specified in this Section shall be installed, connected, calibrated, and tested, and in coordination with the Engineer and the Owner, shall be started to place the processes in operation. This shall include final calibration in concert with equipment specified elsewhere in these Specifications, including pumps, valves, as well as certain existing equipment.

B. Testing:

1. All systems shall be exercised through operational tests in the presence of the Engineer in order to demonstrate achievement of the specified performance. Operational tests depend upon completion of work specified elsewhere in these Specifications. The scheduling of tests shall be coordinated by the Installing Contractor among all parties involved so that the tests may proceed without delays or disruption by incomplete work.
2. Unwitnessed Factory Test (UFT) by the Aerator Supplier:
 - a. An unwitnessed factory test shall be conducted to prepare the I&C Supplier to demonstrate compliance with this specification during the Factory Acceptance Test (FAT). The I&C Supplier shall prepare a written procedure detailing every aspect of the UFT. This procedure must be submitted to the Engineer for approval prior to the commencement of the UFT. This procedure along with any forms generated during the UFT shall comprise the basis of the FAT.
 - b. The I&C Supplier shall inspect and test the Integrated Control System (ICS) to ensure it is ready for the FAT. This test shall take place at the I&C Supplier's factory. It shall consist of interconnecting computers, PLC control panels, communications links, and other new Control Panels (unless specifically excluded below).
 - c. All primary element inputs shall be simulated (inputs shall be adjustable by switch, if discrete; by potentiometer or similar device, if analog). Primary outputs shall be monitored via output devices (pilot lights, for discrete; a meter, digital display (12-bit min. resolution) or other such analog device, if analog output).
 - d. Excluded New Panels: None.

C. Factory Acceptance Test (FAT): Refer to specification 11362 for Belt Filter Press Factory Acceptance Test requirements.

D. Installation and Connection:

1. The Installing Contractor shall install and connect all field-mounted components and assemblies under the criteria imposed in Part 1, 1.03, herein. The installation personnel shall be provided with a final reviewed copy of the Shop Drawings and data.

2. The instrument process sensing lines and air signal tubing shall, in general, be installed in a similar manner to the installation of conduit specified under Section 16050. Individual tubes shall be run parallel and near the surfaces from which they are supported:
 - a. Supports shall be used at intervals of not more than 3 feet of rigid tubing.
 - b. Bends shall be formed with the proper tool and to uniform radii and shall be made without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at all panels.
3. The Installing Contractor shall have a technical field representative of the I&C supplier to instruct these installation personnel on any and all installation requirements; thereafter, the technical field representative shall be readily available by telephone to answer questions and supply clarification when needed by the installation personnel:
 - a. Where primary elements (supplied by I&C supplier) shall be part of a mechanical system, the I&C supplier shall coordinate the installation of the primary elements with the mechanical system manufacturer.
4. Fiber optic cable shall be furnished by the I&C Supplier and installed by the Electrical Contractor. The I&C Supplier shall provide the services of an experienced fiber optic cable terminator and tester. The I&C Supplier shall supervise the cable installation and shall carry out all terminations at the I/O racks, repeaters, and data concentrators at PLC's and computers. Fiber optic cable termination shall be carried out using the appropriate connectors and termination kit. All fiber optic system components shall be products of one manufacturer:
 - a. Fiber optic cable system shall be designed to minimize cable splicing. Where splicing becomes necessary perform fusion splice with loss not to exceed 0.2 dB. Test all splices with an Optical Time Domain Reflectometer (OTDR) bi-directionally to verify splice loss at the time of splicing. Redo any splices not conforming to Specifications. Provide means to protect the unspliced portions of the cable from intrusion of moisture and other foreign matter. Identify required splices in the submittal. Splices not identified in the submittal shall not be acceptable unless approved by the Engineer.
 - b. After the fiber optic data link is in place, test the attenuation from hub to hub bi-directionally and document test results. Attenuation in excess of 3.5 dB/km at 850 nm wavelength or 1.0 dB/km at 1300 nm wavelength shall require the I&C supplier to replace the defective sections and retest until the attenuation is below the attenuation allowed per kilometer at the wavelengths cited.
 - c. The I&C Supplier is responsible for the satisfactory performance of all fiber optic data links. Demonstrate and document error free bi-directional data files transfer from each host computer to each PLC node.
5. Finally, after all installation and connection work has been completed, the technical field representative shall check it all for correctness, verifying polarity of electric power and signal connections, making sure all process connections are free of leaks, and all such similar details. If the initial inspection finds no deficiencies, the technical field representative shall proceed to the certification to the Installing Contractor. Any completed work that is found to have deficiencies shall have those deficiencies corrected by installation personnel at no additional cost to the Owner. The technical field representative shall then

recheck the work after the identified deficiencies are corrected. If the technical field representative finds deficiencies in the follow-up inspection, then remedial action shall be taken by the Installing Contractor at no cost to the Owner. This pattern shall be repeated until the installation is free from defect. The technical field representative shall then certify in writing to the Installing Contractor that for each loop or system that he has inspected is complete and without discrepancies.

6. The field representative of the Single I&C supplier shall coordinate all work required to interface the new equipment and control devices with the existing equipment, including all required modifications to existing equipment and related devices.

E. Calibration:

1. All instruments and systems shall be calibrated after installation, in conformance with the component manufacturer's written instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation, and that the components and/or systems are within the specified limits of accuracy. Defective elements which cannot achieve proper calibration or accuracy, either individually or within a system, shall be replaced. This calibration work shall be accomplished by the technical field representatives of the I&C system supplier who shall certify in writing to the Installing Contractor that for each loop or system all calibrations have been made and that all instruments are ready to operate. See Article 3.02 supplements for sample "Instrumentation Calibration Sheet".

F. Pre-Commissioning:

1. The I&C Supplier shall test each loop (discrete and analog) to determine if it is functioning correctly. The I&C Supplier shall furnish a loop sheet for each loop to be tested. The loop sheet shall represent the actual "as-built" condition of the loop. The I&C Supplier shall perform a field functional loop test which shall be witnessed by the Engineer and Owner. If the loop fails the functional test, the I&C Supplier shall coordinate repairs for the Installing Contractor to correct whatever is wrong with the loop. The I&C Supplier shall retest the loop until it is approved.
2. Each loop shall be tested and approved by Engineer and Owner until all loops have been approved.

G. Start-up and Instruction:

1. When all systems are assessed by the Installing Contractor to have been successfully carried through complete operational tests with a minimum of simulation, and the Engineer concurs in this assessment, plant start-up by the Owner's operating personnel can follow. For a minimum of three times for (4) hours prior to start-up, operating and maintenance personnel shall be instructed in the functions and operation of each system and shall be shown the various adjustable and set point features which may require readjustment, resetting or checking, re-calibration or maintenance by them from time to time. This instruction shall be scheduled at a time arranged with the Owner at least two (2) weeks in advance. Instruction shall be given by qualified persons who have been made familiar in advance with the systems. All equipment shall be checked during the first year of operation at intervals of three months for a period of not less than one day or as may be required to correct any defects to the satisfaction of the Owner.

- H. Modifications to Existing Facilities:
 - 1. The Installing Contractor shall make all modifications to existing equipment and control devices which are required to successfully install and integrate all new instrumentation equipment. All costs for any required modification and rehabilitation effort shall be included in the Installing Contractor's original bid amount and no additional payment shall be allowed.
- I. Plant Shutdowns:
 - 1. The Single I&C supplier shall carefully examine all work to be performed relative to existing I&C equipment and the installation of new equipment and control devices. Work shall be scheduled to minimize required plant shutdown times.
- J. Coordination with Other Concurrent Projects:
 - 1. The single I&C supplier shall coordinate extensively with other I&C suppliers of concurrent projects. Some of the equipment shown in this contract as existing might be installed while this contract is underway.

3.02 SUPPLEMENTS

- A. Supplements listed below, following "END OF SECTION," are part of this Specification:
 - 1. Loop Status Report.
 - 2. Functional Acceptance Test Sheet.
 - 3. Instrumentation Calibration Sheet.

END OF SECTION

LOOP STATUS REPORT

PROJECT NAME: _____

PROJECT NO.: _____

FUNCTIONAL REQUIREMENTS

[illegible]

* INITIAL AND DATE WHEN COMPLETE

FUNCTIONAL ACCEPTANCE TEST SHEETPROJECT NAME: _____
PROJECT NO.: _____FUNCTIONAL REQUIREMENTS AND
SUMMARY OF COMPONENTS:
(ATTACH XEROX OF LOOP SPECIFICATION FROM THE CONTRACT DOCUMENTS)

VERIFICATION OF LOOP STATUS REPORT AND

BY: _____

INSTRUMENT AND VALVE CALIBRATION SHEETS

DATE: _____

DEMONSTRATION TEST(S): FOR EACH FUNCTIONAL REQUIREMENT OF THE LOOP:
REQUIRED PERFORMANCE

- | | | |
|--|---------------|--|
| (a) LIST AND NUMBER THE REQUIREMENT | (c) | CITE THE RESULTS THAT WILL VERIFY THE |
| (b) BRIEFLY DESCRIBE THE DEMONSTRATION | (d) | PROVIDE SPACES FOR INITIAL AND DATE OF |
| TEST | TEST WITNESS. | |

PERFORMED BY:

WITNESSED BY:

COMPLETED DATE:

LOOP
ACCEPTED BY
(OWNER)

BY

DATE

CHECK IF REMARKS ON REVERSE SIDE

LOOP NO.

INSTRUMENTATION CALIBRATION SHEET

COMPONENT CODE: NAME:				MANUFACTURER: MODEL: SERIAL:				PROJECT NUMBER: NAME:			
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>RANGE CHART</p> <p><input type="checkbox"/> INDICATE/RECORD</p> <p>SCALE INPUT</p> <p><input type="checkbox"/> TRANS/CONVERT</p> <p>OUTPUT</p> </div> <div style="width: 45%;"> <p>VALUE _____</p> <p>_____</p> <p>_____</p> <p>_____</p> </div> <div style="width: 10%;"> <p>UNITS _____</p> <p>_____</p> <p>_____</p> <p>_____</p> </div> </div>				<input type="checkbox"/> COMPUTE FUNCTIONS				<input type="checkbox"/> CONTROL ACTION (DIRECT/REVERSE) MODES (P/I/D) <input type="checkbox"/> SWITCH UNIT RANGE (VALUE/UNITS) DIFFERENTIAL (FIXED/ADJUSTABLE) RESET (AUTOMATIC/MANUAL)			

ANALOG							DISCRETE					REMARKS CODE	
REQUIRED			AS CALIBRATED				REQUIRED			AS CALIBRATED			
IN	SCALE	OUT	SCALE	OUT	SCALE	OUT	NUMBER	TRIP PT	RESET PT	TRIP PT	RESET PT		
C. MODE SETTINGS: P I D													

	COMPONENT CALIBRATED AND READY FOR START-UP BY DATE
	TAG NO.

APPENDIX A

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Structural steel shapes and plate.
 - 2. Fasteners and structural hardware:
 - a. All thread rods.
 - b. Forged steel structural hardware.
 - c. High-strength bolts.
 - 3. Welding.
 - 4. Bolting.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

1.02 REFERENCES

- A. American Institute of Steel Construction (AISC):
 - 1. 303 - Code of Standard Practice for Steel Buildings and Bridges.
 - 2. 360 - Specification for Structural Steel Buildings.
- B. American Iron and Steel Institute (AISI):
 - 1. Steel and stainless steel alloys ("types") as indicated.
- C. American Welding Society (AWS):
 - 1. A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 - 2. A5.17 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
 - 3. A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
 - 4. D1.1 - Structural Welding Code - Steel.
 - 5. D1.6 - Structural Welding Code - Stainless Steel.
- D. ASTM International (ASTM):
 - 1. A 6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - 2. A 36 - Standard Specification for Carbon Structural Steel.
 - 3. A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
 - 4. A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

5. A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 6. A 193 - Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.
 7. A 194 - Standard Specification for Steel Bars Subject to Restricted End-Quench Hardenability Requirements.
 8. A 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 9. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
 10. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 11. A 380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 12. A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 13. A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 14. A 563 - Standard Specification for Carbon and Alloy Steel Nuts.
 15. A 992 - Standard Specification for Structural Steel Shapes.
 16. F 436 - Standard Specification for Hardened Steel Washers.
 17. F 959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
 18. F 2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- E. Research Council on Structural Connections (RCSC):
1. Specification for Structural Joints Using High-Strength Bolts (RCSC Specification).

1.03 DEFINITIONS

- A. Snug-tight: At bolted joints, the tightness attained with a few impacts of an impact wrench, or by the full effort of an ironworker using a spud wrench to bring the connected plies into firm contact.
- B. Stainless steel related terms:
1. Descaling: Removal of heavy, tightly adherent oxide films resulting from hot-forming, heat-treatment, welding, and other high-temperature operations.
 2. Pickling: Chemical descaling of stainless steel using aqueous solutions of nitric and hydrofluoric acid, or various proprietary formulations as specified.
 3. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.

1.04 SUBMITTALS

- A. General: As specified in:
1. Section 01330 Shop Drawing Submittal.
 2. This Section.

- B. Quality control submittals:
 - 1. Submit shop drawings of members to be fabricated before starting fabrication.
 - 2. Welder's certificates.
- C. Test reports:
 - 1. Certified copies of mill tests and analyses made in accordance with applicable ASTM standards, or reports from a recognized commercial laboratory, including chemical and tensile properties of each shipment of structural steel or part thereof having common properties.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Perform welding of structural metals with welders who have current AWS certificate for the type of welding to be performed.
 - 2. Steel fabricators shall be certified by the AISC or other certification as recognized and accepted by the local building official having jurisdiction.
 - 3. Notify Design Engineer 24 hours minimum before starting field welding.
 - 4. Design Engineer may check materials, equipment, and qualifications of welders.
 - 5. Remove welders performing unsatisfactory Work, or require to requalification.
 - 6. Design Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or other aids to visual inspection to examine any part of welds or all welds.
 - 7. Contractor shall bear costs of retests on defective welds.
 - 8. Contractor shall also bear costs in connection with qualifying welders.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping: Deliver structural steel free from mill scale, rust, and pitting.
- B. Storage and protection: Until erection and painting, protect from weather items not galvanized or protected by a shop coat of paint.
- C. Do not store metal fabrication in direct contact with the ground.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Unless otherwise specified or indicated on the Drawings, materials shall conform to the following:

Item	ASTM Standard	Class, Grade, Type, or Alloy Number
Steel		
Plate, bars, rolled shapes (except W and WT shapes), and miscellaneous items	A 36	--
Rolled W and WT shapes	A 992	Grade 50

Item	ASTM Standard	Class, Grade, Type, or Alloy Number
Hollow structural sections (HSS): Round, square, or rectangular	A 500	Grade B
Round HSS	A 500	Grade B
Steel pipe	A 53	Grade B
Stainless steel		
Plate, sheet, and strip	A 240	316**
Bars and shapes	A 276	316**
** Use Type 316L if material will be welded.		

- B. Where stainless steel is welded, use extra low-carbon stainless steel (316L).

2.02 FASTENERS AND STRUCTURAL HARDWARE

- A. General:
- Materials: Of domestic manufacture.
 - Where fasteners and hardware are specified to be galvanized, galvanize in accordance with ASTM A 153 or ASTM F 2329.
- B. All thread rods:
- Uncoated:
 - In accordance with ASTM A 36 unless otherwise indicated on the Drawings.
 - Nuts: ASTM A 194.
 - Washers: ASTM F 436.
 - Galvanized:
 - In accordance with ASTM A 36 unless otherwise indicated on the Drawings, and hot dip galvanized in accordance with ASTM A 123.
 - Nuts: ASTM A 194, hot-dip galvanized in accordance with ASTM A 153.
 - Washers: ASTM F 436, hot-dip galvanized in accordance with ASTM A 153.
 - Stainless steel:
 - Units descaled, pickled, and passivated as specified in "Fabrication" in this Section.
 - Threaded rods and nuts to be the products of a single manufacturer/fabricator to ensure proper fit without galling. Ship threaded rods with properly fitting nuts attached.
 - Alloy: Type 316/316L:
 - Bolts: ASTM A 193, Grade B8M, Class 1, heavy hex.
 - Nuts: ASTM A 194, Grade 8M, heavy hex.
 - Washers: Type 316 stainless steel.
- C. Anchor bolts, anchor rods, and post-installed steel anchors: As indicated on the Drawings and as specified in Section 05190:
- Provide high-strength bolt assembly, with nuts, hardened flat washers, and compressible-washer-type direct tension indicators.

2. Uncoated:
 - a. Bolts: Plain heavy hex structural bolts in accordance with ASTM A 325
Type 1 Nuts: Heavy hex nuts in accordance with ASTM A 563, Grade C.
 - b. Washers: Flat:
 - 1) Adjacent to normal, oversized, and short-slotted holes: Circular and square or rectangular beveled washers in accordance with ASTM F 436.
 - 2) Adjacent to long slotted holes: 5/16-inch thick plate washer fabricated from steel in accordance with ASTM A 36.
 - c. Washers: Tension indicating: In accordance with ASTM F 959.
3. Galvanized:
 - a. Bolt and nut assemblies fabricated, galvanized, tested for rotational capacity, and shipped accordance with the provisions ASTM A 325 and the RCSC Specification.
 - b. Bolts, nuts, and washers: Hot-dip galvanized and in accordance with ASTM A 153, Class C or ASTM F 2329.
 - c. Bolts: Plain heavy hex structural bolts in accordance with ASTM A 325 Type 1 and galvanized as specified.
 - d. Nuts: Heavy hex nuts in accordance with ASTM A 563, Grade DH, galvanized as specified, and lubricated in accordance with ASTM A 563, Supplementary Requirement S1 to minimize galling.
 - e. Washers:
 - 1) Adjacent to normal, oversized, and short-slotted holes: Circular and square or rectangular beveled washers in accordance with ASTM F 436 and galvanized as specified.
 - 2) Adjacent to long slotted holes: 5/16-inch thick plate washer fabricated from steel in accordance with ASTM A 36, and galvanized in accordance with ASTM A 123.

2.03 ISOLATING SLEEVES AND WASHERS

- A. As indicated on the Drawings and as specified in Section 05190.

2.04 SUPPLEMENTARY PARTS

- A. Furnish as required for complete structural steel erection, whether or not such parts and Work are specified or indicated on the Drawings.

2.05 FABRICATION

- A. Shop assembly:
 1. Fabricate structural steel in accordance with AISC 360 and AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
 2. Where anchors, connections, or other details of structural steel are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.
 3. Round off sharp and hazardous projections and grind smooth.
 4. Take measurements necessary to properly fit work in the field. Take responsibility for and be governed by the measurements and proper working out of all the details.
 5. Take responsibility for correct fitting of all metalwork.

- B. Stainless steel shapes and assemblies:
1. For structural members such as W shapes, S shapes, channels, angles, and similar rolled shapes not available in quantity, size, and type of stainless steel specified or indicated on the Drawings:
 - a. Fabricate shapes using laser-fused, full penetration welds between pieces of plate to attain same or higher section modulus and moment of inertia as that of members indicated on the Drawings.
 - b. Fabricate shapes from dual grade stainless steel.
 - c. Fabricate beams and channels to ASTM A 6 tolerances.
 - d. Manufacturers: The following, or equal:
 - 1) Stainless Structurals, LLC, Jacksonville, FL.
 2. Cleaning and passivation:
 - a. Following shop fabrication of stainless steel members and bolts, clean and passivate fabrications at point of manufacture.
 - b. Finish requirements: Remove free iron, heat tint oxides, weld scale and other impurities, and obtain a bright passive finished surface with no etching, pitting, frosting, or discoloration.
 - c. Provide quality control testing to verify effectiveness of cleaning agents and procedures and to confirm that finished surfaces are clean and passivated:
 - 1) Conduct sample runs using test specimens with proposed cleaning agents and procedures as required to avoid adverse effects on surface finishes and base materials.
 - d. Pre-clean, chemically de-scale ("pickle"), passivate, and final-clean fabrications in accordance with the requirements of ASTM A 380:
 - 1) If degreasing is required before cleaning (pickling) to remove scale or iron oxide, cleaning with citric acid treatments is permissible; however, such treatments shall be followed inorganic cleaners.
 - 2) Pickle and passivate stainless steel using a nitric acid solution in accordance with ASTM A 380, Annex A2, Table A2.1, Part II.
 - 3) Pickling by citric acid treatment or sulfuric acid treatment is not considered to satisfy the requirements of this Section.
 - e. Inspect after cleaning using methods specified for "gross inspection" in ASTM A 380.
 - f. Improperly or poorly cleaned and passivated materials shall not be shipped and will not be accepted at the site.
- C. Galvanized steel:
1. Where galvanizing is required, hot-dip structural steel after fabrication in accordance with ASTM A 123.
 2. Do not electro-galvanize or mechanically-galvanize unless specified or accepted by Design Engineer.
 3. Re-straighten galvanized items that bend or twist during galvanizing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 ERECTION

A. General:

1. Fabricate structural and foundry items to true dimensions without warp or twist.
2. Form welded closures neatly, and grind off smooth where weld material interferes with fit or is unsightly.
3. Install structural items accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.
4. Do not cock out of alignment, re-drill, re-shape, or force fit fabricated items.
5. Place anchor bolts or other anchoring devices accurately and make surfaces that bear against structural items smooth and level.
6. Rigidly support and brace structural items needing special alignment to preserve straight, level, even, and smooth lines. Keep structural items braced until concrete, grout, or dry pack mortar has hardened for 48 hours minimum.
7. Erect structural steel in accordance with AISC 360 unless otherwise specified or modified by applicable regulatory requirements.
8. Where anchors, connections, and other details of structural steel erection are not specifically indicated on the Drawings or specified, form, locate, and attach with equivalent in quality and workmanship to items specified.
9. Round off sharp or hazardous projections and grind smooth.
10. Paint or coat steel items as specified in Sections 09910 and 09960.

B. Stainless steel. Take all necessary precautions to avoid iron contamination of stainless steel during delivery, storage, and handling:

1. Segregate stainless steel from iron.
2. Tools and handling devices:
 - a. Do not use iron tools clamps, chokes, working surfaces, or brushes when fabricating, handling, and erecting stainless steel.
 - b. Do not use tools that have been contaminated by contact with iron.
 - c. Use stainless steel, polymer coated, or wood tools and handling equipment. Do not use tools that have been contaminated by contact with iron or steel.

C. Welding: General:

1. Make welds full penetration type, unless otherwise indicated on the Drawings.
2. Remove backing bars and weld tabs after completion of weld. Repair defective welds observed after removal of backing bars and weld tabs.

D. Welding stainless steel:

1. General: In accordance with AWS D1.6.

E. Welding carbon steel:

1. General: In accordance with AWS D1.1:
 - a. Weld ASTM A 36 and A 992 structural steel, ASTM A 500 and A 501 structural tubing, and ASTM A 53 pipe with electrodes conforming to AWS A5.1, using E70XX electrodes; AWS A5.17, using F7X-EXXX electrodes; or AWS A5.20, using E7XT-X electrodes.
 - b. Field repair cut or otherwise damaged galvanized surfaces to equivalent original condition using a galvanized surface repair.

- F. Interface with other products:
 - 1. Where steel members and fasteners come in contact with dissimilar metals (aluminum, stainless steel, etc.), separate or isolate the dissimilar metals with isolating sleeves and washers as specified in Section 05190.
- G. Fasteners: General:
 - 1. Install bolts to project 2 threads minimum, but 1/2 inch maximum beyond nut.
 - 2. Anchor bolts and anchor rods: Install as specified in Section 05190:
 - a. Unless otherwise specified, tighten nuts on anchor bolts and anchor rods specified in Section 05190 to the "snug-tight" condition.
 - 3. All thread rods in drilled holes and bonded to concrete with epoxy.
- H. Fasteners: High-strength bolts:
 - 1. Connections with high-strength bolts shall in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
 - 2. Joints: Slip-critical:
 - a. Confirm that faying surfaces at connections are free of dirt and other foreign material, have been blast cleaned, and are free of coatings and inadvertent overspray in accordance with RCSC Specification.
 - b. Furnish hardened flat washers in accordance with ASTM F 436:
 - 1) On outer plies with slotted holes.
 - 2) When 1 or more plies of the connected material has a yield strength less than 40 ksi.
 - 3) Under element, nut, or bolt head, turned in tightening.
 - c. Install tension indicator washers, placed in accordance with ASTM F 959 Figure X1, to confirm adequate tightening of bolts.
 - d. Tighten bolts to full pretension.
- A. Fasteners: Stainless steel bolts:
 - 1. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.
 - 2. Rotate nuts using a slow, smooth action without interruptions. Avoid over-tightening.

END OF SECTION

SECTION 05140
STRUCTURAL ALUMINUM

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Structural aluminum products, including sheet, pipe, extrusions, and associated accessories.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents:
 - a. Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
 - b. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 3. B 308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- B. American Welding Society (AWS):
 - 1. A5.10 - Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods.
 - 2. D1.2 - Structural Welding Code - Aluminum.

1.03 SUBMITTALS

- A. Quality control submittals:
 - 1. Test Reports: Certified copies of mill tests or reports from a recognized commercial laboratory including chemical and tensile properties of each shipment of structural metal or part thereof having common properties. Tests and analyses shall be made in accordance with applicable ASTM Standards.
 - 2. Welder's certificates.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Perform welding of structural metals with welders who have current AWS certificate for the type of welding to be performed.
 - 2. Notify Engineer 24 hours minimum before starting shop or field welding.
 - 3. Engineer may check materials, equipment, and qualifications of welders.
 - 4. Remove welders performing unsatisfactory work, or require to requalify.
 - 5. Engineer may use gamma ray, magnetic particle dye penetrant, or other aids to visual inspection to examine any part of welds or all welds.
 - 6. Contractor shall bear costs of retests on defective welds.
 - 7. Contractor shall bear costs in connection with qualifying welders.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Structural sheet aluminum: ASTM B 209, Alloy 6061-T6.
- B. Structural aluminum: ASTM B 308, Alloy 6061-T6.
- C. Extruded aluminum: ASTM B 221, Alloy 6063-T42.
- D. Miscellaneous materials:
 - 1. Furnish supplementary parts necessary to complete each item even where such work is neither definitely indicated on the Drawings nor specified.
 - 2. Size, form, attachment, and location shall conform to the best of current practice.
 - 3. Conform to applicable ASTM Standards for materials not otherwise specified.

2.02 FABRICATION

- A. Aluminum layout:
 - 1. Center punch hole centers, and punch or scribe cutoff lines, except where marks would remain on fabricated material.
 - 2. Apply temperature correction where necessary in layout of critical dimensions. Use a coefficient of expansion of 0.000013 per degree of Fahrenheit.
- B. Cutting aluminum:
 - 1. Material 1/2-inch thick or less: Shear, saw, or cut with a router.
 - 2. Material more than 1/2-inch thick: Saw or rout.
 - 3. Make cut edges true and smooth, free from excessive burrs or ragged breaks.
 - 4. Avoid reentrant cuts wherever possible. Where used, fillet by drilling prior to cutting.
 - 5. Do not flame cut aluminum alloys.
 - 6. Punch or drill rivet or bolt holes to finished size before assembly:
 - a. Make finished diameter of holes for bolts 1/16-inch maximum larger than nominal bolt diameter.
 - b. Make holes cylindrical and perpendicular to principal surface.
 - c. Do not permit holes to drift in a manner to distort metal.

- C. Aluminum forming and assembly:
 - 1. Do not heat structural aluminum, except as follows:
 - a. Heat aluminum to 400 degrees Fahrenheit for 30 minutes maximum, to facilitate bending or welding.
 - b. Heat only when proper temperature controls and supervision can ensure that limitations on temperature and time are observed.
- D. Before assembly, remove chips lodged between contacting surfaces.
- E. Welding aluminum:
 - 1. Perform welding of aluminum in accordance with AWS D1.2.
 - 2. Weld aluminum in accordance with the following:
 - a. Preparation:
 - 1) Remove dirt, grease, forming or machining lubricants, and organic materials from areas to be welded by cleaning with a suitable solvent or by vapor degreasing.
 - 2) Additionally, etch or scratch brush to remove oxide coating just prior to welding when inert gas tungsten arc welding method is used.
 - 3) Oxide coating may not need to be removed if welding is performed by automatic or semi-automatic inert gas shielded metal arc.
 - 4) Suitably prepare edges to assure 100 percent penetration in butt welds by sawing, chipping, machining, or shearing. Do not cut with oxygen.
 - b. Filler metal: Aluminum alloys conforming to the requirements of AWS A5.10 and AWS classification ER 4043, ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556.
 - c. Perform welding of structures which are to be anodized using filler alloys which will not discolor when anodized, AWS ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556.
 - d. Perform welding by using a non-consumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG).
 - e. Do not use welding process that requires use of a welding flux.
 - f. Neatly make welded closures.
 - g. Where weld material interferes with fit or is unsightly in appearance, grind it smooth.
 - h. Make welds full penetration welds unless otherwise indicated on the Drawings.

2.03 FINISHES

- A. Coating for dissimilar metals:
 - 1. Alkali resistant bitumastic: Manufacturers: One of the following or equal:
 - a. Caroline, Bitumastic Super Service Black.
 - b. Tnemec, 46-465.
 - c. Wasser, MC-Tar.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION

- A. Install structural aluminum products as indicated on the Drawings and specified.
- B. Install structural aluminum products accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.
- C. Do not cock out of alignment, redrill, reshape, or force fit fabricated items.
- D. Place anchor bolts or other anchoring devices accurately and make surfaces which bear against structural items smooth and true to level.
- E. Rigidly support and brace structural products needing special alignment to preserve straight, level, even, smooth lines, and keep braced until concrete, grout, or dry pack mortar has hardened for a minimum 48-hour period.
- F. Interface with other products:
 - 1. Where aluminum comes in contact with dissimilar metals, bolt it with stainless steel bolts and separate or isolate it from dissimilar metals as specified in Section 05190.
 - 2. Do not paint exposed aluminum surfaces. Remove markings and leave surfaces clean. Coat those parts of aluminum which will be cast into concrete, and those parts of aluminum which will come in contact with masonry, concrete, or wood, with a minimum of 2 coats of specified coating for protection of similar metals.
 - 3. Coat those parts of aluminum which will be cast into concrete or which will be in contact with concrete, grout, masonry, wood, or other materials that will cause the aluminum to corrode, as specified in Section 09960.

END OF SECTION

SECTION 05190

MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Cast-in anchors and fasteners:
 - a. Anchor bolts.
 - b. Welded studs.
 - 2. Post-installed steel anchors and fasteners:
 - a. Concrete anchors.
- B. Related sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
 - 3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents:
 - a. Section 01330 - Submittals.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete & Commentary.
- B. American National Standards Institute (ANSI):
 - 1. B212.15 - Cutting Tools - Carbide-tipped Masonry Drills and Blanks for Carbide-tipped Masonry Drills.
- C. American Welding Society (AWS):
 - 1. D1.1 - Structural Welding Code - Steel.
 - 2. D1.6 - Structural Welding Code - Stainless Steel.
- D. ASTM International (ASTM):
 - 1. A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. A 108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold Finished.
 - 3. A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

5. A 193 - Standard Specification for Alloy Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 6. A 194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 7. A 240 - Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 8. A 308 - Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot-Dip Process.
 9. A 496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 10. A 563 - Standard Specification for Carbon and Alloy Steel Nuts.
 11. B 633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 12. B 695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 13. E 488 - Standard Test Methods for Strength of Anchors in Concrete Elements.
 14. F 436 - Standard Specification for Hardened Steel Washers.
 15. F 1554 - Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
- E. International Code Council Evaluation Service, Inc. (ICC-ES):
1. AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

1.03 DEFINITIONS

- A. Built-in anchor: Headed bolt or assembly installed in position before filling surrounding masonry units with grout.
- B. Cast-in anchor: Headed bolt or assembly installed in position before placing plastic concrete around.
- C. Overhead installations: Fasteners installed on overhead surfaces where the longitudinal axis of the fastener is more than 60-degrees above a horizontal line so that the fastener resists sustained tension loads.
- D. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.
- E. Post-installed anchor: Fastener or assembly installed in hardened concrete or finished masonry construction, typically by drilling into the structure and inserting a steel anchor assembly.
- F. Terms relating to structures or building environments as used with reference to anchors and fasteners:
 1. Corrosive locations: Describes interior and exterior locations as follows:
 - a. Locations used for delivery, storage, transfer, or containment (including spill containment) of chemicals used for plant treatment processes.

2. Wet and moist locations: Describes locations, other than “corrosive locations,” that are submerged, are immediately above liquid containment structures, or are subject to frequent wetting, splashing, or wash down. Includes:
 - a. Exterior portions of buildings and structures.
 - b. Liquid-containing structures:
 - 1) Locations at and below the maximum operating liquid surface elevation.
 - 2) Locations above the maximum operating liquid surface elevation and:
 - a) Below the top of the walls containing the liquid.
 - b) At the inside faces and underside surfaces of a structure enclosing or spanning over the liquid (including walls, roofs, slabs, beams or walkways enclosing the open top of the structure).
 - c. Liquid handling equipment:
 - 1) Bases of pumps and other equipment that handles liquids.
 - d. Indoor locations exposed to moisture, splashing or routine wash down during normal operations, including floors with slopes toward drains or gutters.
 - e. Other locations indicated on the Drawings.
3. Other locations:
 - a. Interior dry areas where the surfaces are not exposed to moisture or humidity in excess of typical local environmental conditions.

1.04 SUBMITTALS

- A. General:
 1. Submit as specified in Section 01330.
 2. Submit information listed for each type of anchor or fastener to be used.
- B. Action submittals:
 1. Product data:
 - a. Cast-in anchors:
 - 1) Manufacturer’s data including catalog cuts showing anchor sizes and configuration, materials, and finishes.
 - b. Post-installed anchors:
 - 1) For each anchor type, manufacturer’s data including catalog cuts showing anchor sizes and construction, materials and finishes, and load ratings.
 2. Samples:
 - a. Samples of each type of anchor, including representative diameters and lengths, if requested by the Engineer.
 3. Certificates:
 - a. Cast-in anchors:
 - 1) Mill certificates for steel anchors that will be supplied to the site.
 - b. Post-installed anchors:
 - 1) Manufacturer’s statement or certified test reports demonstrating that anchors that will be supplied to the site comply with the materials properties specified.

4. Test reports:
 - a. Post-installed anchors: For each anchor type used for the Work:
 - 1) Current ICC-ES Report (ESR), or equivalent acceptable to the Engineer and the authority having jurisdiction, demonstrating:
 - a) Acceptance of that anchor for use under the building code specified in Section 01410.
5. Manufacturer's instructions:
 - a. Requirements for storage and handling.
 - b. Recommended installation procedures including details on drilling, hole size (diameter and depth), hole cleaning and preparation procedures, anchor insertion, and anchor tightening.
 - c. Requirements for inspection or observation during installation.
6. Qualification statements:
 - a. Post-installed anchors: Installer qualifications:
 - 1) Submit list of personnel performing installations and include date of manufacturer's training for each.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 1. Post installed anchors shall be in accordance with building code specified in Section 01410.
- B. Special inspection:
 1. Provide special inspection of post-installed anchors.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver post-installed anchors in manufacturer's standard packaging with labels visible and intact. Include manufacturer's installation instructions.
- B. Handle and store anchors and fasteners in accordance with manufacturer's recommendations and as required to prevent damage.
- C. Protect anchors from weather and moisture until installation.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. General:
 1. Furnish threaded fasteners with flat washers and hex nuts fabricated from materials corresponding to the material used for threaded portion of the anchor:
 - a. Cast-in anchors: Provide flat washers and nuts as listed in the ASTM standard for the anchor materials specified.
 - b. Post-installed anchors: Provide flat washers and nuts supplied for that product by the manufacturer of each anchor.
 2. Size of anchors and fasteners, including diameter and length or minimum effective embedment depth: As indicated on the Drawings or as specified in this Section. In the event of conflicts, contact Engineer for clarification.

3. Where anchors and connections are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.

B. Materials:

1. Provide and install anchors of materials as in this Section.

2.02 CAST-IN ANCHORS AND FASTENERS

A. Anchor bolts:

1. Description:

- a. Straight steel rod having one end with integrally forged head, and one threaded end. Embedded into concrete with the headed end cast into concrete at the effective embedment depth indicated on the Drawings or specified, and with the threaded end left to project clear of concrete face as required for the connection to be made.
- b. Furnish anchor bolts with heavy hex forged head or equivalent acceptable to Engineer:
 - 1) Rods or bars with angle bend for embedment in concrete (i.e.: "L" or "J" shaped anchor bolts) are not permitted in the Work.

2. Materials:

- a. Type 316 stainless steel:
 - 1) Bolts: ASTM A 193, Grade B8M, Class 1, heavy hex.
 - 2) Nuts: ASTM A 194, Grade 8M, heavy hex.
 - 3) Washers: Type 316 stainless steel.

2.03 POST-INSTALLED ANCHORS AND FASTENERS – MECHANICAL

A. General:

1. Post-installed anchors used for the Work shall hold a current ICC Evaluation Service Report demonstrating acceptance for use under the building code specified in Section 01410:
 - a. Conditions of use: The acceptance report shall indicate acceptance of the product for use under the following conditions:
 - 1) In regions of concrete where cracking has occurred or may occur.
 - 2) To resist short-term loads due to wind forces.
 - 3) To resist short-term loading due to seismic forces for the Seismic Design Category of the structure where the product will be used.
2. Substitutions: When requesting product substitutions, submit calculations, indicating the diameter, effective embedment depth and spacing of the proposed anchors, and demonstrating that the substituted product will provide load resistance that is equal to or greater than that provided by the anchors listed in this Section:
 - a. Calculations shall be prepared by and shall bear the signature and sealed of a Professional Engineer licensed in the State of Florida.
 - b. Decisions regarding the acceptability of proposed substitutions shall be at the discretion of the Engineer.

- B. Concrete anchors:
1. Description. Post-installed anchor assembly consisting of a threaded stud and a surrounding wedge expansion sleeve that is forced outward by torquing the center stud to transfer loads from the stud to the concrete through bearing, friction, or both. (Sometimes referred to as "expansion anchors" or "wedge anchors."):
 - a. Do not use slug-in, lead cinch, and similar systems relying on deformation of lead alloy or similar materials to develop holding power.
 2. Concrete anchors for anchorage to concrete:
 - a. Acceptance criteria:
 - 1) Concrete anchors shall have a current ICC-ES Report demonstrating that the anchors have been tested and qualified for performance in both cracked and un-cracked concrete, and for short term loading due to wind and seismic forces for Seismic Design Categories A through F in accordance with ACI 355.2 and with ICC-ES AC193 (including all mandatory tests and optional tests for seismic tension and shear in cracked concrete).
 - 2) Concrete anchor performance in the current ICC-ES Report shall be "Category 1" as defined in ACI 355.2.
 - b. Manufacturers: One of the following or equal:
 - 1) Hilti: Kwik Bolt TZ Expansion Anchor.
 - 2) Powers fasteners: PowerStud+ SD2.
 - 3) Simpson Strong-Tie®: Strong Bolt 2 Wedge Anchor.
 - c. Materials. Integrally threaded stud, wedge, washer and nut:
 - 1) Stainless steel: Type 316.
- C. Flush shells:
1. Description: Post-installed anchor assembly consisting of an internally threaded mandrel that is forced into a pre-drilled concrete hole with a setting tool until the top of the anchor is flush with the face of the concrete. Once installed, a removable threaded bolt is installed in the mandrel.
 2. Flush shell anchors are not permitted in the Work.

2.04 APPURTENANCES FOR ANCHORING AND FASTENING

- A. Anchor bolt sleeves:
1. having inside diameter approximately 2 inches greater than bolt diameter and minimum 10-bolt diameters long.
 2. Plastic sleeves:
 - a. High-density polyethylene, corrugated sleeve, threaded to provide adjustment of location on the anchor bolt.
 - b. Manufacturers: One of the following, or equal:
 - 1) Wilson Anchor Bolt Sleeve Company.
- B. Isolating sleeves and washers:
1. Manufacturers: One of the following or equal:
 - a. Central Plastics Company, Shawnee, Oklahoma.
 - b. Corrosion Control Products, PSI Inc., Gardena, CA.
 2. Sleeves: Mylar, 1/32 inch thick, 4,000 volts per mil dielectric strength, of proper size to fit bolts and extending half way into both steel washers.
 3. One sleeve required for each bolt.

4. Washers: The inside diameter of all washer shall fit over the isolating sleeve and both the steel and isolating washers shall have the same inside diameter and outside diameter:
 - a. Proper size to fit bolts. 2 insulating washers are required for each bolt.
 - b. Two 1/8-inch thick steel washers for each bolt.
 - c. G3 Phenolic:
 - 1) Thickness: 1/8 inch.
 - 2) Base material: Glass.
 - 3) Resin: Phenolic.
 - 4) Water absorption: 2 percent.
 - 5) Hardness (Rockwell): 100.
 - 6) Dielectric strength: 450 volts per mil.
 - 7) Compression strength: 50,000 pounds per square inch.
 - 8) Tensile strength: 20,000 pounds per square inch.
 - 9) Maximum operating temperature: 350 degrees Fahrenheit.
- C. Coating for repair of galvanized surfaces:
 1. Manufacturers: One of the following or approved equal:
 - a. Galvinox.
 - b. Galvo-Weld.
- D. Thread coating. For use with threaded stainless steel fasteners:
 1. Manufacturers: One of the following or equal:
 - a. Never Seez Compound Corporation, Never-Seez.
 - b. Oil Research, Inc., WLR No. 111.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION: GENERAL

- A. Where anchors and fasteners are not specifically indicated on the Drawings or specified, make attachments with materials specified in this Section.
- B. Substitution of anchor types:
 1. Post-installed anchors may not be used as an alternative to cast-in/built-in anchors at locations where the latter are indicated on the Drawings.
 2. Cast-in/built-in anchors may be used as an alternative to post-installed mechanical anchors at locations where the latter are indicated on the Drawings.
- C. Protect products from damage during installation. Take special care to protect threads and threaded ends.

- D. Accurately locate and position anchors and fasteners:
 - 1. Unless otherwise indicated on the Drawings, install anchors perpendicular to the surfaces from which they project.
 - 2. Install anchors so that at least 2 threads, but not more than 1/2 inch of threaded rod, projects past the top nut.
- E. Interface with other products:
 - 1. Where steel anchors come in contact with dissimilar metals (aluminum, stainless steel, etc.), bolt with stainless steel bolts and separate or isolate dissimilar metals using isolating sleeves and washers.
 - 2. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.

3.03 INSTALLATION: CAST-IN ANCHORS

- A. General:
 - 1. Accurately locate cast-in and built-in anchors:
 - a. Provide anchor setting templates to locate anchor bolts and anchor rods. Secure templates to formwork.
 - b. Brace or tie off embedments as necessary to prevent displacement during placement of plastic concrete or of surrounding masonry construction.
 - c. Position and tie cast-in and built-in anchors in place before beginning placement of concrete or grout. Do not “stab” anchors into plastic concrete, mortar, or grout.
 - d. Do not allow cast-in anchors to touch reinforcing steel. Where cast-in anchors are within 1/4 inch of reinforcing steel, isolate the metals by wrapping the anchors with a minimum of 4 wraps of 10-mil polyvinyl chloride tape in area adjacent to reinforcing steel.
 - 2. For anchoring at machinery bases subject to vibration, use 2 nuts, with 1 serving as a locknut.
 - 3. Where anchor bolts or anchor rods are indicated on the Drawings as being for future use, thoroughly coat exposed surfaces that project from concrete or masonry with non-oxidizing wax. Turn nuts down full length of the threads, and neatly wrap the exposed thread and nut with a minimum of 4 wraps of 10-mil waterproof polyvinyl tape.
- B. Anchor bolts:
 - 1. Minimum effective embedment: 10-bolt diameters, unless a longer embedment is indicated on the Drawings.
 - 2. Where indicated on the Drawings, set anchor bolts in 316 stainless steel sleeves to allow for adjustment.

3.04 INSTALLATION: POST-INSTALLED ADHESIVE ANCHORS.

- A. Epoxy and acrylic adhesive bonding of reinforcing bars, all thread rods, and internally threaded inserts in concrete.

3.05 INSTALLATION: POST-INSTALLED MECHANICAL ANCHORS.

- A. General:
 - 1. Install anchors in accordance with the manufacturer's instructions, ACI 355.2, the anchor's ICC-ES Report. Where conflict exists between the ICC-ES Report

and the requirements in this Section, the requirements of the ICC-ES Report shall control.

2. Where anchor manufacturer recommends the use of special tools and/or specific drill bits for installation, provide and use such tools.
3. After anchors have been positioned and inserted into concrete or masonry, do not:
 - a. Remove and reuse/reinstall anchors.
 - b. Loosen or remove bolts or studs.

B. Holes drilled into concrete and masonry:

1. Do not drill holes in concrete or masonry until the material has achieved its minimum specified compression strength (f'_c or f'_m).
2. Accurately locate holes:
 - a. Before drilling holes, use a reinforcing bar locator to identify the position of all reinforcing steel, conduit, and other embedded items within a 6-inch radius of each proposed hole.
 - b. If the hole depth exceeds the range of detection for the rebar locator, the Engineer may require radiographs of the area designated for investigation before drilling commences.
3. Exercise care to avoid damaging existing reinforcement and other items embedded in concrete and masonry:
 - a. If embedments are encountered during drilling, immediately stop work and notify the Engineer. Await Engineer's instructions before proceeding.
4. Unless otherwise indicated on the Drawings, drill holes perpendicular to the concrete surface into which they are placed.
5. Drill using anchor manufacturer's recommended equipment and procedures:
 - a. Unless otherwise recommended by the manufacturer, drill in accordance with the following:
 - 1) Drilling equipment: Electric or pneumatic rotary type with light or medium impact. Where edge distances are less than 2 inches, use lighter impact equipment to prevent micro-cracking and concrete spalling during drilling process.
 - 2) Drill bits: Carbide-tipped in accordance with ANSI B212-15. Hollow drills with flushing air systems are preferred.
6. Drill holes at manufacture's recommended diameter and to depth required to provide the effective embedment indicated.
7. Clean and prepare holes as recommended by the manufacturer and as required by the ICC-ES Report for that anchor:
 - a. Unless otherwise recommended by anchor manufacturer, remove dust and debris using brushes and clean compressed air.
 - b. Repeat cleaning process as required by the manufacturer's installation instructions.
 - c. When cleaning holes for stainless steel anchors, use only stainless steel or non-metallic brushes.

C. Insert and tighten (or torque) anchors in full compliance with the manufacturer's installation instructions:

1. Once anchor is tightened (torque), do not attempt to loosen or remove its bolt or stud.

D. Concrete anchors: Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Concrete Anchors			
Nominal Diameter	Minimum Effective Embedment Length		Minimum required member thickness
	In concrete	In grouted masonry	
3/8 inch	2 1/2 inch	2 5/8 inch	8 inch
1/2 inch	3 1/2 inch	3 1/2 inch	8 inch
5/8 inch	4 1/2 inch	4 1/2 inch	10 inch
3/4 inch	5 inch	5 1/4 inch	12 inch

E. Flush shell anchors:

1. Flush shell anchors are not permitted in the Work.
2. If equipment manufacturer's installation instructions recommend the use of flush shell anchors, contact Engineer for instructions before proceeding.

F. Sleeve anchors:

1. Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Sleeve Anchors			
Nominal Diameter	Minimum Effective Embedment Length		Minimum Member Thickness
	In concrete	In grouted masonry	
M8 (1/2 inch)	70 mm (2 3/4 inch)	Not accepted	100 mm (8 inch)
M10 (5/8 inch)	76 mm (3 inch)	Not accepted	250 mm (10 inch)
M12 (3/4 inch)	80 mm (3 1/4 inch)	Not accepted	300 mm (12 inch)

2. Install with the sleeve fully engaged in the base material.

G. Screw anchors:

1. Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Screw Anchors			
Nominal Diameter	Minimum Effective Embedment Length		Minimum Member Thickness
	In concrete	In grouted masonry	
3/8 inch	2 1/2 inch	3 1/4 inch	8 inch
1/2 inch	3 1/4 inch	4 1/2 inch	8 inch
5/8 inch	4 inch	5 inch	10 inch
3/4 inch	5 1/2 inch	6 1/4 inch	12 inch

2. Install screw anchors using equipment and methods recommended by the manufacturer. Continue driving into hole until the washer head is flush against the item being fastened.

H. Undercut concrete anchors:

1. Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Sleeve Anchors			
Nominal Diameter (bolt)	Minimum Effective Embedment Length		Minimum Member Thickness ¹
	In concrete	In grouted masonry	
M10 (3/8 inch)	100 mm (4 inch)	Not accepted	200 mm (8 inch)
M12 (1/2 inch)	125 mm (5 inch)	Not accepted	350 mm (14 inch)
M16 (5/8 inch)	190 mm (7 1/2 inch)	Not accepted	460 mm (18 inch)
M20 (7/8 inch)	250 mm (10 inch)	Not accepted	510 mm (20 inch)
Notes: Thickness indicated is for pre-set units. If through-set units are accepted, obtain minimum member thickness requirements from the Engineer.			

2. Installations of undercut anchors shall not be allowed where edge distances are less than 12 times the nominal diameter of the anchor stud.
3. Undercut bottom of hole using cutting tools manufactured for this purpose by the manufacturer of the undercut anchors being placed.

3.06 FIELD QUALITY CONTROL

- A. Contractor shall provide quality control over the Work of this Section as specified in Section 01460:
 1. Expenses associated with work described by the following paragraphs shall be paid by the Contractor.
- B. Post-installed anchors:
 1. Review anchor manufacturer's installation instructions and requirements of the Evaluation Service Report (hereafter referred to as "installation documents") for each anchor type and material.
 2. Observe hole-drilling and cleaning operations for conformance with the installation documents.
 3. Certify in writing to the Engineer that the depth and location of anchor holes, and the torque applied for setting the anchors conforms to the requirements of the installation documents.

3.07 FIELD QUALITY ASSURANCE

- A. Owner's Construction Coordinator/Plant Superintendent and Engineer's representative will provide on-site observation and field quality assurance for the Work of this Section:
 1. Expenses associated with work described by the following paragraphs shall be paid by the Contractor.

- B. Field inspections and special inspections (performed by Engineer's representative in coordination with Contractor):
 - 1. Required inspections: Observe construction for conformance to the approved Contract Documents, the accepted submittals, and manufacturer's installation instructions for the products used.
 - 2. Record of inspections:
 - a. Maintain record of each inspection.
 - b. Submit copies to Owner upon request.
- C. Special inspections: Anchors cast into concrete and built into masonry:
 - 1. Provide special inspection during positioning of anchors and placement of concrete or masonry (including mortar and grout) around the following anchors:
 - a. Anchor bolts.
 - 2. During placement, provide continuous special inspection at each anchor location to verify that the following elements of the installation conform to the requirements of the Contract Documents:
 - a. Anchor:
 - 1) Type and dimensions.
 - 2) Material: Type 316 stainless steel as specified in this Section or indicated on the Drawings.
 - 3) Positioning: Spacing, edge distances, effective embedment, and projection beyond the surface of the construction.
 - 4) Reinforcement at anchor: Presence, positioning, and size of additional reinforcement at anchors indicated on the Drawings.
 - 3. Following hardening and curing of the concrete or masonry surrounding the anchors, provide periodic special inspection to observe and confirm the following:
 - a. Base material (concrete or grouted masonry):
 - 1) Solid and dense concrete or grouted masonry material within required distances surrounding anchor.
 - 2) Material encapsulating embedment is dense and well-consolidated.
- D. Special Inspections: Post-installed mechanical anchors placed in hardened concrete and in grouted masonry:
 - 1. Provide special inspection during installation of the following anchors:
 - a. Concrete anchors.
 - 2. Unless otherwise noted, provide periodic special inspection during positioning, drilling, placing, and torquing of anchors:
 - a. Provide continuous special inspection for post-installed anchors in "overhead installations" as defined in this Section.
 - 3. Requirements for periodic special inspection:
 - a. Verify items listed in the following paragraphs for conformance to the requirements of the Contract Documents and the Evaluation Report for the anchor being used. Observe the initial installation of each type and size of anchor, and subsequent installation of the same anchor at intervals of not more than 4 hours:
 - 1) Any change in the anchors used, in the personnel performing the installation, or in procedures used to install a given type of anchor, shall require a new "initial inspection."
 - b. Substrate: Concrete or masonry surfaces receiving the anchor are sound and of a condition that will develop the anchor's rated strength.

- c. Anchor:
 - 1) Manufacturer, type, and dimensions (diameter and length).
 - 2) Material (Type 316 stainless steel).
 - d. Hole:
 - 1) Positioning: Spacing and edge distances.
 - 2) Drill bit type and diameter.
 - 3) Diameter, and depth.
 - 4) Hole cleaned in accordance with manufacturer's required procedures. Confirm multiple repetitions of cleaning when recommended by the manufacturer.
 - 5) Anchor's minimum effective embedment.
 - 6) Anchor tightening/installation torque.
 - 4. Requirements for continuous special inspection:
 - a. The special inspector shall observe all aspects of anchor installation, except that holes may be drilled in his/her absence provided that he/she confirms the use of acceptable drill bits before drilling, and later confirms the diameter, depth, and cleaning of drilled holes.
- E. Field tests:
- 1. Owner's Construction Coordinator/Plant Superintendent may, at any time, request testing to confirm that materials being delivered and installed conform to the requirements of the Specifications:
 - a. If such additional testing shows that the materials do not conform to the specified requirements, the Contractor shall pay the costs of these tests.
 - b. If such additional testing shows that the materials do conform to the specified requirements, the Owner shall pay the costs of these tests:
 - 1) Anchors as specified in "non-conforming work."

3.08 NON-CONFORMING WORK.

- A. Remove miss-aligned or non-performing anchors.
- B. Fill empty anchor holes and repair failed anchor locations as specified in Section 03600 using high-strength, non-shrink, non-metallic grout.
- C. If more than 10 percent of all tested anchors of a given diameter and type fail to achieve their specified torque or proof load, the Engineer will provide directions for required modifications. Make such modifications, up to and including replacement of all anchors, at no additional cost to the Owner.

3.09 SCHEDULES

- A. Stainless steel. Provide and install stainless steel anchors at the following locations:
 - 1. "Corrosive locations" as defined in this Section: Type 316 stainless steel.
 - 2. "Wet and moist locations" as defined in this Section: Type 316 stainless steel.
 - 3. "Other locations":
 - a. For connecting aluminum members to concrete
 - 4. At locations indicated on the Drawings.

Table – Required Anchoring Materials by Location.		
Location / Exposure	Materials	Notes
1. Anchors into concrete and grouted masonry for attachment of carbon steel , including structural steel and other steel fabrications:		
a) Interior dry areas:	Stainless steel 316.	
b) Locations with galvanized steel structures or fabrications:	Stainless steel 316.	1
c) Exterior and interior wet and moist locations:	Stainless steel – Type 316	1
d) Corrosive locations:	Stainless steel – Type 316	1
2. Anchors into concrete and grouted masonry for attachment of aluminum, stainless steel, or fiber-reinforced plastic (FRP) shapes and fabrications.		
a) Interior dry areas:	Stainless steel – Type 316.	1
b) Exterior and interior wet and moist locations:	Stainless steel – Type 316.	1
c) Corrosive locations:	Stainless steel – Type 316.	1
3. Anchors for attaching equipment and its appurtenances		
a) All locations	Stainless steel – Type 316	1
Notes: (1) Where anchors are in contact with a metal that differs from that of the anchor, provide isolation sleeves and washers.		

END OF SECTION

SECTION 09910

PAINTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Field applied paints and coatings for normal exposures.
 - 2. Painting Accessories.

1.02 DEFINITIONS

- A. Paints: Manufacturer's best ready-mixed coatings, except when field catalyzed, with fully ground pigments having soft paste consistency and capable of being readily and uniformly dispersed to complete homogeneous mixture, having good flowing and brushing properties, and capable of drying or curing free of streaks or sags.
- B. Volatile Organic Compound (VOC): Content of air polluting hydrocarbons in uncured coating product measured in units of grams per liter or pounds per gallon.

1.03 SUBMITTALS

- A. General: Submit as specified in Section 01330 - Submittal Procedures.
- B. Shop drawings: Include schedule of where and for what use coating materials are proposed in accordance with requirements for Product Data.
- C. Product data: Include description of physical properties of coatings including solids content and ingredient analysis, VOC content, temperature resistance, typical exposures and limitations, and manufacturer's standard color chips.
- D. Samples: Include 8-inch square draw-downs or brush-outs of topcoat finish when requested. Identify each sample as to finish, formula, color name and number and sheen name and gloss units.
- E. Manufacturer's instructions: Submit in accordance with requirements for Product Data. Include:
 - 1. Special requirements for transportation and storage.
 - 2. Mixing instructions.
 - 3. Shelf life.
 - 4. Pot life of material.
 - 5. Precautions for applications free of defects.
 - 6. Surface preparation.
 - 7. Method of application.
 - 8. Recommended number of coats.
 - 9. Recommended thickness of each coat.
 - 10. Recommended total thickness.
 - 11. Drying time of each coat, including prime coat.

12. Required prime coat.
13. Compatible and non-compatible prime coats.
14. Recommended thinners, when recommended.
15. Limits of ambient conditions during and after application.
16. Time allowed between coats.
17. Required protection from sun, wind and other conditions.
18. Touch-up requirements and limitations.

1.04 QUALITY ASSURANCE

- A. Products: First line or best grade.
- B. Materials for each paint system: By single manufacturer.
- C. Applicator qualifications: Applicator of products similar to specified products with minimum 3 years' experience.
- D. Regulatory requirements: Comply with by using paints that do not exceed governing agency's VOC limits or do not contain lead.
- E. Field samples:
 1. Paint 1 complete surface of each color scheme to show colors, finish texture, materials, and workmanship.
 2. Obtain approval before painting other surfaces.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as specified in Section 01600 - Product Requirements.
- B. Remove unspecified and unapproved paints from Project site immediately.
- C. Deliver containers with labels identifying:
 1. Manufacturer's name.
 2. Brand name.
 3. Product type.
 4. Batch number.
 5. Date of manufacturer.
 6. Expiration date or shelf life.
 7. Color.
 8. Mixing and reducing instructions.
- D. Store coatings in well-ventilated facility that provides protection from the sun weather, and fire hazards:
 1. Maintain ambient storage temperature between 45 and 90 degrees Fahrenheit, unless otherwise recommended by the manufacturer.
- E. Take precautions to prevent fire and spontaneous combustion.

1.06 ENVIRONMENTAL CONDITIONS

- A. Surface moisture contents: Do not paint surfaces that exceed manufacturer specified moisture contents, or when not specified by the manufacturer, the following moisture contents:
 - 1. Plaster and gypsum wallboard: 12 percent.
 - 2. Masonry, concrete and concrete block: 12 percent.
 - 3. Interior located wood: 15 percent.
 - 4. Concrete floors: 7 percent.
- B. Do not paint or coat:
 - 1. Under dusty conditions.
 - 2. When light on surfaces measures less than 15 foot-candles.
 - 3. When ambient or surface temperature is less than 50 degrees Fahrenheit or unless manufacturer allow a lower temperature.
 - 4. When relative humidity is higher than 85 percent, unless manufacturer allows a higher relative humidity.
 - 5. When surface temperature is less than 5 degrees Fahrenheit above dew point.
 - 6. When surface temperature exceeds the manufacturer's recommendation.
 - 7. When ambient temperature exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.
 - 8. Apply clear finishes at minimum 65 degrees Fahrenheit.
- C. Provide fans, heating devices, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.
- D. Provide adequate continuous ventilation and sufficient heating facilities to maintain minimum 50 degrees Fahrenheit for 24 hours before, during and 48 hours after application of finishes.

1.07 PROTECTION

- A. Protect adjacent surfaces from paint and damage. Repair damage resulting from inadequate or unsuitable protection.
- B. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.
- C. Place cotton waste, cloths, and material that may constitute fire hazard in closed metal containers and remove daily from site.
- D. Remove electrical plates, surface hardware, fittings and fastenings, prior to painting operations:
 - 1. Carefully store, clean and replace on completion of painting in each area.
 - 2. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finish.

1.08 EXTRA MATERIALS

- A. Extra materials: Deliver as specified in Section 01770 - Closeout Procedures. Include minimum 1 gallon of each type and color of coating applied:
 - 1. When manufacturer packages material in gallon cans, deliver unopened labeled cans as comes from factory.
 - 2. When manufacturer does not package material in gallon cans, deliver material in new gallon containers, properly sealed and identified with typed labels indicating brand, type, and color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Paints: One of the following or equal:
 - 1. S/W: Sherwin-Williams Co., Cleveland, OH.
- B. Submit requests for substitutions as specified in Section 01600:
 - 1. Include certified ingredient analyses.
 - 2. Provide colors that match specified colors.

2.02 PAINT TO BE APPLIED IN THE INTERIOR OF THE BELT FILTER PRESS ROOM

- A. Wall and Ceiling Surfaces:
 - 1. First apply one coat of primer with a thickness of 1.5 to 2.0 mils DFT. Use the following or equal, unless noted otherwise in the schedule:
 - a. S/W Corothane 1 Clear Pre-Prime B65C10 Series.
 - 2. Afterwards, apply one coat of a moisture cured urethane with a thickness of 2.0 to 3.0 mils DFT. Use the following or equal, unless noted otherwise in the schedule:
 - a. S/W Corothane 1 HS, B65W15 Series.
- B. Concrete Floors and Equipment Pedestals:
 - 1. First apply one coat of epoxy primer with a thickness of 2.0 to 3.0 mils DFT. Use the following or equal, unless noted otherwise in the schedule:
 - a. S/W General Polymers #3477 Water Based Epoxy Primer.
 - 2. Afterwards apply one coat of epoxy paint with a thickness of 10.0 to 15.0 mils DFT. Use the following or equal, unless noted otherwise in the schedule:
 - a. S/W General Polymers #3746 100 percent Solids Epoxy Coating.
- C. Structural Steel Beams, Perlins, and Miscellaneous Metals:
 - 1. First apply two coats of a moisture tolerant epoxy coating with a thickness of 4.0 to 6.0 mils DFT per coat. Use the following or equal, unless noted otherwise in the schedule:
 - a. S/W Dura-Plate 301K, B62W340 Series.
 - 2. Afterwards, apply one coat of a moisture cured urethane with a thickness of 2.0 to 3.0 mils DFT per coat. Use the following or equal, unless noted otherwise in the schedule:
 - a. S/W Corothane 1 HS, B65W15 Series.

PART 3 EXECUTION

3.01 INSPECTION

- A. Thoroughly examine surfaces scheduled to be painted before starting work.
- B. Start painting when unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Prepare surfaces in accordance with paint manufacturer's instructions or when none, the following:
 - 1. Structural Steel Beams, Perlins, and Miscellaneous Metals:
 - a. Pressure wash and degrease with a minimum pressure of 3,000 psi.
 - b. Use a biodegradable cleaner to remove all dirt, dust, mildew, sludge, loose coatings, and all other surface contaminants.
 - 2. Concrete, Masonry, and Plywood Wall Surfaces:
 - a. Pressure wash and degrease with a minimum pressure of 3,000 psi.
 - b. Use a biodegradable cleaner to remove all dirt, dust, mildew, sludge, loose coatings, and all other surface contaminants.
 - 3. Concrete Floors and Equipment Pedestals:
 - a. Pressure wash and degrease with a minimum pressure of 3,000 psi.
 - b. Use a biodegradable cleaner to remove all dirt, dust, mildew, sludge, loose coatings, and all other surface contaminants.
 - c. Mechanically abrade surface to remove existing coatings to achieve a final surface profile of a CSP #2 to #3 per the Concrete Surface Preparation Standards.
 - 4. Unprimed steel and iron: Remove grease, rust, scale, dirt and dust by wire brushing, sandblasting, or other necessary method.
 - 5. Shop primed steel:
 - a. Sand and scrape to remove loose primer and rust.
 - b. Feather out edges to make touch-up patches inconspicuous.
 - c. Clean surfaces.
 - d. Prime bare steel surfaces.

3.03 APPLICATION

- A. Apply each coat at proper consistency.
- B. Tint each coat of paint slightly darker than preceding coat.
- C. Sand lightly between coats to achieve required finish.
- D. Do not apply finishes on surfaces that are not sufficiently dry.
- E. Allow each coat of finish to dry before following coat is applied, unless directed otherwise by manufacturer.
- F. Prime top and bottom edges of wood and metal doors with enamel undercoat when they are to be painted.

3.04 MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Identify equipment, ducting, piping, and conduit in accordance with related sections.
- B. Remove grilles, covers, and access panels for mechanical and electrical system from location and paint separately.
- C. Finish paint primed equipment with color selected by the Engineer.
- D. Prime and paint insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are plated or covered with prefinished coating.
- E. Replace identification markings on mechanical or electrical equipment when painted over or spattered.
- F. Paint dampers exposed immediately behind louvers, grilles, convactor, and baseboard cabinets to match face panels.
- G. Paint exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.
- H. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.
- I. Color code equipment, piping, conduit, exposed ductwork, and apply color banding and identification, such as flow arrows, naming and numbering, in accordance with the Contract Documents.

3.05 SURFACES NOT REQUIRING FINISHING

- A. Stainless steel, brass, bronze, copper, Monel®, chromium, anodized aluminum: Specially finished articles such as porcelain enamel, plastic coated fabrics, and baked enamel.
- B. Finished products such as ceramic tile, windows, glass, brick, resilient flooring, acoustical tiles, board and metal tees; other architectural features, such as finish hardware, furnished in aluminum, bronze or plated ferrous metal, prefinished panels, or other items that are installed prefinished.
- C. Items completely finished at factory, such as preformed metal roof and wall panels, aluminum frames, toilet compartments, sound control panels, acoustical tiles, shower compartments, folding partition, and flagpole.

3.06 CLEANING

- A. As work proceeds and upon completion, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of work, keep premises free from unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Upon completion of work, leave premises neat and clean.

3.07 INTERIOR PAINT SCHEDULE

- A. All painted surfaces shall receive a prime coat as specified in Part 2 of this specification or per manufacturer suggestion if not listed in Part 2.
- B. Paints shall match the type called for in Part 2 of this specification with the exception of piping.
- C. All pipe shall be painted with the Sherwin Williams Sher-Cryl as noted in the table below and as per the pipe paint schedule in Section 15076.

Location	Name	Sheen
Dewatering Press Room Walls and Ceiling	Antique White	Semi-Gloss
Dewatering Press Room Floor Around Outside of BFP Containment Area	Grey	Semi-Gloss

Sherwin Williams Custom Match to Pantone Purple 522-C 1 Gallon of Sher-Cryl (High Performance Acrylic)					
CC#	Color Cast	OZ	32	64	128
B1	Black	-	21	-	1
L1	Blue	-	10	1	1
R3	Magenta	2	16	1	1
R2	Maroon	-	1	1	-
W1	White	2	16	-	-

END OF SECTION

SECTION 09960

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Field-applied coatings.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - 2. D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- B. International Concrete Repair Institute (ICRI):
 - 1. Guideline 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- C. NACE International (NACE):
 - 1. SP0178 - Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service.
 - 2. SP0188 - Discontinuity (Holiday) Testing of Protective Coatings.
- D. National Association of Pipe Fabricators (NAPF):
 - 1. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
- E. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.
- F. Society for Protective Coatings (SSPC):
 - 1. SP COM - Surface Preparation Commentary for Steel and Concrete Substrates.
 - 2. SP 1 - Solvent Cleaning.
 - 3. SP 2 - Hand Tool Cleaning.
 - 4. SP 3 - Power Tool Cleaning.
 - 5. SP 5 - White Metal Blast Cleaning.
 - 6. SP 6 - Commercial Blast Cleaning.
 - 7. SP 7 - Brush-Off Blast Cleaning.
 - 8. SP 10 - Near-White Blast Cleaning.
 - 9. SP 13 - Surface Preparation of Concrete.
- G. United States Environmental Protection Agency (EPA):
 - 1. Method 24 - Surface Coatings.

1.03 DEFINITIONS

- A. Submerged metal: Steel or iron surfaces below tops of channel or structure walls that will contain water even when above expected water level.
- B. Submerged concrete and masonry surfaces: Surfaces that are or will be:
 - 1. Underwater.
 - 2. In structures that normally contain water.
 - 3. Below tops of walls of water-containing structures.
- C. Exposed surface: Any metal or concrete surface, indoors or outdoors, that is exposed to view.
- D. Dry film thickness (DFT): Thickness of fully cured coating, measured in mils.
- E. Volatile organic compound (VOC): Content of air polluting hydrocarbons in uncured coating product measured in units of grams per liter or pounds per gallon, as determined by EPA Method 24.
- F. Ferrous: Cast iron, ductile iron, wrought iron, and all steel alloys except stainless steel.
- G. Where SSPC surface preparation standards are specified or implied for ductile iron pipe or fittings, the equivalent NAPF surface preparation standard shall be substituted for the SSPC standard.

1.04 PERFORMANCE REQUIREMENTS

- A. Coating materials shall be especially adapted for use in wastewater treatment plants.
- B. Coating materials used in contact with potable water supply systems shall be certified to NSF 61.

1.05 SUBMITTALS

- A. General: Submit as specified in Section 01330 - Submittal Procedures.
- B. Shop drawings:
 - 1. Schedule of proposed coating materials.
 - 2. Schedule of surfaces to be coated with each coating material.
- C. Product data: Include description of physical properties of coatings including solids content and ingredient analysis, VOC content, temperature resistance, typical exposures and limitations, and manufacturer's standard color chips:
 - 1. Regulatory requirements: Submit data concerning the following:
 - a. VOC limitations.
 - b. Coatings containing lead compounds and polychlorinated biphenyls.
 - c. Abrasives and abrasive blast cleaning techniques, and disposal.
 - d. NSF certification of coatings for use in potable water supply systems.

- D. Samples: Include 8-inch square drawdowns or brush-outs of topcoat finish when requested. Identify each sample as to finish, formula, color name and number, sheen name, and gloss units.
- E. Certificates: Submit in accordance with requirements for Product Data.
- F. Manufacturer's instructions: Include the following:
 - 1. Special requirements for transportation and storage.
 - 2. Mixing instructions.
 - 3. Shelf life.
 - 4. Pot life of material.
 - 5. Precautions for applications free of defects.
 - 6. Surface preparation.
 - 7. Method of application.
 - 8. Recommended number of coats.
 - 9. Recommended DFT of each coat.
 - 10. Recommended total DFT.
 - 11. Drying time of each coat, including prime coat.
 - 12. Required prime coat.
 - 13. Compatible and non-compatible prime coats.
 - 14. Recommended thinners, when recommended.
 - 15. Limits of ambient conditions during and after application.
 - 16. Time allowed between coats (minimum and maximum).
 - 17. Required protection from sun, wind, and other conditions.
 - 18. Touch-up requirements and limitations.
 - 19. Minimum adhesion of each system submitted in accordance with ASTM D4541.
- G. Manufacturer's Representative's Field Reports.
- H. Operations and Maintenance Data: Submit as specified in Section 01770 - Closeout Procedures:
 - 1. Reports on visits to project site to view and approve surface preparation of structures to be coated.
 - 2. Reports on visits to project site to observe and approve coating application procedures.
 - 3. Reports on visits to coating plants to observe and approve surface preparation and coating application on items that are "shop coated."
- I. Quality Assurance Submittals:
 - 1. Quality assurance plan.
 - 2. Qualifications of coating applicator including List of Similar Projects.
- J. Certifications:
 - 1. Submit notarized certificate that:
 - a. All paints and coatings to be used on this project comply with current federal, state, and local VOC regulations.

1.06 QUALITY ASSURANCE

- A. Applicator qualifications:
 - 1. Minimum of 5 years of experience applying specified type or types of coatings under conditions similar to those of the Work:
 - a. Provide qualifications of applicator and references listing 5 similar projects completed in the past 2 years.
 - 2. Manufacturer-approved applicator when manufacturer has approved applicator program.
 - 3. Approved and licensed by polymorphic polyester resin manufacturer to apply polymorphic polyester resin coating system.
 - 4. Approved and licensed by elastomeric polyurethane (100-percent solids) manufacturer to apply 100-percent solids elastomeric polyurethane system.
 - 5. Applicator of off-site application of coal-tar epoxy shall have successfully applied coal-tar epoxy on similar surfaces in material, size, and complexity as on the Project.
- B. Regulatory requirements: Comply with governing agencies regulations by using coatings that do not exceed permissible VOC limits and do not contain lead:
 - 1. Do not use coal-tar epoxy in contact with drinking water or exposed to ultraviolet radiation.
- C. Certification: Certify that applicable pigments are resistant to discoloration or deterioration when exposed to hydrogen sulfide and other sewage gases and product data designates coating as suitable for wastewater service.
- D. Field samples:
 - 1. Prepare and coat a minimum 100-square-foot area between corners or limits such as control or construction joints of each system.
 - 2. Approved field sample may be part of the Work.
 - 3. Obtain approval before painting other surfaces.
- E. Pre-installation conference: Installing Contractor shall conduct pre-installation conference. Notify Owner and Engineer no later than 7 calendar days in advance of meeting date. Prepare an agenda and preside at meeting. Review conditions of installation, preparation and installation procedures. Review coordination with related work. Record minutes and distribute electronic copies within 7 calendar days after meeting to participants.
- F. Compatibility of coatings: Use products by same manufacturer for prime coats, intermediate coats, and finish coats on same surface, unless specified otherwise.
- G. Services of coating manufacturer's representative: Arrange for coating manufacturer's representative to attend pre-installation conferences. Make periodic visits to the project site to provide consultation and inspection services during surface preparation and application of coatings, and to make visits to coating plants to observe and approve surface preparation procedures and coating application of items to be "shop-primed and coated."

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as specified in Section 01600 - Product Requirements.

- B. Remove unspecified and unapproved paints from Project site immediately.
- C. Deliver new unopened containers with labels identifying the manufacturer's name, brand name, product type, batch number, date of manufacturer, expiration date or shelf life, color, and mixing and reducing instructions:
 - 1. Do not deliver materials aged more than 12 months from manufacturing date.
- D. Store coatings in well-ventilated facility that provides protection from the sun weather, and fire hazards. Maintain ambient storage temperature between 45 and 90 degrees Fahrenheit, unless otherwise recommended by the manufacturer.
- E. Take precautions to prevent fire and spontaneous combustion.

1.08 PROJECT CONDITIONS

- A. Surface moisture contents: Do not coat surfaces that exceed manufacturer-specified moisture contents, or when not specified by the manufacturer, with the following moisture contents:
 - 1. Plaster and gypsum wallboard: 12 percent.
 - 2. Masonry, concrete, and concrete block: 12 percent.
 - 3. Interior located wood: 15 percent.
 - 4. Concrete floors: 7 percent.
- B. Do not apply coatings:
 - 1. Under dusty conditions or adverse environmental conditions, unless tenting, covers, or other such protection is provided for structures to be coated.
 - 2. When light on surfaces measures less than 15 foot-candles.
 - 3. When ambient or surface temperature is less than 55 degrees Fahrenheit unless manufacturer allows a lower temperature.
 - 4. When relative humidity is higher than 85 percent.
 - 5. When surface temperature is less than 5 degrees Fahrenheit above dew point.
 - 6. When surface temperature exceeds the manufacturer's recommendation.
 - 7. When ambient temperature exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.
 - 8. Apply clear finishes at minimum 65 degrees Fahrenheit.
- C. Provide fans, heating devices, dehumidifiers, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.
- D. Provide adequate continuous ventilation and sufficient heating facilities to maintain minimum 55 degrees Fahrenheit for 24 hours before, during, and 48 hours after application of finishes.
- E. Dehumidification and heating for coating of high humidity enclosed spaces:
 - 1. Provide dehumidification and heating of digester interior spaces in which surface preparation, coating application, or curing is in progress according to the following schedule:
 - a. October 1 to April 30: Provide continuous dehumidification and heating as required to maintain the tanks within environmental ranges as specified in this Section and as recommended by the coating material manufacturer.

For the purposes of this Section, "continuous" is defined as 24 hours per day and 7 days per week.

- b. May 1 to September 30: Provide temporary dehumidification and heating as may be required to maintain the tanks within the specified environmental ranges in the event of adverse weather or other temporary condition. At Contractor's option and at his sole expense, Contractor may suspend work until such time as acceptable environmental conditions are restored, in lieu of temporary dehumidification and heating. Repair or replace any coating or surface preparation damaged by suspension of work, at Contractor's sole expense.
2. Equipment requirements:
 - a. Capacity: Provide dehumidification, heating, and air circulation equipment with minimum capacity to perform the following:
 - 1) Maintain the dew point of the air in the tanks at a temperature at least 5 degrees Fahrenheit less than the temperature of the coldest part of the structure where work is underway.
 - 2) Reduce dew point temperature of the air in the tanks by at least 10 degrees Fahrenheit in 20 minutes.
 - 3) Maintain air temperature in the tanks at 60 degrees Fahrenheit minimum.
 - b. Systems:
 - 1) Dehumidification: Provide desiccant or refrigeration drying. Desiccant types shall have a rotary desiccant wheel capable of continuous operation. No liquid, granular, or loose lithium chloride drying systems will be allowed.
 - 2) Heating: Electric, indirect combustion, or steam coil methods may be used. Direct-fired combustion heaters will not be allowed during abrasive blasting, coating application, or coating cure time.
3. Design and submittals:
 - a. Contractor shall prepare dehumidification and heating plan for this project, including all equipment and operating procedures.
 - b. Suppliers of services and equipment shall have not less than 3 years of experience in similar applications:
 - 1) Manufacturers: The following or equal:
 - a) Cargocaire Corp. (Munters).
 - c. Submit dehumidification and heating plan for Engineer's review.
4. Monitoring and performance:
 - a. Measure and record relative humidity and temperature of air, and structure temperature twice daily (beginning and end of work shifts) to verify that proper humidity and temperature levels are achieved inside the work area after the dehumidification equipment is installed and operational. Test results shall be made available to the Engineer upon request.
 - b. Interior space of the working area and tank(s) shall be sealed, and a slight positive pressure maintained as recommended by the supplier of the dehumidification equipment.
 - c. The filtration system used to remove dust from the air shall be designed so that it does not interfere with the dehumidification equipment's ability to control the dew point and relative humidity inside the reservoir:
 - 1) The air from the tank, working area, or dust filtration equipment shall not be recirculated through the dehumidifier during coating application or when solvent vapors are present.

1.09 MAINTENANCE

- A. Extra materials: Deliver as specified in Section 01770 - Closeout Procedures. Include minimum 1 gallon of each type and color of coating applied:
 - 1. When manufacturer packages material in gallon cans, deliver unopened labeled cans as comes from factory.
 - 2. When manufacturer does not package material in gallon cans, deliver material in new gallon containers, properly sealed and identified with typed labels indicating brand, type, and color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Special coatings: One of the following or equal:
 - 1. Carboline: Carboline.
 - 2. Ceilcote: International Protective Coatings.
 - 3. Dampney: The Dampney Co.
 - 4. Devoe: International Protective Coatings.
 - 5. Dudick: Dudick, Inc.
 - 6. GET: Global Eco Technologies.
 - 7. Henkel: Henkel North America.
 - 8. IET: Integrated Environmental Technologies.
 - 9. PPC: Polymorphic Polymers Corp.
 - 10. PPG Amercoat: PPG Protective & Marine Coatings.
 - 11. Rustoleum: Rustoleum Corp.
 - 12. Sanchem: Sanchem.
 - 13. Superior: Superior Environmental Products, Inc.
 - 14. S-W: Sherwin-Williams Co.
 - 15. Tnemec: Tnemec Co.
 - 16. Wasser: Wasser High Tech Coatings.
 - 17. ZRC: ZRC Worldwide Innovative Zinc Technologies.

2.02 PREPARATION AND PRETREATMENT MATERIALS

- A. Metal pretreatment:
 - 1. Manufacturers: One of the following or equal:
 - a. Henkel, Galvaprep 5.
 - b. International, AWLGrip Alumiprep 33.
- B. Surface cleaner and degreaser:
 - 1. manufacturers: One of the following or equal:
 - a. Carboline Surface Cleaner No. 3.
 - b. Devoe, Devprep 88.
 - c. S-W, Clean and Etch.

2.03 COATING MATERIALS

- A. Alkali-resistant bitumastic:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Bitumastic No. 50.
 - b. S-W, Targuard.

- c. Wasser, MC-Tar.
 - d. As specified for Coal Tar Epoxy Substitute.
- B. Wax coating:
 - 1. Manufacturers: The following or equal:
 - a. Sanchem, No-Ox-Id A special.
- C. High solids epoxy (self-priming) not less than 72 percent solids by volume:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Carboguard 891.
 - b. Devoe, Bar Rust 233H.
 - c. PPG Amercoat: Amerlock 2.
 - d. S-W, Macropoxy 646.
 - e. Tnemec, HS Epoxy Series 104.
- D. Aliphatic or aliphatic-acrylic polyurethane:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Carbothane 134 VOC.
 - b. Devoe, Devthane 379.
 - c. PPG Amercoat: Amershield VOC.
 - d. Non-submerged: S-W High Solids Polyurethane.
 - e. Tnemec, Endura-Shield II Series 1075 (U).
- E. Polymorphic polyester resin coating system: 2-component, modified styrene based thermoset resin, EPA approved for potable water, with 100 percent solids and maximum 10 grams per liter VOC:
 - 1. Manufacturers: One of the following or equal:
 - a. IET: IET Prime Coat DS-101, Intermediate Coat DS-301, and Finish Coat DS 401.
 - b. PPC: PPC Prime Coat, IC-Filler Coat, and FC-Final Coat.
- F. High-temperature coating 150 to 350 degrees Fahrenheit:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Thermaline 4900.
 - b. Dampney, Thermalox 245 Silicone - Zinc Dust.
 - c. PPG Amercoat: Amerlock 2/400 GFK.
- G. High-temperature coating 400 to 1,000 degrees Fahrenheit (dry):
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Thermaline 4700.
 - b. Dampney, Thermolox 230C Series Silicone.
 - c. Devoe, HT-12, High Heat Silicone.
- H. High-temperature coating up to 1,400 degrees Fahrenheit:
 - 1. Manufacturers: The following or equal:
 - a. Dampney, Thermalox 240 Silicone Ceramix.
- I. Asphalt varnish: AWWA C 500.
- J. Protective coal tar:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Bitumastic No. 50.

- b. PPG Amercoat: 78HB
 - c. As specified for Coal Tar Epoxy.
- K. Coal-tar epoxy:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, 300-M, Bitumastic.
 - b. PPG Amercoat: 78HB.
 - c. S-W, Tar Guard 100.
 - d. Tnemec, Series 46H-413.
- L. Vinyl ester: Glass mat reinforced, total system 125 mils DFT:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Semstone 870.
 - b. Ceilcote, 6640 Ceilcrete.
 - c. Dudick, Protecto-Flex 800.
 - d. Tnemec, Chembloc Series 239SC.
- M. Elastomeric polyurethane, 100-percent solids, ASTM D16, Type V, (Urethane P):
 - 1. Manufacturers: The following or equal:
 - a. GET, Endura-Flex EF-1988.
- N. Concrete floor coatings:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Semstone 140SL.
 - b. Devoe, Devran 124.
 - c. Dudick, Polymer Alloy 1000.
 - d. Tnemec, Tneme-Glaze Series 282.
- O. Waterborne acrylic emulsion:
 - 1. Manufacturers: One of the following or equal:
 - a. S-W, DTM Acrylic B66W1.
 - b. Tnemec, Tneme-Cryl Series 6.
- P. Galvanizing zinc compound:
 - 1. Manufacturers: One of the following or equal:
 - a. ZRC, Cold Galvanizing Compound.

2.04 COATING MATERIALS

- A. Alkali-resistant bitumastic:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Bitumastic No. 50 WB.
 - b. S-W, Targuard 100.
 - c. As specified for Coal Tar Epoxy Substitute.
- B. Wax coating:
 - 1. Manufacturers: The following or equal:
 - a. Sanchem, No-Ox-Id A special.

- C. High solids epoxy (self-priming) not less than 72-percent solids by volume with a mixed applied flash point of 140 degrees Fahrenheit or less:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline:
 - 1) Non-submerged: Carboguard 890 VOC.
 - 2) Submerged: Phenoline 341 (100-percent solids, 2-component epoxy).
 - b. Devoe:
 - 1) Bar Rust 233 Low VOC.
 - 2) Devran 133 (100-percent solids, 2-component epoxy).
 - c. S-W:
 - 1) Non-submerged: Macropoxy 646-100.
 - d. PPG Amercoat: Amerlock 2 VOC.
- D. Aliphatic or aliphatic-acrylic polyurethane not less than 80-percent solids with a mixed flash point of 140 degrees Fahrenheit or less:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Carbothane 134MC.
 - b. Devoe, Devthane 379 H.
 - c. S-W, High Solids Polyurethane 100.
 - d. PPG Amercoat: Amershield VOC.
- E. Polymorphic polyester resin coating system: 2-component, modified styrene based thermoset resin, EPA approved for potable water, with 100 percent solids and maximum 10 grams per liter VOC:
 - 1. Manufacturers: One of the following or equal:
 - a. IET: IET Prime Coat DS-101, Intermediate Coat DS-301, and Finish Coat DS 401.
 - b. PPC: PPC Prime Coat, IC-Filler Coat, and FC-Final Coat.
- F. High-temperature coating 150 to 350 degrees Fahrenheit:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Thermaline 4900.
 - b. Dampney, Thermalox 245 Silicone - Zinc Dust.
 - c. PPG Amercoat: Amerlock 2/400 GFK.
- G. High-temperature coating 400 to 1,000 degrees Fahrenheit (Dry):
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Thermaline 4700 VOC.
 - b. Dampney, Thermolox 230C Series Silicone.
 - c. Devoe, HT-12, High Heat Silicone.
- H. High-temperature coating up to 1,400 degrees Fahrenheit:
 - 1. Manufacturers: The following or equal:
 - a. Dampney, Thermalox 240 Silicone Ceramix.
- I. Asphalt varnish: AWWA C 500.
- J. Coal tar: Where coal tar, coal-tar epoxy, or coal-tar mastic are specified or indicated on the Drawings, coal-tar epoxy substitute, as specified, shall be used in their place. Coal tar shall not be allowed.

- K. Coal-tar epoxy substitute:
 - 1. Manufacturers: One of the following or equal:
 - a. Devoe, Devtar 5A HS.
 - b. S-W, Macropoxy 646 Black.
- L. Vinyl ester: Glass mat reinforced, total system 125 mils DFT, manufacturer's recommended topcoat:
 - 1. Manufacturers: One of the following or equal:
 - a. Carboline, Semstone 870.
 - b. Ceilcote, 6640 Ceilcrete.
 - c. Dudick, Protecto-Flex 800.
 - d. Tnemec, Chembloc Series 239SC.
- M. Elastomeric polyurethane 100-percent solids, ASTM D16, Type V, (Urethane P):
 - 1. Manufacturers: The following or equal:
 - a. GET, Endura-Flex EF-1988.
- N. Concrete floor coatings:
 - 1. Manufacturers: One of the following or equal:
 - a. Devoe, Devran 124.
 - b. Dudick, Polymer Alloy 1000.
 - c. Tnemec, Tneme-Glaze Series 282.
- O. Waterborne acrylic emulsion:
 - 1. Manufacturers: One of the following or equal:
 - a. S-W, DTM Acrylic B66W1.
 - b. Tnemec, Tneme-Cryl Series 6.
- P. Galvanizing zinc compound:
 - 1. Manufacturers: The following or equal:
 - a. ZRC, Cold Galvanizing Compound.

2.05 MIXES

- A. Mix in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.01 GENERAL PROTECTION

- A. Protect adjacent surfaces from coatings and damage. Repair damage resulting from inadequate or unsuitable protection.
- B. Protect adjacent surfaces not to be coated from spatter and droppings with drop cloths and other coverings:
 - 1. Mask off surfaces of items not to be coated or remove items from area.
- C. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being coated and, in particular, surfaces within storage and preparation areas.

- D. Place cotton waste, cloths, and material that may constitute a fire hazard in closed metal containers and remove daily from site.
- E. Remove electrical plates, surface hardware, fittings, and fastenings prior to application of coating operations. Carefully store, clean, and replace on completion of coating in each area. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finish.

3.02 GENERAL PREPARATION

- A. Prepare surfaces in accordance with coating manufacturer's instructions, unless more stringent requirements are specified in this Section.
- B. Protect the following surfaces from abrasive blasting by masking or other means:
 - 1. Threaded portions of valve and gate stems, grease fittings, and identification plates.
 - 2. Machined surfaces for sliding contact.
 - 3. Surfaces to be assembled against gaskets.
 - 4. Surfaces of shafting on which sprockets are to fit.
 - 5. Surfaces of shafting on which bearings are to fit.
 - 6. Machined surfaces of bronze trim, including slide gates.
 - 7. Cadmium-plated items except cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment requiring abrasive blasting.
 - 8. Galvanized items, unless scheduled to be coated.
- C. Protect installed equipment, mechanical drives, and adjacent coated equipment from abrasive blasting to prevent damage caused by entering sand or dust.
- D. Concrete:
 - 1. Allow new concrete to cure for minimum of 28 days before coating.
 - 2. Clean concrete surfaces of dust, mortar, fins, loose concrete particles, form release materials, oil, and grease. Fill voids so that surface is smooth. Prepare concrete surface for coating in accordance with SSPC SP 13. Provide ICRI 310.2 CSP-3 surface profile, or as recommended by coating manufacturer. All concrete surfaces shall be vacuumed clean prior to coating application.
- E. Ferrous metal surfaces:
 - 1. Remove grease and oil in accordance with SSPC SP 1.
 - 2. Remove rust, scale, and welding slag and spatter, and prepare surfaces in accordance with appropriate SSPC standard as specified.
 - 3. Abrasive blast surfaces prior to coating.
 - a. When abrasive blasted surfaces rust or discolor before coating, abrasive blast surfaces again to remove rust and discoloration.
 - b. When metal surfaces are exposed because of coating damage, abrasive blast surfaces and feather in to a smooth transition before touching up.
 - c. Ferrous metal surfaces not to be submerged: Abrasive blast in accordance with SSPC SP 10, unless blasting may damage adjacent surfaces, prohibited, or specified otherwise. Where not possible to abrasive blast, power tool clean surfaces in accordance with SSPC SP 3.
 - d. Ferrous metal surfaces to be submerged: Unless specified otherwise, abrasive blast in accordance with SSPC SP 5 to clean and provide roughened surface profile of not less than 2 mils and not more than 4 mils

- in depth when measured with Elcometer 123, or as recommended by the coating manufacturer.
4. All abrasive blast cleaned surfaces shall be blown down with clean dry air and/or vacuumed.
- F. Ductile iron pipe and fittings to be lined or coated: Abrasive blast clean in accordance with NAPF 500-03.
- G. Sherardized, aluminum, copper, and bronze surfaces: Prepare in accordance with coating manufacturer's instructions.
- H. Galvanized surface:
1. Degrease or solvent clean (SSPC SP 1) to remove oily residue.
 2. Power tool or hand tool clean or whip abrasive blast.
 3. Test surface for contaminants using copper sulfate solution.
 4. Apply metal pretreatment within 24 hours before coating galvanized surfaces that cannot be thoroughly abraded physically, such as bolts, nuts, or preformed channels.
- I. Shop-primed metal:
1. Certify that primers applied to metal surfaces in the shop are compatible with coatings to be applied over such primers in the field.
 2. Remove shop primer from metal to be submerged by abrasive blasting in accordance with SSPC SP 10, unless greater degree of surface preparation is required by coating manufacturer's representative.
 3. Correct abraded, scratched, or otherwise damaged areas of prime coat by sanding or abrasive blasting to bare metal in accordance with SSPC SP 2, SP 3, or SP 6, as directed by the Engineer. When entire shop priming fails or has weathered excessively (more than 25 percent of the item), or when recommended by coating manufacturer's representative, abrasive blast shop prime coat to remove entire coat and prepare surface in accordance with SSPC SP 10.
 4. When incorrect prime coat is applied, remove incorrect prime coat by abrasive blasting in accordance with SSPC SP 10.
 5. When prime coat not authorized by Engineer is applied, remove unauthorized prime coat by abrasive blasting in accordance with SSPC SP 10.
 6. Shop applied bituminous paint or asphalt varnish: Abrasive blast clean shop applied bituminous paint or asphalt varnish from surfaces scheduled to receive non-bituminous coatings.
- J. Cadmium-plated, zinc-plated, or sherardized fasteners:
1. Abrasive blast in the same manner as unprotected metal when used in assembly of equipment designated for abrasive blasting.
- K. Abrasive blast components that are to be attached to surfaces that cannot be abrasive blasted before components are attached.
- L. Grind sharp edges to approximately 1/16-inch radius before abrasive blast cleaning.
- M. Remove and grind smooth all excessive weld material and weld spatter before blast cleaning in accordance with NACE SP0178.

- N. Polyvinyl chloride (PVC) and FRP surfaces:
 - 1. Prepare surfaces to be coated by light sanding (de-gloss) and wipe-down with clean cloths, or by solvent cleaning in strict accordance with coating manufacturer's instructions.
- O. Cleaning of previously coated surfaces:
 - 1. Utilize cleaning agent to remove soluble salts such as chlorides and sulfates from concrete and metal surfaces:
 - a. Cleaning agent: Biodegradable non-flammable and containing no VOC.
 - b. Manufacturer: The following or equal:
 - 1) CHLOR*RID International, Inc.
 - 2. Steam clean and degrease surfaces to be coated to remove oils and grease.
 - 3. Cleaning of surfaces utilizing the decontamination cleaning agent may be accomplished in conjunction with abrasive blast cleaning, steam cleaning, high-pressure washing, or hand washing as approved by the coating manufacturer's representative and the Engineer.
 - 4. Test cleaned surfaces in accordance with the cleaning agent manufacturer's instructions to ensure all soluble salts have been removed. Additional cleaning shall be carried out as necessary.
 - 5. Final surface preparation prior to application of new coating system shall be made in strict accordance with coating manufacturer's printed instructions.

3.03 MECHANICAL AND ELECTRICAL EQUIPMENT PREPARATION

- A. Identify equipment, ducting, piping, and conduit as specified in Section 15075 - Equipment Identification and Section 16075 - Identification for Electrical Systems.
- B. Remove grilles, covers, and access panels for mechanical and electrical system from location and coat separately.
- C. Prepare and finish coat primed equipment with color selected by the Engineer.
- D. Prepare and prime and coat insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are covered with prefinished coating.
- E. Replace identification markings on mechanical or electrical equipment when coated over or spattered.
- F. Prepare and coat interior surfaces of air ducts, and convactor and baseboard heating cabinets that are visible through grilles and louvers with 1 coat of flat black paint, to limit of sight line.
- G. Prepare and coat dampers exposed immediately behind louvers, grilles, and convactor and baseboard heating cabinets to match face panels.
- H. Prepare and coat exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.

- I. Prepare and coat both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.
- J. Color code equipment, piping, conduit, and exposed ductwork and apply color banding and identification, such as flow arrows, naming, and numbering, in accordance with the Contract Documents.

3.04 GENERAL APPLICATION REQUIREMENTS

- A. Apply coatings in accordance with manufacturer's instructions.
- B. Coat metal unless specified otherwise:
 - 1. Aboveground piping to be coated shall be empty of contents during application of coatings.
- C. Verify metal surface preparation immediately before applying coating in accordance with SSPC SP COM.
- D. Allow surfaces to dry, except where coating manufacturer requires surface wetting before coating.
- E. Wash coat and prime sherardized, aluminum, copper, and bronze surfaces, or prime with manufacturer's recommended special primer.
- F. Prime shop-primed metal surfaces. Spot prime exposed metal of shop-primed surfaces before applying primer over entire surface.
- G. Multiple coats:
 - 1. Apply minimum number of specified coats.
 - 2. Apply additional coats when necessary to achieve specified thicknesses.
 - 3. Apply coats to thicknesses specified, especially at edges and corners.
 - 4. When multiple coats of same material are specified, tint prime coat and intermediate coats with suitable pigment to distinguish each coat.
 - 5. Lightly sand and dust surfaces to receive high-gloss finishes, unless instructed otherwise by coating manufacturer.
 - 6. Dust coatings between coats.
- H. Coat surfaces without drops, overspray, dry spray, runs, ridges, waves, holidays, laps, or brush marks.
- I. Remove spatter and droppings after completion of coating.
- J. Apply coating by brush, roller, trowel, or spray, unless particular method of application is required by coating manufacturer's instructions or these Specifications.
- K. Plural component application: Drums shall be premixed each day. All gauges shall be in working order prior to the start of application. Ratio checks shall be completed prior to each application. A spray sample shall be sprayed on plastic sheeting to ensure set time is complete prior to each application. Hardness testing shall be performed after each application.

- L. Spray application:
 - 1. Stripe coat edges, welds, nuts, bolts, and difficult-to-reach areas by brush before beginning spray application, as necessary, to ensure specified coating thickness along edges.
 - 2. When using spray application, apply coating to thickness not greater than that recommended in coating manufacturer's instructions for spray application.
 - 3. Use airless spray method, unless air spray method is required by coating manufacturer's instruction or these Specifications.
 - 4. Conduct spray coating under controlled conditions. Protect adjacent construction and property from coating mist, fumes, or overspray.
- M. Drying and recoating:
 - 1. Provide fans, heating devices, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.
 - 2. Limit drying time to that required by these Specifications or coating manufacturer's instructions.
 - 3. Do not allow excessive drying time or exposure, which may impair bond between coats.
 - 4. Recoat epoxies within time limits recommended by coating manufacturer.
 - 5. When time limits are exceeded, abrasive blast clean and de-gloss clean prior to applying another coat.
 - 6. When limitation on time between abrasive blasting and coating cannot be met before attachment of components to surfaces that cannot be abrasive blasted, coat components before attachment.
 - 7. Ensure primer and intermediate coats of coating are unscarred and completely integral at time of application of each succeeding coat.
 - 8. Touch-up suction spots between coats and apply additional coats where required to produce finished surface of solid, even color, free of defects.
 - 9. Leave no holidays.
 - 10. Sand and feather in to a smooth transition and recoat scratched, contaminated, or otherwise damaged coating surfaces so damages are invisible to the naked eye.
- N. Concrete:
 - 1. Apply first coat (primer) only when surface temperature of concrete is decreasing in order to eliminate effects of off-gassing on coating.

3.05 ALKALI-RESISTANT BITUMASTIC

- A. Preparation:
 - 1. Prepare surfaces in accordance with general preparation requirements.
- B. Application:
 - 1. Apply in accordance with general application requirements and as follows:
 - a. Apply at least 2 coats, 8 to 14 mils DFT each.

3.06 WAX COATING

- A. Preparation:
 - 1. Prepare surfaces in accordance with general preparation requirements.

- B. Application:
 - 1. Apply in accordance with general application requirements and as follows:
 - a. Apply at least 1/32-inch thick coat with 2-inch or shorter bristle brush.
 - b. Thoroughly rub coating into metal surface with canvas covered wood block or canvas glove.

3.07 HIGH SOLIDS EPOXY SYSTEM

- A. Preparation:
 - 1. Prepare surfaces in accordance with general preparation requirements and as follows:
 - a. Abrasive blast ferrous metal surfaces to be submerged at jobsite in accordance with SSPC SP 5 prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP 10.
 - b. Abrasive blast non-submerged ferrous metal surfaces at jobsite in accordance with SSPC SP 10, prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP 6.
 - c. Abrasive blast clean ductile iron surfaces at jobsite in accordance with SSPC SP 7.
- B. Application:
 - 1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply minimum 2-coat system with minimum total DFT of 12 mils.
 - b. Recoat or apply succeeding epoxy coats within time limits recommended by manufacturer. Prepare surfaces for recoating in accordance with manufacturer's instructions.
 - c. Coat metal to be submerged before installation when necessary, to obtain acceptable finish, and to prevent damage to other surfaces.
 - d. Coat entire surface of support brackets, stem guides, pipe clips, fasteners, and other metal devices bolted to concrete.
 - e. Coat surface of items to be exposed and adjacent 1 inch to be concealed when embedded in concrete or masonry.

3.08 HIGH SOLIDS EPOXY AND POLYURETHANE COATING SYSTEM

- A. Preparation:
 - 1. Prepare surfaces in accordance with general preparation requirements and as follows:
 - a. Prepare concrete surfaces in accordance with general preparation requirements.
 - b. Touch up shop-primed steel and miscellaneous iron.
 - c. Abrasive blast ferrous metal surfaces at jobsite prior to coating. Abrasive blast clean rust and discoloration from surfaces.
 - d. Degrease or solvent clean, whip abrasive blast, power tool, or hand tool clean galvanized metal surfaces.
 - e. Lightly sand (de-gloss) fiberglass and PVC pipe to be coated and wipe clean with dry cloths, or solvent clean in accordance with coating manufacturer's instructions.
 - f. Abrasive blast clean ductile iron surfaces.

- B. Application:
1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply a 3-coat system consisting of:
 - 1) Primer: 4 to 5 mils DFT high solids epoxy.
 - 2) Intermediate coat: 4 to 5 mils DFT high solids epoxy.
 - 3) Topcoat: 2.5 to 3.5 mils DFT aliphatic or aliphatic-acrylic polyurethane topcoat.
 2. Recoat or apply succeeding epoxy coats within 30 days or within time limits recommended by manufacturer, whichever is shorter. Prepare surfaces for recoating in accordance with manufacturer's instructions.

3.09 POLYMORPHIC POLYESTER RESIN SYSTEM

- A. Preparation:
1. Prepare surfaces in accordance with general preparation requirements and as follows.
 2. Prepare concrete to obtain clean, open pore with exposed aggregate in accordance with manufacturer's instructions.
 3. Prepare ferrous metal surfaces in accordance with SSPC SP 5, with coating manufacturer's recommended anchor pattern.
 4. Complete abrasive blast cleaning within 6 hours of applying prime coat. Dew point shall remain 5 degrees above dew point 8 hours after application of coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP 5.
 5. When handling steel, wear gloves to prevent hand printing.
 6. Adjust pH of concrete to within 5.5 to 8.0 before applying prime coat.
- B. Application:
1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply minimum DFT system consisting of primer, tie coat and top coat in accordance with manufacturer's instructions as follows:
 - 1) Steel: 35 mils.
 - 2) Concrete: 45 mils.

3.10 HIGH-TEMPERATURE COATING

- A. Preparation:
1. Prepare surfaces in accordance with general preparation requirements and as follows:
 - a. Abrasive blast surface in accordance with SSPC SP 10.
- B. Application:
1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply number of coats in accordance with manufacturer's instructions.

3.11 ASPHALT VARNISH

- A. Preparation:
1. Prepare surfaces in accordance with general preparation requirements.

- B. Application:
 - 1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply minimum 2 coats.

3.12 PROTECTIVE COAL TAR

- A. Preparation:
 - 1. Prepare surfaces in accordance with general preparation of coal-tar requirements.
- B. Application:
 - 1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply minimum 20 mils DFT coating.

3.13 COAL-TAR EPOXY

- A. Preparation:
 - 1. Prepare surfaces in accordance with general preparation requirements and as follows:
 - a. Abrasive blast iron or steel surfaces to be coated as submerged metal in accordance with SSPC SP 5. Prepare other metal surfaces to be coated with coal-tar epoxy in accordance with epoxy manufacturer's instructions.
- B. Application:
 - 1. Apply coatings in accordance with general application requirements and as follows:
 - a. Waterproofing outside surfaces of concrete structures: Apply minimum 2 coats with total DFT of 40 mils.
 - b. Apply 2 coats of 8 mils each for a total 16 mils DFT.
 - c. Apply coal-tar epoxy on blasted steel on same day that steel is blasted.
 - d. Apply succeeding coats over previous coat as soon as application does not cause sagging, within the following times, or as recommended by the coating manufacturer, whichever is sooner.

Average Temperature Degrees (Fahrenheit)	Maximum Time Between Coats (Hours)
50 to 60	36
60 to 70	24
70 to 80	12
80 to 120	4

- e. Apply additional coats required to obtain specified thickness.
- f. When previous coat has cured or set, or Maximum Time Between Coats has lapsed, abrasive blast previous coat until surface film is removed. Wash and clean surface with cleaning solvent. Apply succeeding coat within Maximum Time Between Coats or as recommended by coating manufacturer, whichever is sooner.
- g. When succeeding coat is applied over previous coat that has cured or set, or Maximum Time Between Coats has lapsed, and surface has not been

abrasive blasted, remove entire coating system to substrate, and apply new coating system.

- h. Where coating system is applied to exterior concrete surfaces below grade, extend system at least 3 inches above finish grade in straight level. Step extended system down 3 inches when extended system reaches 6 inches above finish grade.

3.14 COAL-TAR EPOXY SUBSTITUTE

A. Preparation:

- 1. Prepare surfaces in accordance with general preparation requirements and in accordance with the coating manufacturer's printed instructions.

B. Application:

- 1. Apply 2 coats at 6 mils to 8 mils each, for a minimum total DFT of 12 mils.

3.15 VINYL ESTER

A. Preparation:

- 1. Prepare surfaces in accordance with coating manufacturer's recommendations and as directed and approved by coating manufacturer's representative.

B. Application:

- 1. Apply prime coat, as required by coating manufacturer, base coat, glass mat, and topcoat to total dry film thickness of 125 mils minimum:
 - a. Final topcoat on floors shall include non-skid surface, applied in accordance with manufacturer's instructions.
- 2. Perform high-voltage holiday detection test in accordance with NACE SP0188, over 100 percent of coated surface areas to ensure pinhole-free finished coating system.
- 3. All work shall be accomplished in strict accordance with coating manufacturer's instructions and under direction of coating manufacturer's representative.

3.16 ELASTOMERIC POLYURETHANE (100 PERCENT SOLIDS)

A. Preparation:

- 1. Prepare surfaces in strict accordance with coating manufacturer's instructions and as directed and approved by coating manufacturer's representative.

B. Application:

- 1. Apply epoxy primer at DFT of 1 to 2 mils, in strict accordance with manufacturer's instructions.
- 2. Apply polyurethane coating at minimum total DFT as follows:
 - a. Steel: 60 mils DFT.
 - b. Ductile iron and ductile iron pipe coating and lining: 30 mils DFT.
 - c. Concrete: 120 mils DFT.
 - d. Or as recommended by the coating manufacturer and accepted by the Engineer.

3. For concrete application, provide saw cutting for coating terminations in strict accordance with manufacturer's instructions.
4. Perform high voltage holiday detection test in accordance with NACE SP0188, over 100 percent of coated surface areas to ensure pinhole free finished coating system.

3.17 CONCRETE FLOOR COATINGS

- A. Preparation:
 1. Prepare surfaces in accordance with general application requirements and in strict accordance with coating manufacturer's instructions.
- B. Application:
 1. Apply primer if required by coating manufacturer.
 2. Apply 1 or more coats as recommended by coating manufacturer to receive a minimum total DFT of 25 mils; color as selected by the Owner.
- C. Final topcoat shall include non-skid surface, applied in strict accordance with coating manufacturer's instructions.

3.18 WATERBORNE ACRYLIC EMULSION

- A. Preparation:
 1. Remove all oil, grease, dirt, and other foreign material by solvent cleaning in accordance with SSPC SP 1.
 2. Lightly sand all surfaces and wipe thoroughly with clean cotton cloths before applying coating.
- B. Application:
 1. Apply 2 or more coats to obtain a minimum DFT of 5.0 mils.

3.19 FIELD QUALITY CONTROL

- A. Each coat will be inspected. Strip and remove defective coats, prepare surfaces, and recoat. When approved, apply next coat.
- B. Control and check DFT and integrity of coatings.
- C. Measure DFT with calibrated thickness gauge.
- D. DFT on ferrous-based substrates may be checked with Elcometer Type 1 Magnetic Pull-Off Gauge or PosiTector® 6000.
- E. Verify coat integrity with low-voltage sponge or high-voltage spark holiday detector, in accordance with NACE SP0188. Allow Engineer to use detector for additional checking.
- F. Check wet film thickness before coal-tar epoxy coating cures on concrete or nonferrous metal substrates.
- G. Arrange for services of coating manufacturer's field representative to provide periodic field consultation and inspection services to ensure proper surface

preparation of facilities and items to be coated, and to ensure proper application and curing:

1. Notify Engineer 24 hours in advance of each visit by coating manufacturer's representative.
2. Provide Engineer with a written report by coating manufacturer's representative within 48 hours following each visit.

3.20 SCHEDULE OF ITEMS NOT REQUIRING COATING

- A. General: Unless specified otherwise, the following items do not require coating:
1. Items that have received final coat at factory and are not listed to receive coating in field.
 2. Aluminum, brass, bronze, copper, plastic (except PVC pipe), rubber, stainless steel, chrome, Everdur, or lead.
 3. Buried or encased piping or conduit.
 4. Exterior concrete.
 5. Galvanized steel wall framing, galvanized electrical conduits, galvanized pipe trays, galvanized cable trays, and other galvanized items:
 - a. Areas on galvanized items or parts where galvanizing has been damaged during handling or construction shall be repaired as follows:
 - 1) Clean damaged areas by SSPC SP 1, SP 2, SP 3, or SP 7 as required.
 - 2) Apply 2 coats of a galvanizing zinc compound in strict accordance with manufacturer's instructions.
 6. Grease fittings.
 7. Fiberglass ducting or tanks in concealed locations.
 8. Steel to be encased in concrete or masonry.

3.21 SCHEDULE OF SURFACES TO BE COATED IN THE FIELD

- A. In general, apply coatings to steel, iron, galvanized surfaces, and wood surfaces unless specified or otherwise indicated on the Drawings. Coat concrete surfaces and anodized aluminum only when specified or indicated on the Drawings. Color coat all piping as specified in Section 15075.
- B. The following schedule is incomplete. Coat unlisted surfaces with same coating system as similar listed surfaces. Verify questionable surfaces.
- C. Concrete:
1. High solids epoxy:
 - a. Safety markings.
 2. Concrete floor coating:
 - a. The coating system for the polymer storage secondary containment shall be as follows:
 - 1) Surface Preparation:
 - a) All new concrete shall be cured for a minimum of 28 days prior to performing any surface preparation.
 - b) Remove all grease, oil, dirt, duct, mold, mildew, and other soluble contaminant by High Pressure Water Cleaning (min. 3,500 psi, 3 to 5 gallons per minute).
 - c) Abrasive blast all concrete vertical walls to remove all laitance, curing compounds, and hardeners to provide a surface profile

- equivalent to a minimum ICRI CSP 5(SSPC-SP13). The floor must meet a surface profile of a minimum ICRI CSP 3 (SSPC-SP13).
- d) Apply Tnemec Series 218 MortarClad (or equal) to all vertical surfaces @ 1/16 inch to fill all bugholes, voids, and build a monolithic surface to be coated.
 - e) Follow any floor cracks with a grinding disc (1/4 inch wide), grind a 1/2 inch deep groove. Make sure the groove is cleaned out, apply Tnemec Series 215 Surfacing Epoxy (or equal) with a putty knife or trowel, filling the groove and feathering out to nothing onto the surfaces on both sides of the groove.
 - f) All surfaces must be clean and dry prior to the application of any coatings.
- 2) Coating System for Bare Concrete:
- a) Prime: Apply (1) coat of:
 - (1) Tnemec Series 201 Epoxoprime @ a rate of 6.0 – 10.0 mils DFT.
 - (2) Or equal.
 - b) Base Coat: Apply (1) coat of:
 - (1) Tnemec Series 237SC-RCK @ a rate of 8.0 – 12.0 mils DFT.
 - (2) Or equal.
 - c) Fiberglass Mat: Immediately imbed:
 - (1) Tnemec Series 211-0215 SC Mat into Base Coat.
 - (2) Or equal.
 - d) Saturant Coat: Apply (1) coat of:
 - (1) Tnemec Series 237SC-RCK @ a rate of 8.0 – 12.0 mils DFT.
 - (2) Or equal.
 - e) Top Coat: Apply (1) coat of:
 - (1) Tnemec Series 280 Tneme-Glaze @ a rate of 6.0 – 10.0 mils DFT.
 - (2) Or equal.
- 3) The High Performance Coating System must exceed a minimum 65.0 mils DFT

D. Metals:

- 1. Alkali-resistant bitumastic:
 - a. Aluminum surfaces to be placed in contact with wood, concrete, or masonry.
- 2. High solids epoxy and polyurethane system: Interior and exterior non immersed ferrous metal surfaces including:
 - a. Doors, doorframes, ventilators, louvers, grilles, exposed sheet metal, and flashing.
 - b. Pipe, valves, pipe hangers, supports and saddles, conduit, cable tray hangers, and supports.
 - c. Motors and motor accessory equipment.
 - d. Drive gear, drive housing, coupling housings, and miscellaneous gear drive equipment.
 - e. Valve and gate operators and stands.
 - f. Structural steel including galvanized structural steel.
 - g. Crane and hoist rails.

- h. Exterior of tanks and other containment vessels.
- i. Mechanical equipment supports, drive units, and accessories.
- j. Pumps not submerged.
- k. Degritters, grit classifiers, frames, supports, and associated equipment.
- l. Other miscellaneous metals.
- m. Grit separation and washer, frames, supports, and associated equipment.
- 3. High solids epoxy system:
 - a. Field priming of ferrous metal surfaces with defective shop-prime coat where no other prime coat is specified; for non-submerged service.
 - b. Bell rings, underside of manhole covers and frames.
 - c. Sump pumps and grit pumps, including underside of base plates and submerged suction and discharge piping.
 - d. Chlorine diffuser supports.
 - e. Exterior of submerged piping and valves other than stainless steel or PVC piping.
 - f. Submerged pipe supports and hangers.
 - g. Stem guides.
 - h. Vertical shaft mixers and aerators below supports.
 - i. Other submerged iron and steel metal unless specified otherwise.
 - j. Interior surface of suction inlet and volute of submersible influent pumps. Apply coating prior to pump testing.
 - k. Submerged piping.
 - l. Exterior of influent pumps and influent pump submerged discharge piping.
- 4. Asphalt varnish:
 - a. Underground valve boxes.
- 5. Protective coal tar:
 - a. Underground pipe flanges, excluding pipe, corrugated metal pipe couplings, flexible pipe couplings and miscellaneous underground metals not otherwise specified to receive another protective coating.
- E. Fiberglass and PVC pipe surfaces:
 - 1. Waterborne acrylic emulsion:
 - a. Exterior of fiberglass ducting and fan housings.
 - b. Fiberglass expose to sunlight.
 - c. PVC piping exposed to view.
 - d. ABS piping as determined by Design Engineer.

END OF SECTION