

THE CITY OF DAYTONA BEACH
WESTSIDE REGIONAL WRF BIOSOLIDS DEWATERING SYSTEM
IMPROVEMENTS

INVITATION TO BID No. 20403
PROJECT SPECIFIC CONSTRUCTION SERVICES
NIGP COMMODITY CODES

91063
91200
91300
91356
91359
91391
91931



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

ISSUE DATE: March 30, 2020

ITB-Project Specific Construction 2/17/2020

INV-1
ITB 20403

LEGAL ADVERTISEMENT
INVITATION TO BID

The City of Daytona Beach, Florida will receive sealed bids until 2:00 PM, April 31, 2020 at Daytona Beach City Hall, Office of the Purchasing Agent, 301 S Ridgewood Ave, Room 146, Daytona Beach, FL 32114 for:

ITB 20403 - WESTSIDE REGIONAL WRF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS

Bidders may obtain copies of the Invitation to Bid at www.codb.us/841/Purchasing by clicking the "Public Solicitations" link.

A Non-Mandatory Pre-Bid Conference will be conducted via teleconference, on **April 9, 2020 at 10:00 AM**. Interested Contractors please call **386-671-3178** no earlier than 9:45 AM. Please pre-register for this meeting online at www.codb.us/841/Purchasing. Click "Public Solicitations" link then select this solicitation.

JOANNE FLICK, CPPO, CPPB – PURCHASING AGENT
CITY OF DAYTONA BEACH
Issue date: March 30, 2020

INVITATION TO BID – PROJECT SPECIFIC CONSTRUCTION SERVICES

The City of Daytona Beach will receive bids for “**WESTSIDE REGIONAL WRF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS**”, Invitation to Bid No. 20403, 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 April 31, 2020**, 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 WESTSIDE REGIONAL WRF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS , ITB No. 20403” plainly written on the outside of the envelope.

The work generally consists of includes furnishing all labor, equipment, materials, and construction services to complete the project work as noted in the Project Documents. The primary work includes installation of two 3-belt filter presses; two washwater pumps; two skid-mounted emulsion polymer blending units; one horizontal and one inclined shaftless screw conveyor; one shaftless screw truck unloading conveyor; all supporting concrete, structural walkways, supports, pipe, valves, pipe supports, and appurtenances; and all electrical and instrumentation controls at the Westside Regional Water Reclamation Facility.

Bid Documents may be obtained as pdf files on-line at <http://purchasing.codb.us>. There is no charge for downloading Bid Documents. The Bid Documents and all other Contract Documents, including Drawings and Technical Specifications if applicable, are also on file at the Daytona Beach Purchasing Division, 301 S. Ridgewood Avenue, Room 146, Daytona Beach, Florida, 32114. A complete set of these Documents may be obtained upon payment of \$75, NON-REFUNDABLE. Checks must be made payable to the City of Daytona Beach, Florida. All inquiries and checks pertaining to this project which are mailed should be directed to Post Office Box 2451, Daytona Beach, Florida 32115-2451.

Each bid must be accompanied by **Bid Security** in an amount not less than **10%** of the total bid.

BIDDERS SHALL NOTE RECENT REVISIONS THAT REQUEST SUBMISSION OF “GOOD FAITH EFFORT” DOCUMENTATION EVIDENCING THE BIDDER’S ATTEMPTS TO ACHIEVE THE CITY’S MBE/WBE CONTRACT PARTICIPATION AND EMPLOYMENT GOALS.

A Non-Mandatory Pre-Bid Conference will be conducted via **teleconference**, on **April 9, 2020 at 10:00 AM**. Interested Contractors please call **386-671-3178** no earlier than 9:45 AM. Please pre-register for this meeting online at www.codb.us/841/Purchasing. Click “Public Solicitations” link then select this solicitation.

The successful contractor will be required to furnish separate 100% Performance and Payment Bonds unless the Contract price is less than \$100,000.

The City reserves the right to reject any and all bids, or any portion of any bid, or to waive any informalities in the bidding.

Bids may be held by the City 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.

By: JOANNE FLICK, CPPO, PURCHASING AGENT
CITY OF DAYTONA BEACH
Issue Date: March 30, 2020

INSTRUCTIONS TO BIDDERS – PROJECT SPECIFIC CONSTRUCTION SERVICES

THESE INSTRUCTIONS ARE STANDARD FOR ALL BID SOLICITATIONS FOR PROJECT SPECIFIC CONSTRUCTION SERVICES 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 Bid Proposal Letter, the Bid Schedule and all other Forms to be completed, signed, and submitted by the Bidder; and all additional documents required to be completed and submitted by the Bidder as part of the Bid.

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 order for the Bid to be considered complete:

A. The Bid Proposal Letter, the Bid Schedule, and all other required Forms must be completed. All blank spaces must be completed.

B. All information/documentation that is required to be submitted by this solicitation must be provided in the manner indicated.

C. The Bidder is requested to submit only the Bid Proposal Letter and other Forms, documents, and information specifically required. Any extraneous documents or information submitted by the Bidder will be discarded. The Bidder be asked to sign a written contract only if the City awards a contract to Bidder.

D. Where the Bid Schedule only calls for unit prices the Bidder must provide quotes for all unit prices and extended unit prices set forth in the Bid Schedule unless Special Instructions are included in this solicitation specifically allowing for partial or lot-by-lot bids. 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 Schedule.

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

F. 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 standard and the alternative bid in order to be considered responsive.

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

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

3. SIGNING THE BID. The Bid Proposal Letter, the Bid Schedule and all other Forms and documents requiring Bidder's signature must contain the signature of an individual authorized to bind the Bidder. The signature must be located in the space(s) marked for the Bidder's signature. In addition, the person signing the Bid must also sign all of the other Forms to be submitted.

Electronic signatures will be accepted.

4. REQUESTS FOR INTERPRETATIONS. If the Bidder is in doubt as to the meaning of any of the Bid Documents or other Contract Documents included in this solicitation, the Bidder may submit a written

request to the City for an interpretation, care of the Purchasing Agent at PO Box 2451, Daytona Beach, FL 32115-2451 or on-line through the Bid Platform. Such requests must be received **10 days** prior to bid opening in order to be considered. The City is not obligated to respond to such requests. Any clarification or interpretation issued by the City in the form of a written addendum or on-line response will be deemed to be a part of the Bid Documents.

No oral clarification or interpretation will be binding.

Questions may also be submitted online through the City's Bid Platform. Prospective bidders may ask questions which will be forwarded to the project manager. Any responses will be posted in the form of an addendum or replied to the public through the online Bid Platform. The bidder is responsible to view the online responses at the web site listed above before submitting their bid.

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 an on-line response to an on-line question, or issue an addenda for additions or alterations to these Instructions, the Bid Documents, and to any or any Drawings, Specifications, or other Contract Documents previously supplied by the City. In addition, the City may by addenda or on-line response extend the date scheduled for Bid Opening.

The Purchasing Agent will make reasonable efforts to notify all potential bidders of the issuance of an on-line response or Addendum. The Purchasing Agent will post Addenda on the Purchasing Division's web page, www.codb.us/841/purchasing.

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

6. BID SECURITY. The Bidder must submit Bid Security equal to 10% of the Bid. The Bid Security will be in the form of a bid bond; or any of the following alternate forms: cashier's check, certified check, money order, notes at par value, U.S. Currency, or U.S. Government Bond. Any Bid Security provided must be in original form; copies are unacceptable. The City has the right to retain the Bid Security as liquidated damages should the Successful Bidder fail to comply with the terms of the bid. The City will return the Bid Security to unsuccessful Bidders after the contract award.

Any bid bond provided must be in a form approved or provided by the City, and must be accompanied by sufficient evidence of the issuing agent's authority. The surety company executing the bond must be authorized to do business in the State of Florida. If the bid bond is in an amount greater than \$5,000.00 the surety company executing the bond is listed by the United States Treasury Department as being approved for writing bonds for federal projects on its current list in an amount not less than the required bond amount.

Bidders shall submit a copy of the Bid Security with the electronic submittal. Bid security must be provided in original form as a hard copy to the Purchasing Division at 301 South Ridgewood, Room 146, Daytona Beach, FL 32114 within 5 business days after the Bid Opening Date.

7. ON-LINE BIDS. The City will only accept on-line Bids for this solicitation through its Bid Platform. The City's only authorized Bid Platform is Vendor Registry, accessible through the City's website www.codb.us/841/Purchasing under the link to "Public Solicitation", then by selecting the proper bid and clicking "Submit Bid". No other forms of on-line bids will be accepted. Any reference in this document to "sealed bids" is hereby replaced with "sealed on-line Bids".

8. SUBMISSION OF BID. The Bidder must submit the Bid on-line at or prior to the time fixed for bid opening in the Invitation for Bids. A Bid submitted after the time fixed for bid opening will not be accepted. Telephonic 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

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.

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 bid proposals 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.

10. BID OPENING. Bid opening will be scheduled at the date and time specified by the Invitation for Bid, or by any applicable Bid Addenda or response 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 bid tabulation will be reviewed and verified by the Buyer after opening by the Purchasing Agent, or her designee.

The Bidder is solely responsible to ensure that the Bid is submitted on-line prior to bid opening date and time. Late bids will be rejected.

11. BID AS OFFER; FIRM PRICING; NO GUARANTEES AS TO QUANTITIES ORDERED. 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, the Successful Bidder, and the surety for the Successful Bidder.

In addition, if this solicitation requests submission of unit prices: (i) all unit prices will be deemed to be held firm for the duration of the Contract, including any extension thereof, unless specifically authorized by the Contract Documents; and (ii) 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. 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.

13. BID PRICE INCLUSIVE OF COSTS. The Bid Price is inclusive of all of the Bidder's direct and indirect costs of performing the Work.

14. BIDS AND PUBLIC RECORDS. Sealed bids received by the City pursuant to this solicitation will be temporarily exempt from disclosure in accordance with Florida's Public Records Laws. Thereafter, bids will be open for 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 in a certified letter addressed to the Purchasing Agent and received at least 3 days prior to the Bid Opening. 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 withdraw the sealed bid.

16. BID OPENING RESULTS. The Bidder may secure information pertaining to bid opening results on the Purchasing Division webpage under the “Expired Solicitations” link by selecting “Documents” to view the Bid tabulation, by visiting the Purchasing Division Office Monday through Friday between 8:00 am and 3:00 pm, 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 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 of the Daytona Beach Code of Ordinances. Any contract awarded pursuant to this solicitation will be made on the basis of the criteria for award of bids provided in the Purchasing Code.

A link to the Code of Ordinances is available on the City's web site, www.codb.us.

19. RESERVED

20. 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 in compliance with the drug free workplace certification requirements set forth in Florida Statutes 287.087; or b) the most responsible bidder as defined under the City Code 30-82 (9)(c).

21. RIGHT TO ACCEPT OR REJECT BIDS. The City will reject bids which contain modifications, qualifications, or exceptions, 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.

22. CRA MAY AWARD PURCHASE ORDERS ISSUED PURSUANT TO CONTRACT. In the case of a continuing/term supply or service 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 Community Redevelopment Agency (CRA) is authorized to issue the purchase order corresponding to the supply or service instead of the City.

23. CITY'S PROJECT-SPECIFIC CONSTRUCTION CONTRACT FORM. The City's contract form for project specific construction projects, which is included in this solicitation, contains additional terms and conditions, including indemnification and insurance requirements, completion deadlines, and liquidated damages, that the Bidder should review prior to submitting the Bid. The City reserves the right to make minor changes to the form contract prior to execution by the successful bidder to correct errors, make other minor formatting changes, or for legal sufficiency. The City will provide the successful bidder the final contract for execution.

24. LICENSES. 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. Required licensure must be maintained in full force and effect during the contract term.

25. 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.

26. POST-AWARD SUBMITTAL REQUIREMENTS. Within 15 business days after the City's issuance of a notice of award, the Successful Bidder must submit each of the following:

- A. A fully-executed contract, using the form provided with or referenced by the notice of intent to award.
- B. Proof of insurance, in accordance with the requirements of the Contract. See the Contract form for more information regarding insurance requirements.
- C. Performance Security, as further described below, in an amount equal to 100% of the Contract Price.

The award is subject to cancellation and the Bid Security subject to forfeiture if this deadline is not met.

27. PERFORMANCE SECURITY. Performance Security is required unless Contract Price is less than \$100,000.00. Payment and performance bonds may be submitted; or an alternative form of security as specified in Florida Statutes § 255.05(7) may be provided upon the City's prior written approval.

If the Successful Bidder elects to use payment and performance bonds for required Performance Security, the Successful Bidder will use forms provided by the City. Copies of the City's current form bonds will be provided with the Notice of Award. Completed bonds must be originals, not copies, with raised corporate seals included where applicable. The bonds must be accompanied by sufficient evidence of the authority of the issuing agent, including a certified copy of the power of attorney of the person signing the bond on the surety's behalf. The surety company executing the bonds must be must be rated "A" or better by A.M. Best Key Rating Guide, authorized to do business in the State of Florida, and must be listed by the United States Treasury Department Treasury Fiscal Service, Bureau of Government Financial Operations, Federal Register, Part V, latest revision, entitled: "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies," as being approved for writing bonds for federal projects on its current list in an amount not less than the required bond amount.

END OF INSTRUCTIONS TO BIDDERS SECTION

SPECIAL INSTRUCTIONS

SI 1. MINIMUM CONSTRUCTION EXPERIENCE QUALIFICATIONS. The Bid requires that the BIDDER has sufficient experience in similar construction projects. This Special Instruction sets forth certain Minimum Construction Experience Qualifications ("Minimum Qualifications") that must be met by the BIDDER, and describes the reference information that the BIDDER must submit as part of the Bid to allow the City to confirm that these Minimum Qualifications are met. The imposition of the Minimum Qualifications stated herein will not be deemed to restrict the City's ability to determine whether the BIDDER is "responsible" as that term is referenced in Section 30-82(8) of Chapter 30 of the City of Daytona Beach Code of Ordinances.

1. **Definition:** "Task" means Dewatering Improvements

2. **Who Must Meet the Minimum Qualifications?** The BIDDER must meet a Minimum Qualification associated with a Task listed below, if the BIDDER proposes to perform 50% or more of the Task through the BIDDERS' own forces for the Project. A Significant Task Subcontractor must meet a Minimum Qualification associated with a Task listed below, if the BIDDER proposes to have the Subcontractor perform 50% of the Task in the course of the Project.

3. **What are the Minimum Qualifications?**

Dewatering Improvements: The BIDDER shall be a licensed contractor and shall have completed a minimum of two (2) projects similar in character and scope to this project with a minimum value of \$3M each. At least one (1) of the projects or the BIDDER's portion of the project completed must have included new belt filter press installation. Contractor shall provide two (2) project examples with references that were successfully and substantially completed within 10 years of the due date of this ITB.

A project will be deemed "successful" only if: (i) the entire project, including the Task referenced, achieved final acceptance; or (ii) the Task referenced was deemed substantially complete (i.e., the Facility Owner accepted the equipment installed or other result of the Task for the Facility Owner's beneficial use).

A project will not be deemed to be "successful" for purposes above, even if it otherwise meets the foregoing, conditions, if any of the following occurred: (i) the BIDDER was terminated from the project for cause, (ii) in association with the work listed, the BIDDER received any enforcement agency warning letters, administrative fines or penalties, or the BIDDER was required to pay damages by a court of law, for Occupational Safety and Health Administration (OSHA) violations in association with work; (iii) after project completion, the Facility Owner requested the BIDDER to provide warranty work and the BIDDER failed to provide such work to the Facility Owner's satisfaction; or (iv) the Facility Owner or the Facility Owner's contact person (listed below), for any other reason provides the City a negative reference regarding the BIDDER.

4. **What is the BIDDER Required to Provide?**

BIDDER must submit the following as part of the signed and sealed Bid. All documents are included in the Bid Proposal Letter section ("Reference Package").

- A. A list of Significant Task Subcontractor(s), including the name of the person or firm.
- B. A Reference Package. The Reference Package includes the title page containing the CITY contract number and title as referenced in the Invitation to Bid; the name of the CONTRACTOR, followed by References for the BIDDER.
- C. Each Project contained within the Reference Package will contain a sufficient number of references to show that the Minimum Qualification is met. Two references must be provided to show that the Minimum Qualification is met.

The BIDDER is encouraged to provide a backup Contact Person in each instance in case the City is unable to reach the primary Contact Person.

5. How will the city use the Information Submitted Above?

In evaluating the Bids received, the City intends to contact each reference listed (and with respect to OSHA violations, the appropriate agencies) to verify that the Minimum Qualification was met. BIDDERS meeting the Minimum Qualification (including with respect to their Significant Task Subcontractor(s)) will be considered qualified to perform the work and their Bid considered responsive provided other material requirements of the Bid are met.

SI 2. MINORITY AND WOMEN OWNED BUSINESS ENTERPRISE PARTICIPATION. The Daytona Beach City Commission has established a goal of 10% MBE/WBE participation in business contracts (i.e., contractors, subcontractors, and suppliers) with the City. The goal may be adjusted on a case-by-case basis to reflect experience and the relevant availability of MBE/WBE businesses.

Bidders are asked to provide documentation of their “good faith efforts” to achieve the MBE/WBE participation goal as outlined below.

A. Definitions:

Bid means all purchases prices sought by any procurement method

Construction means the process of building, altering, repairing, improving, or demolishing any public structure, building, roadway, or other public improvements of any kind to any public real property. It does not include the routine operation, repair, or maintenance of existing structures, buildings, or real property.

Contract means all types of city agreements, regardless of what they may be called, for the purchase or disposal of supplies or services or performance of construction with the following exceptions: salaries/employee benefits, taxes, judgments, travels, dues, pensions, utilities, subscriptions, auto allowances, debt service requirements and postage. It includes contracts for a fixed price, costs, cost plus a fixed fee, or incentive contracts, contracts providing for the issuance of job or task orders, leases, letter contracts, and purchase orders.

Good faith efforts includes demonstrations and actions which show that the stated goal was pursued far beyond neutrality; indeed, was pursued intensely. Acting in a manner such that a prudent and reasonable person would conclude that the stated goal would be achieved.

Minority means Blacks, Hispanics, American Indians, Alaskan Natives, Asians, and Pacific Islanders.

Minority-Owned Business Enterprise (MBE) means a business which is certified as an MBE by the State of Florida Office of Supplier Diversity or other Florida public agency.

Services means the furnishing of labor, time, or effort by a contractor, not involving the delivery of a specific end product other than reports which are merely incidental to the required performance. This term includes professional services, but does not include employment agreements or collective bargaining agreements.

Supplies means all property, including but not limited to equipment, materials, printing, insurance, and leases, but excluding land or a permanent interest in land.

Women-Owned Business Enterprise (WBE) means a business firm which is certified as a WBE by the State of Florida Office of Supplier Diversity or other Florida public agency

B. Contract Participation Good Faith Effort Documentation

(1) Bidders are asked to document its good faith efforts to achieve the 10% contract participation goal by submitting Attachment A *with the Bid*, listing all MBEs and WBEs contacted by the Bidder with a request to submit a subcontracting/supplier quote. Attachment A should be accompanied by copies of MBE/WBE certification for each MBE/WBE subcontractor and supplier.

The State of Florida Office of Supplier Diversity maintains a searchable database of Florida Minority and Woman Owned Businesses. Bidders may utilize that database or any other public agency maintained database of certified MBEs and WBEs to locate and contact MBE/WBEs for potential participation in the Bid. The State's database may be accessed through the Purchasing Division webpage: <http://www.codb.us/841.purchasing> by clicking the "Minority & Women Owned Businesses Registration and Searchable Database" link.

(2) Bidders are asked to submit Attachment B with the Bid, listing all MBE and WBE subcontractors and suppliers selected to be awarded subcontracts or purchase orders by the Bidder if awarded the Contract.

(3) If the Bidder is an MBE or WBE and self-performs a minimum of 10% of the work with its own forces, the 10% participation goal will be considered achieved. Bidder should submit Attachment B and the Bidder's MBE/WBE certification *with the Bid* to document Bidder's achievement of the goal.

(4) Nothing in this section shall be construed to require the award of a contract or a sub-contract to an MBE, WBE, or other purveyor of supplies, services or construction which fails to meet contract specifications or for which the bid is unreasonably priced or for which the bid is not in the best interest of the City nor is the lowest and best bid.

(5) The Successful Bidder should submit copies of MBE and WBE subcontracts and purchase orders within 15 days of receipt of the City's Notice of Intent to Award.

C. MBE/WBE Reporting During performance of the contract, the Successful Bidder will report payments made to MBE and WBE subcontractors and suppliers with each progress payment using Attachment E.

D. Minority and Women Employment

(1) *Employment* .The city commission has established a goal of 10% employment of minorities and women (combined) in the work forces of its contractors and subcontractors. The goals for minority and women employment may be adjusted on a case-by-case basis to reflect experience and availability of minorities and women with requisite skills.

(2) Bidders should list the total number of employees working for the Bidder on Attachment C and submit that Attachment with the Bid.

(3) Bidders should list the total number of and percentage of minority and women employees working for each subcontractor and supplier. Bidders should submit Attachment D, "Subcontractor/Supplier Employment Levels", upon issuance by the City of a Notice of Intent to Award.

END SPECIAL INSTRUCTIONS

SUBMITTAL CHECKLIST

The following items will be submitted with the Bid Proposal Letter. Each blank on the form will be filled out. Use NA (not applicable) rather than leaving blank.

Item(s) Required with Submittal	
	BID PROPOSAL LETTER
	BID SCHEDULE
	NONCOLLUSION AFFIDAVIT OF PRIME BIDDER
	DRUG-FREE WORKPLACE CERTIFICATION
	AFFIDAVIT ON PUBLIC ENTITY CRIMES
	MINORITY AND WOMEN OWNED BUSINESS ENTERPRISES CERTIFICATION FORM
	MINORITY AND WOMEN OWNED BUSINESS ENTERPRISE OFFICER CERTIFICATION FORM
	Bid Security (10% for all construction bids)
Label the outer most package with the following: Bid Number Date of the Opening Bidder's Name and Address	
Item(s) Required after Issuance of Notice of Intent to Award	
CERTIFICATE OF INSURANCE indicating the coverages outlined in this solicitation, including naming the City as additional insured	
Contract signed by Authorized Representative of the Bidder	
Payment & Performance Bonds to be returned as instructed within 15 days after the Notice of Award is issued <i>(Bond forms acceptable to the City will be sent with Notice of Award)</i>	
Attachment E – Minority and Woman Owned Business Enterprise Usage Form with each pay application	
Voluntary MBE/WBE Reporting	
Attachment A - Good Faith Effort Documentation	
Attachment B – MBE/WBE Contract Participation	
Attachment C – Bidder Employment Levels	
Attachment D – Subcontractor/Supplier Employment Levels	
MBE/WBE Subcontracts and Purchase Orders	

BID PROPOSAL LETTER - ITB NO.: 20403

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

Dear Mayor and Commissioners:

This Bid is submitted by _____
(insert Bidder'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 BIDDER or BIDDER's authorized representative, hereby declares and affirms each of the following:

1. That BIDDER has had the opportunity to examine the project site(s) and is fully informed in regard to all conditions pertaining to the site(s).
2. That BIDDER is fully informed regarding local conditions where the work will be required.
3. That BIDDER has thoroughly examined all Contract Documents, including Plans and Specifications as applicable, relative to the work to be performed, and that BIDDER is sufficiently knowledgeable of the work to be performed.
4. That BIDDER hereby agrees to furnish all labor, materials, and equipment to do the work in strict accordance with the Contract Documents for the price(s) stated in the attached Bid Schedule.
5. That, subject to the terms and conditions stated in the Contract Documents, BIDDER will perform the work in accordance with the completion date(s) specified in the Contract Documents, and will pay liquidated damages in the amounts specified in the Contract Documents for BIDDER's failure to comply with the completion date(s).
6. That BIDDER agrees to indemnify and hold harmless the CITY any other interests as set forth in the Contract Documents.
7. 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, BIDDER will be entitled to payment only based on the units constructed, installed, or otherwise placed in service.

BID PROPOSAL LETTER -- ITB No.: 20403, cont.

8. That BIDDER 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*): _____

9. That, if within the time period specified in the bid solicitation, BIDDER fails to execute the form Contract, provide proof of insurance, and submit (if required) Performance Security, the bid award will be subject to cancellation and the Bid Security provided with this Bid will be subject to forfeiture.

10. That all information provided by BIDDER as part of this Proposal is truthful to the best of BIDDER's knowledge.

11. That BIDDER 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**

☐ A joint venture***

☐ Other _____ (*specify, including type of entity*)

* *Attach proof of formation/registry from State of Florida.*

** *Provide on separate, signed sheets(s) of paper, full legal name and address of the partnership; and names of all general partners.*

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

BID PROPOSAL LETTER -- ITB NO.: 20403, CONT.

12. That BIDDER has completed and attached all required and requested attachments with this Bid Proposal, including Bid Schedule, Non-Collusion Affidavit, Drug Free Workplace Certification, MWBE Certifications and Attachments, and Public Entity Crimes Affidavit.

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

By: _____
(Signature)

Printed Name: _____

Title: _____

Date signed: _____

Email: _____

BID SCHEDULE - ITB NO. 20403

**WESTSIDE REGIONAL WRF BIOSOLIDS DEWATERING SYSTEM
IMPROVEMENTS**

**BIDDERS SHALL COMPLETE AND SUBMIT THE BID ITEM SCHEDULE PROVIDED
AS A PROTECTED EXCEL SPREADSHEET**

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: _____

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 in compliance with the drug free workplace certification requirements set forth in Florida Statutes 287.087; or b) 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 section (1), above.

(4) In the statement specified in section (1), above, 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.

By: _____
(Signature)

Title: _____
(leave blank if sole proprietor)

Date: _____

AFFIDAVIT ON PUBLIC ENTITY CRIMES

(SWORN STATEMENT PURSUANT TO SECTION 287.133(3) (a), FLORIDA STATUTES)

THIS FORM MUST BE SIGNED AND SWORN TO IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL AUTHORIZED TO ADMINISTER OATHS.

This sworn statement is submitted to the City of Daytona Beach

by _____
(insert individual's printed name and title)

for _____ whose business address
(insert name of Bidder)

is _____

- I. I understand that a "public entity crime" as defined in Paragraph 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.
- II. I understand that "convicted" or "conviction" as defined in Paragraph 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.
- III. I understand that an "affiliate" as defined in Paragraph 287.133(1)(a), Florida Statutes, means:
 1. A predecessor or successor of a person convicted of a public entity crime; or
 2. 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.
- IV. 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.

V. Based on information and belief, THE STATEMENT WHICH I HAVE MARKED BELOW is true in relation to the entity submitting this sworn statement (*Place initial of check mark next to applicable statement*):

- _____ Neither the entity submitting this sworn statement, nor any of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, nor any affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989.
- _____ The entity submitting this sworn statement, or one or more of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, or an affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989.
- _____ The entity submitting this sworn statement, or one or more of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, or an affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989. However, 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 Officer determined that it was not in the public interest to place the entity submitting this sworn statement on the convicted vendor list. (Attach a copy of the final order)

I UNDERSTAND THAT THE SUBMISSION OF THIS FORM TO THE CONTRACTING OFFICER FOR THE PUBLIC ENTITY IDENTIFIED IN PARAGRAPH 1 (ONE) ABOVE IS FOR THAT PUBLIC ENTITY ONLY AND, THAT THIS FORM IS VALID THROUGH DECEMBER 31 OF THE CALENDAR YEAR IN WHICH IT IS FILED. I ALSO UNDERSTAND THAT I AM REQUIRED TO INFORM THE PUBLIC ENTITY PRIOR TO ENTERING INTO A CONTRACT IN EXCESS OF THE THRESHOLD AMOUNT PROVIDED IN SECTION 287.017, FLORIDA STATUTES FOR CATEGORY TWO OF ANY CHANGE IN THE INFORMATION CONTAINED IN THIS FORM.

(Signature) (Date)

STATE OF _____)
COUNTY OF _____)

PERSONALLY APPEARED BEFORE ME, the undersigned authority,

_____ who, after first being sworn by me, affixed his/her signature
(Name of individual signing)

in the space provided above on this _____ day of _____, 20_____.

Attest: _____
(Notary Public)

My commission expires: _____

(Notary Seal)

REFERENCE PACKAGE

MINIMUM QUALIFICATIONS OF PROSPECTIVE BIDDER

CITY CONTRACT NUMBER: 20403

PROJECT TITLE: Westside Regional WRF Biosolids Dewatering System Improvements

TO: City of Daytona Beach Purchasing Department
Attn: Joanne Flick
301 South Ridgewood Avenue, Room 146
P.O. Box 2451 Daytona Beach, FL 32115-2451
flickjoanne@codb.us

CONTRACTOR FIRM NAME:

BUSINESS ADDRESS:

CITY, STATE, ZIP CODE:

PHONE NUMBER: _____ **FAX NUMBER:** _____

EMAIL ADDRESS: _____

LIST OF SIGNIFICANT TASK SUBCONTRACTORS

Task: Dewatering Improvements

Name of Firm(s):

TASK: Dewatering Improvements

Reference No. 1

Bidder: _____

Name of Project: _____

Location of Project _____

Type of Work on Project: _____

Dates Work was performed: _____

Project Components:

Yes No

a. Belt Filter Press installation?

☐☐

b. Contract value? \$ _____

c. Provide brief description of project scope/components. _____

Work Completion:

a. Was project substantially completed no earlier than ten years from Bid Opening Date?
(Yes/No) _____

b. Did the Bidder perform at least 50% of the work described for that project? (Yes/No) _____

c. Did project achieve final acceptance? (Yes/No) _____ or, was the project deemed substantially complete and available for beneficial use by the Facility Owner? (Yes/No) _____

Summary of any OSHA safety violations or significant injuries during the course of the work: _____

Name of Facility Owner: _____

Address: _____

Primary Contact Person for Facility Owner: _____

Employed by Owner: (Yes/No) _____ **Consultant:** (Yes/No) _____

Resident Construction Engineer: (Yes/No) _____ **Project Administrator:** (Yes/No) _____

Contact Person Company Name: _____

Telephone Number: _____ **Email Address:** _____

Secondary Contact Person: _____

Company Name: _____

Telephone Number: _____ **Email Address:** _____

TASK: Dewatering Improvements

Reference No. 2

Bidder: _____

Name of Project: _____

Location of Project _____

Type of Work on Project: _____

Dates Work was performed: _____

Project Components:

Yes No

a. Belt Filter Press installation?

☐☐

b. Contract value? _____

c. Provide brief description of project scope/components. _____

Work Completion:

a. Was project substantially completed no earlier than ten years from Bid Opening Date?
(Yes/No) _____

b. Did the Bidder perform at least 50% of the work described for that project? (Yes/No) _____

c. Did project achieve final acceptance? (Yes/No) _____ or, was the project deemed
substantially complete and available for beneficial use by the Facility Owner? (Yes/No) _____

**Summary of any OSHA safety violations or significant injuries during the course of the
work:** _____

Name of Facility Owner: _____

Address: _____

Primary Contact Person for Facility Owner: _____

Employed by Owner: (Yes/No) _____ **Consultant:** (Yes/No) _____

Resident Construction Engineer: (Yes/No) _____ **Project Administrator:** (Yes/No) _____

Contact Person Company Name: _____

Telephone Number: _____ **Email Address:** _____

Secondary Contact Person: _____

Company Name: _____

Telephone Number: _____ **Email Address:** _____

**ATTACHMENT A
GOOD FAITH EFFORT DOCUMENTATION**

SECTION 1: PRIME CONTRACTOR

ITB # 20403

WESTSIDE REGIONAL WRF BIOSOLIDS
DEWATERING SYSTEM IMPROVEMENTS

Bidder: _____

Bidder is MBE Yes No

Bidder is WBE Yes No

The Bidder hereby certifies that in accordance with applicable provisions of the Daytona Beach Purchasing Code, Chapter 30, Daytona Beach Code of Ordinances, a good faith effort has been made to contact the following Minority and Women Owned Business Enterprises:

SECTION 2: SUBCONTRACTORS/SUPPLIERS

Sub/Supplier Company Name	Trade/ Commodity	Check if MBE	Check if WBE	Contact Name	Contact Phone #	Date of Contact

ATTACHMENT B
MBE/WBE CONTRACT PARTICIPATION

SECTION 1: PRIME CONTRACTOR

ITB # 20403

WESTSIDE REGIONAL WRF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS

Bidder:

Bidder is MBE ☐ Yes ☐ No
Bidder is WBE ☐ Yes ☐ No

Total Bid Amount

\$ _____

Value of Self-Performed Work

\$ _____

Percentage of Self-performed Work

% _____

Bidder will list all certified MBE/WBE subcontractors and suppliers selected by the Bidder for award of subcontracts or purchase orders if Bidder is awarded the Contract.

Sub/Supplier Company Name	Trade/Commodity	Check if MBE	Check if WBE	Award Amount	Percentage of Sub Performed Work

Submit copies of all subcontracts/PO's to MBE and WBE subcontractors and suppliers upon receipt of the Notice of Intent to Award

Use additional sheets as necessary.

ATTACHMENT C - BIDDER EMPLOYMENT LEVELS

BIDDER: _____

ITB 20403

WESTSIDE REGIONAL WRF BIOSOLIDS DEWATERING SYSTEM
IMPROVEMENTS

Bidders shall indicate the total number of full-time staff employed by the Bidder at the time of bid opening, the total number of full time women employees, and the total number of full time minority employees. Bidders will calculate the total number of minority and women employees, and the percentage of all employees who are women and minorities.

A	Total Employees:	_____
B	Total Women Employees:	_____
C	Total Minority Employees:	_____
D	Total Women & Minority Employees (B + C):	_____
E	Percentage Women Employees (B ÷ A):	_____
F	Percentage Minority Employees (C ÷ A):	_____
	Total Percentage Women & Minority Employees (D ÷ A):	_____

Prepared by:

(Signature)

Name Printed:

Title:

ATTACHMENT D - SUBCONTRACTOR/SUPPLIER EMPLOYMENT LEVELS

SUBCONTRACTOR: _____

ITB 20403

WESTSIDE REGIONAL WRF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS

PRIME CONTRACTOR: _____

Each subcontractor and supplier with contracts or purchase orders should indicate the total number of full-time staff employed by the sub/supplier at the time of bid opening, the total number of full time women employees, and the total number of full time minority employees. Subcontractor and Suppliers will calculate the total number of minority and women employees, and the percentage of all employees who are women and minorities

A	Total Employees:	_____
B	Total Women Employees:	_____
C	Total Minority Employees:	_____
D	Total Women & Minority Employees (B + C):	_____
E	Percentage Women Employees (B ÷ A):	_____
F	Percentage Minority Employees (C ÷ A):	_____
	Total Percentage Women & Minority Employees (D ÷ A)	_____

Prepared by: _____

(Signature)

Name Printed: _____

Title: _____

Bidder shall submit Attachment D within 15 days of issuance of the Notice of Intent to Award.

**ATTACHMENT E
MINORITY AND WOMEN OWNED BUSINESS ENTERPRISE
USAGE FORM**

Contractor shall submit this form with each application for payment, indicating the MBE and WBE subcontractors and suppliers paid under the pay application.

This report provided by _____
Firm

Representative completing form: _____
Name

Contract Number: 20403

Pay Application No. _____
Indicate if "final"

Date form completed: _____

Total funds paid under this pay application to:

MBE Firms	
Firm Name	Amount

WBE Firms	
Firm Name	Amount

Total Amount Paid MBE's this
Pay Application: \$ _____

Total Amount Paid to WBE's this
Pay Application: \$ _____

DRAFT
PROJECT-SPECIFIC CONSTRUCTION CONTRACT
ITB 20403

THE PARTIES TO THIS CONTRACT are the City of Daytona Beach, a Florida municipal corporation, hereinafter the "CITY" or "OWNER," and >, a >, hereinafter the "CONTRACTOR."

WITNESSETH, that the CONTRACTOR and the CITY agree as follows, for the mutual valuable consideration provided herein:

ARTICLE I. SCOPE OF WORK

The CONTRACTOR will, at its sole cost and expense, provide, perform, and complete the construction project commonly known as "WESTSIDE REGIONAL WRF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS" and more fully described in the Contract Documents, hereinafter the "Work".

ARTICLE II. CONTRACT DOCUMENTS

The Contract Documents are further described in the General Conditions, and if applicable the Supplemental General Conditions. In addition, the Plans, dated February 2020 and referenced herein are the plans or drawings prepared by Sudhanva V. Paranjape (the "Engineer/Architect" or "E/A"), provided or made available with the CITY's Invitation to Bid, as amended by any addenda to the bid documents, are a part of the Contract Documents. These Plans are not physically attached hereto but are incorporated herein by reference. CONTRACTOR acknowledges receipt of all such Plans.

The Contract Documents are intended to include all information necessary for CONTRACTOR's proper prosecution and timely completion of the Work. CONTRACTOR will prosecute the Work as necessary to produce the results indicated by the Contract Documents. The Contract Documents are complementary, and what is required by one will be as binding as if required by all.

ARTICLE III. COMMENCEMENT AND COMPLETION

The CITY and the CONTRACTOR mutually agree that time is of the essence with respect to the dates and times set forth in the Contract Documents. To that end, the CONTRACTOR will commence the Work not later than the Commencement Date set forth in the General Conditions, and will diligently and continuously prosecute the Work at such a rate, and with sufficient forces as will allow the CONTRACTOR to achieve Substantial Completion within **395** days after the Commencement Date and Final Completion within **30** days after the Commencement Date, subject only to any adjustments in the Contract Time that may be authorized by Change Orders properly issued in accordance with the Contract Documents. In executing this Contract, CONTRACTOR affirms that the time set for completion is reasonable.

The CITY will suffer financial loss if Final Completion of the Work is not achieved within the Contract Time. Accordingly, and in lieu of actual damages or proof thereof, if CONTRACTOR fails to meet these deadlines, CONTRACTOR will be liable to the CITY for liquidated damages as follows:

In the amount of **\$570** for each and every day of unexcused delay in achieving Substantial Completion; and

In the amount of **\$285** for each and every day of unexcused delay from the date that Substantial Completion is achieved until Final Completion is achieved.

The CITY will have the right to offset such liquidated damages against any remaining portion of the Contract Price due CONTRACTOR, but will not be limited to the offset if it is insufficient. If the unpaid balance of the Contract Price is less than the amount of the Liquidated Damages, the CONTRACTOR or its Surety must pay the deficiency to the CITY upon demand.

ARTICLE IV. CONTRACT PRICE

Subject to any adjustments that may be authorized pursuant to this Contract, the Contract Price due the CONTRACTOR is \$>_____ for work completed and accepted in accordance with the Contract Documents. The Contract Price represents the CONTRACTOR's sole compensation from the CITY for prosecution of the Work. The Contract Price will be paid in a series of Progress Payments and a Final Payment, and is subject to retainage, as further described in the Contract Documents.

ARTICLE V. PERFORMANCE SECURITY

CONTRACTOR must provide a payment bond and a performance bond, or alternate form of Performance Security in an amount equal to 100% of the Contract Price if the contract price exceeds \$100,000.00.

Additional requirements associated with the provision of Performance Security, including requirements to increase the amount provided, are set forth in the General Conditions and, if applicable, the Supplemental General Conditions.

ARTICLE VI. INDEMNIFICATION

A. The Contractor shall indemnify and hold harmless the City of Daytona Beach, its officers and employees, from liabilities, damages, losses, and costs, including, but not limited to, reasonable attorney's fees, to the extent caused by the negligence, recklessness, or intentional wrongful misconduct of the Contractor and persons employed or utilized by the Contractor in the performance of the construction contract. This indemnification agreement is separate and apart from, and in no way limited by, any insurance provided pursuant to this agreement or otherwise.

B. CONTRACTOR indemnifies the CITY against any claim of supplier's or subcontractor's lien (in cases where such payment is not already guaranteed by payment bond). If any claim or lien remains unsatisfied after all payments are made, CONTRACTOR must refund to the CITY all monies that the latter may be compelled to pay in discharging such a lien, including all costs and a reasonable attorney's fee.

C. For purposes of the obligations stated in this Article, references to the CITY include the CITY's officers, employees, and agents.

D. CONTRACTOR's obligations under this Article are made without regard to the availability of insurance of the CITY or the Engineer/Architect.

ARTICLE VII. INSURANCE

A. Required Insurance.

Contractor will provide and maintain at Contractor's sole expense, insurance of the kinds of coverage and in the amounts set forth in this Article, primary and non-contributory with the City's own insurance, in form and from companies satisfactory to the City. The City shall 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 shall be the sole responsibility of the Contractor or sub-contractor providing such insurance.

1. **Workers' Compensation Insurance** – As required by Florida Statutes, Chapter 440, Workers' Compensation Insurance, for all employees of CONTRACTOR employed at the project site or in any way connected with the Work.

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 accident. Any associated or subsidiary company involved in the service must be named in the Workers' Compensation coverage.

2. **Liability insurance – Including Commercial General Liability coverage** for operations, independent contractors, products-completed operations, broad form property damage, collapse and underground, and personal injury on an "occurrence" basis, insuring the CONTRACTOR and any other interests, including but not limited to any associated or subsidiary companies involved in the Work; and **Automobile Liability coverage** insuring 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 CONTRACTOR at the project site or in any way connected with the Work.

The limit of liability 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, the aggregate will be in an amount of no less than \$2,000,000. The Commercial General Liability policy shall be provided on a project or location specific basis for the location or project site where the work or services are to be performed under this agreement. The Risk Manager may authorize lower liability limits for the automobile policy only, at the Risk Manager's sole discretion.

THE COMMERCIAL GENERAL LIABILITY INSURANCE POLICY WILL NAME THE CITY AS AN 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.

3. **Umbrella Liability** Insurance in the amount of \$1,000,000 per occurrence/aggregate that is no more restrictive in coverage than all underlying coverages described above. Policy shall be written on a follow form basis subject to the same terms, definitions, exclusions and conditions as the primary policies. Policy shall contain dropdown coverage provision as well as a duty to defend.

4. **Builders' Risk** - The CONTRACTOR is required to maintain Builders Risk Insurance on an "all risk" basis, including but not limited to the completed value basis on the insurable portion of the work for the benefit of the CITY, the CONTRACTOR and subcontractors as their interests may appear. The CITY, the CONTRACTOR and any subcontractor insured therein waive all rights against each other for damages caused by fire and other perils to the extent covered by the insurance obtained pursuant to this paragraph.

Unless specifically waived hereafter in writing by the Risk Manager, CONTRACTOR agrees that the insurer will waive its rights of subrogation, if any, against the CITY on of the above-listed types of required insurance coverage.

B. Subcontractors' 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 the services they will provide to the project.

C. Proof of Insurance. CONTRACTOR will furnish proof of insurance acceptable to the CITY prior to or at the time of execution of this Contract. CONTRACTOR will not commence Work until all required insurance has been approved by the CITY. CONTRACTOR 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.

Upon request of the Risk Manager, CONTRACTOR will also provide the CITY copies of the insurance contracts referenced by the certificates.

D. Cancellation and Replacement. CONTRACTOR will file replacement certificates 30 days prior to expiration or termination of any required insurance occurring prior to expiration or termination of this Contract. If such insurance terminates without CONTRACTOR's prior knowledge, immediately upon becoming aware of such termination CONTRACTOR will provide notice to the City's Risk Manager at P.O. Box 2451, Daytona Beach, Florida 32115-2451.

The CITY reserves the right to suspend any or all of the Work until such insurance has been replaced, or to obtain replacement insurance at CONTRACTOR's sole cost.

E. Termination of Insurance. CONTRACTOR will not cancel any required insurance coverage until the work is completed, accepted by the CITY and CONTRACTOR has received written notification from the Risk Manager that CONTRACTOR is authorized to cancel the insurance and the effective date of such authorization. The Risk Manager will provide such written notification at the request of CONTRACTOR if the request is made no earlier than two weeks before the work is to be completed.

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

F. 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.

ARTICLE VIII. NOTICES

A. Where the Contract Documents authorize or require the CITY to provide notice to CONTRACTOR, notice may be provided by delivery by hand to CONTRACTOR's designated Superintendent at the Project Site, or in the absence or unavailability of the Superintendent to any other person on the Project Site who holds himself or herself out as managing the Work on behalf of CONTRACTOR, or in lieu of either of these, by written notice to the address provided below.

B. Where the Contract Documents authorize or require CONTRACTOR to provide notice to the CITY, notice may be provided only by written notice to the address provided below.

C. Written notice is valid only if sent by certified United States mail, return receipt requested, facsimile with confirmation receipt required, or by recognized courier such as Federal Express with confirmation receipt requested. All such notices will be deemed to have been duly given and provided on (i) the date of receipt, (ii) upon receipt or refusal of delivery if transmitted by registered or certified mail, return receipt requested, or (iii) the first business day after the date of deposit, if transmitted by reputable overnight courier service, whichever occurs first. Written notices will be sent to the following persons:

If to the CITY:

Attn: Shannon Ponitz, Utilities Director
The City of Daytona Beach
125 Basin St., Suite 204
Daytona Beach, FL 32114
Fax: 386-671-8501

If to the CONTRACTOR:

Fax: _____

provided, however, that either Party may by written notice change the address designated for receipt of written and faxed notices.

ARTICLE IX. DISPUTE RESOLUTION

If a dispute exists concerning this Contract, the Parties agree to use the following procedure prior to pursuing any judicial remedies.

A. **Negotiations Required.** A Party will request in writing that a meeting be held between representatives of each Party within 14 days of the request or such later date that the Parties may agree to. Each Party will attend and will include, at a minimum, a senior level decision maker (an owner, officer, or employee of each organization) empowered to negotiate on behalf of their organization. The purpose of this meeting is to negotiate the matters constituting the dispute in good faith. The Parties may mutually agree in writing to waive this step and proceed directly to mediation as described below.

B. **Non-Binding Mediation.** Mediation is a forum in which an impartial person, the mediator, facilitates communication between parties to promote reconciliation, settlement, or understanding among them. Within 30 days after the procedure described above proves unsuccessful or the Parties mutually waive the procedure, the Parties will submit to a non-binding mediation. The mediation, at a minimum, will provide for (i) conducting an on-site investigation, if appropriate, by the mediator for fact gathering purposes, (ii) a meeting of all Parties for the exchange of points of view and (iii) separate meetings between the mediator and each Party to the dispute for the formulation of resolution alternatives. The Parties will select a mediator trained in mediation skills and certified to mediate by the Florida Bar, to assist with resolution of the dispute. The Parties will act in good faith in the selection of the mediator and give consideration to qualified individuals nominated to act as mediator. Nothing in this Contract prevents the Parties from relying on the skills of a person who also is trained in the subject matter of the dispute or a contract interpretation expert. Each Party will attend and will include, at a minimum, a senior level decision maker (an owner, officer, or employee of each organization) empowered to negotiate on behalf of their organization.

If the Parties fail to reach a resolution of the dispute through mediation, then the Parties are released to pursue any judicial remedies available to them.

ARTICLE X. GENERAL PROVISIONS

A. This Contract will be governed by the laws of the state of Florida without regard to any choice of law principles that could result in application of the laws of any other jurisdiction. Venue for any legal action or proceeding arising out of this Contract is exclusively in the federal or state courts in and for Volusia County, Florida. The Parties hereby waive any right to stay or dismiss any action or proceeding brought under or in connection with this Contract that is brought before the above-referenced courts on the basis of *forum non-conveniens*.

B. In case of litigation arising out of this Contract where the meaning of one or more provisions is at issue, the CITY will not be penalized by virtue of its having drafted this Contract. CONTRACTOR has carefully reviewed and had the opportunity to seek advice of legal counsel prior to executing this Contract.

C. The CITY and CONTRACTOR agree that they have knowingly waived the right to trial by jury and have instead agreed that, in the event of any litigation arising out of or connected to this Contract, to proceed with a trial before the court, unless both parties subsequently agree otherwise in writing.

D. In performing the services provided for herein, CONTRACTOR is an independent contractor and not an employee of the CITY.

E. The waiver of any provision of this Contract will not be deemed to be a waiver of any other provision of this Contract. No waiver of any provision of this Contract will be deemed to constitute a continuing waiver unless expressly provided in writing, nor will a waiver of any default be deemed a waiver of any subsequent defaults of the same type. The failure at any time to enforce this Contract, whether the default is known or not, does not constitute a waiver or estoppel of the right to do so.

F. All terms and conditions of this Contract which contemplate a period of time beyond completion or termination, will survive such completion or termination and not be merged therein or otherwise terminated.

G. If any word, phrase, clause, sentence or provision of the Contract, or the application of same to any person or set of circumstances is for any reason held to be unconstitutional, invalid or unenforceable, that finding will only effect such word, phrase, clause, sentence or provision, and such finding will not affect the remaining portions of this Contract; this being the intent of the Parties in entering into the Contract; and all provisions of the Contract are declared to be severable for this purpose.

H. The undersigned representative of CONTRACTOR affirms that in executing this Contract on behalf of CONTRACTOR, he or she is fully authorized to bind CONTRACTOR to the terms and conditions herein set forth.

I. No CITY officer, employee, or independent consultant who is involved in the development, evaluation, or decision-making process of the performance of any solicitation will have a financial interest, direct or indirect, in the Contract resulting from that solicitation. Any violation of this provision, with the knowledge, expressed or implied, of CONTRACTOR will render the Contract voidable by the CITY.

J. This Contract represents the entire and integrated agreement between the CITY and CONTRACTOR with respect to the subject matter hereof and supersedes all prior negotiations, representations or agreements, either written or oral.

IN WITNESS WHEREOF, the Parties have executed this Contract on the dates written below.

THE CITY OF DAYTONA BEACH

>CONTRACTOR

By: _____
Derrick L. Henry, Mayor

By: _____
Printed Name: _____
Title: _____

Attest: _____
Letitia LaMagna, City Clerk

Date: _____

Date: _____

Approved as to legal form:

By: _____
Robert Jagger, City Attorney

GENERAL CONDITIONS

ARTICLE 1 – DEFINITIONS AND TERMS

1.1 Defined Terms.

Whenever used in the Contract the following terms have the meanings indicated, which are applicable to both the singular and plural thereof

“50-Percent Completion” means the point at which the OWNER has expended 50% of the Adjusted Contract Price.

“Adjusted Contract Price” means the Contract Price as set forth in the Contract, as previously adjusted by valid Change Order.

“Bid” means the offer of the Bidder.

“Bid Platform” means the software package currently used by the City of Daytona Beach, i.e., Vendor Registry. All communications regarding solicitations will be posted at www.codb.us/841/Purchasing and available by selecting the “Public Solicitations” link.

“Bid Schedule” means the Bid Schedule submitted by CONTRACTOR with the Bid; unless CONTRACTOR was the sole responsive bidder and the Parties have negotiated final pricing as part of the bid solicitation process pursuant to the Purchasing Code, in which instance the term means the Revised Bid Schedule included within the Contract Documents.

“Change Instrument” means a Field Directive or a Change Order.

“Change Order” means a written directive issued by the OWNER authorizing an adjustment in the Contract Price, the Contract Time, the scope of Work, or any other material term or condition of the Contract. When approved by the City Commission, a change order may be in the form of a formal amendment to this Contract.

“City Code” means the City of Daytona Beach Code of Ordinances.

“City Commission” or “Commission” means the City of Daytona Beach City Commission.

“City Manager” means the City Manager for the City.

“Commencement Date” means the date established in the Notice to Proceed upon which the Contract Time begins to run; or if no such date is provided in the Notice to Proceed, the date of the Notice to Proceed.

“Construction Contract form” means that part of the titled as “Project-Specific Construction Contract” or something similar, and signed by the Parties.

“Contract” includes all Contract Documents.

“Contract Administrator” means the individual specifically authorized to administer the Contract on the OWNER’s behalf; provided, however that in all instances the City Manager may act as the Contract Administrator.

“Contract Price” means the total compensation due to CONTRACTOR for the Work to be performed under the contract, subject only to those adjustments provided in the Contract Documents.

“Contract Time” means the total period of time stated in the Contract between the Commencement Date and the deadline for Final Completion, subject only to those adjustments provided in the Contract Documents.

"Critical Path" means the longest series of tasks that runs consecutively from the beginning to the end of the Project, as determined by duration and workflow sequence. This longest path sets the managerial standard for how quickly the Project can be completed, given appropriate resources.

"Day" or *"Days"* means calendar days unless otherwise specifically noted in the Contract Documents.

"Defective Work" or *"Nonconforming Work"* means Work that:

- (i) Does not conform to the requirements of the Contract;
- (ii) Does not meet the requirements of any inspection, test, or approval as referred to in the Contract or as required by law;
- (iii) Contains defects;
- (iv) Represents a substitute for that required by the Technical Provisions, unless properly approved and authorized as provided in the Contract; or
- (v) Has been damaged or destroyed prior to Final Completion.

"Effective Date" means the date on which this Contract is approved by City Commission.

"Electronic Signature" means the original signatures transmitted and received via electronic transmission of a scanned document, (e.g., PDF or similar format) are true and valid signatures for all purposes hereunder and shall bind the parties to the same extent as that of an original signature. Any such electronic counterpart shall be of sufficient quality to be legible either electronically or when printed as hardcopy. The City shall determine legibility and acceptability for public record purposes.

"E/A" (also, *"Engineer/Architect"*, *"Architect"*, or *"Engineer"* as applicable) generally means the professional licensed architect or engineer who develops the criteria and concept for the Project, performs the analysis, and is responsible for the preparation of the Technical Provisions and Plans. The E/A may be the OWNER's in-house staff or a consultant retained by the OWNER. No contractual relationship is created by this Contract between CONTRACTOR and the E/A.

"Equipment" means the machinery and equipment, together with the necessary supplies for upkeep and maintenance thereof, and all other tools and apparatus necessary for the construction and acceptable completion of the Work.

"Field Directive" means a written order prepared and signed by the OWNER, not involving a change in Contract Price or Contract Time, directing a minor change in the Work where a Change Order is not required.

"Final Completion" means acceptance of the Work by the OWNER as evidenced by its signature upon the Certificate of Final Completion.

"Force Account" means a method for payment of additional Work that is based on CONTRACTOR's labor, equipment and materials costs with consideration for overhead and profit.

"Force Majeure Event" means conditions or other circumstances, such as acts of God, that: (i) were not foreseen, and could not have been reasonably foreseen, by CONTRACTOR or the OWNER, (ii) are beyond the control of CONTRACTOR and the OWNER, and (iii) materially hinder or interfere with the ability of CONTRACTOR to prosecute the Work; provided, however, that no such condition or circumstance will be a Force Majeure event if it is the result of CONTRACTOR's fault, negligence, or material breach of this Contract. Examples of Force Majeure events include wars, floods, strikes and labor disputes, unusual delay in transportation, epidemics abroad, earthquakes, and severe adverse weather conditions not reasonably anticipated.

"Hazardous Materials" has the meaning as provided by law.

“Legal Requirements” means, collectively, all applicable federal, state, and local laws, codes, ordinances, rules, regulations, orders and decrees of any government or quasi-government entity having jurisdiction over the Project or Site, the practices involved in the Project or Site, or any Work. The term includes the City Code and other CITY ordinances and regulations.

“Materials” means goods or substances to be incorporated in the Work under the Contract.

“Milestone” means a significant event specified in the Contract Documents relating to an intermediate completion date or time prior to Final Completion of the Work.

“OWNER” means the City of Daytona Beach; or, if the form Contract so provides, the Community Redevelopment Agency for the CITY. All references within the Technical Provisions to the “CITY” (whether or not capitalized) are intended to refer to the “OWNER” unless logic dictates otherwise.

“Plans” means the plan documents prepared by the E/A and identified in the Table of Contents or otherwise incorporated into the Contract, including reproductions thereof, showing the location, character, dimensions, and details of the Work. The term may also be referred to herein as “drawings,” “contract drawings,” “contract plans,” or similar terms; but not “shop drawings.”

“Project” means the subject of the Work and its intended result.

“Project Site” or *“Site”* means the land or premises on which the Project is located, and in addition any land and areas identified in and permitted for use by CONTRACTOR by the Contract, subject to conditions that may apply such as for rights-of-way, permits, and easements.

“The Prompt Payment Act” means the Local Government Prompt Payment Act, F.S. § 218.70 et seq. (2014), as hereafter amended.

“Purchasing Code” means the provisions of Chapter 30 of the City Code.

“Referenced Standards” includes standards, standard details, specifications, manuals, regulations or codes of any technical society, organization or association, or of any governmental or quasi-governmental authority referred to in the Contract to describe the nature or quality of any of the Work, whether such reference be specific or by implication, and means the latest standard, standard detail, specification, manual, regulation or code in effect at the time of Bid opening, except as may be otherwise specifically stated in the Contract.

“Resident Project Representative” means, where the E/A is a private firm or person under contract with the CITY to act as the E/A, the authorized representative of E/A assigned to the Project Site; and in all other instances, the Contract Administrator.

“Risk Manager” means the Risk Manager for the CITY or designee; provided however, that the City Manager may act on behalf of the Risk Manager.

“Schedule of Values” means the written breakdown of the Contract Price by Construction Specification Institute divisions or by other format acceptable to the OWNER, prepared by CONTRACTOR for OWNER’s review and approval.

“Shop Drawings” means all drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR as required by this Contract.

“Site-Related Reports” means any environmental, geotechnical, subsoil, and related reports relating to conditions at the Project Site which were used or made available for the OWNER’s or E/A’s use in creating the Plans.

“Specifications” means the Technical Provisions and Plans.

"*Stored Materials*" means delivered materials or equipment that are located at the Project Site, or with the OWNER's approval at another location, and that have not yet been incorporated into the Work.

"*Subcontractor*" means a person or firm that under a direct contract with CONTRACTOR to perform a portion of the Work, and also unless logic dictates otherwise, sub-subcontractors and persons or firms doing work through such sub-subcontractors.

"*Substantial Completion*" means the completion of the Work, or an agreed upon portion of the Work, so as to allow the OWNER to occupy and use the Project or a portion thereof for its intended purposes.

"*Sub-subcontractor*" means a person or firm who has a direct or indirect contract at any tier with a subcontractor to perform a portion of the Work.

"*Supplemental General Conditions*" means that part of the Contract labeled as such and identified in the Table of Contents or otherwise incorporated into the Contract, that amends and supplements these General Conditions.

"*Supplier*" means a person or firm having a contract with CONTRACTOR or with any subcontractor of any tier to furnish materials to be incorporated in the Work.

"*Technical Provisions*" means those provisions of the Contract containing or referencing required technical specifications and standards. The term includes all such technical specifications and standards of other governmental jurisdictions, or professional association where referenced in the Contract, including any exceptions thereto regardless of whether these are attached to or enumerated within the Contract.

Whenever this Contract refers to but does not include a specific Technical Provision, the reference will be deemed to be to the version of the referenced Technical Provision included in the applicable CITY engineering or utility standard unless logic dictates otherwise.

"*Unilateral Change Instrument*" means a Change Instrument issued by the OWNER and not executed by CONTRACTOR.

"*Unit Price Schedule*" means the Bid Schedule.

"*Working Hours*" means 7:00 am through 6:00 pm, Monday through Friday excluding holidays designated by the CITY.

1.2 Abbreviations. The following abbreviations, when used in the Contract, represent the full text shown.

AAN	American Association of Nurserymen, Inc.
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGC	The Associated General Contractors of America, Inc.
AGMA	American Gear Manufacturers Association
AIA	American Institute of Architects.
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute, Inc.
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association

CRSI	Concrete Reinforcing Steel Institute
DIPRA	Ductile Iron Pipe Research Association
EASA	Electrical Apparatus Service Association
EPA	Environmental Protection Agency of the United States Government
FDHR	Florida Division of Historical Resources
FEMA	Federal Emergency Management Agency
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FSS	Federal Specifications and Standards
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFAS	Institute of Food and Agricultural Sciences
IMSA	International Municipal Signal Association
IPCEA	Insulated Power Cable Engineers Association
ISA	International Society of Arboriculture
ISO	International Organization for Standards
MPO	Volusia County Metropolitan Planning Organization
MSTCSD	Minimum Specifications for Traffic Control Signals and Devices
MUTCD	Manual on Uniform Traffic Control Devices
NACE	National Association of Corrosion Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute for Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NSPE	National Society of Professional Engineers
OSHA	Occupational Safety and Health Administration
SAE	Society of Automotive Engineers
SJWRMD	St. Johns River Water Management District
SI	International System of Units
SSPC	Society of Protective Coatings
UL	Underwriters' Laboratories
USACOE	United States Army Corps of Engineers
USGS	United States Geological Service

Each of the above abbreviations, when followed by a number or letter designation, or combination of numbers and letters, designates a specification, test method, or other code or recommendation of the particular authority or organization shown. Where the above-referenced abbreviations refer to a written standard, specifications, test method, or other code, the reference will be deemed to be the edition of the code promulgated at the time of Bid opening.

1.3 Use of Terms.

1.3.1 Singular and Plural. The OWNER, E/A, CONTRACTOR, subcontractor, sub-subcontractor, supplier, other contractors, surety, insurer and others may be referred to in the Contract Documents as if singular in number. In the event that more than one person or entity occupies the position referred to and unless otherwise indicated, the term is interpreted to include all such persons or entities.

1.3.2 Technical Terms and Trade Usage. Terms in the Contract which have well-known technical or construction industry meanings and are not otherwise defined are used in accordance with such recognized meanings unless the context clearly indicates otherwise.

ARTICLE 2 –ORGANIZATION AND INTENT OF CONTRACT

2.1 Interpreting the Contract.

2.1.1 Order of Precedence. In cases of conflict or discrepancy among Contract Documents, interpretations will generally be based on the following order of precedence, ranked from highest to lowest priority:

- .1 Change Orders;
- .2 The Construction Contract form;
- .3 Supplemental General Conditions, if any;
- .4 General Conditions;
- .5 Technical Provisions;
- .6 Plans (figured dimensions will govern over scaled dimensions);
- .7 The Invitation to Bid and General and Supplemental Instructions to Bidders, including Addenda thereto;
- .8 The Bid Schedule;
- .9 All other documents required to be submitted and submitted as part of CONTRACTOR's Bid Proposal; and
- .10 All other Contract Documents that are neither listed above nor expressly incorporated into one of the foregoing Contract Documents;

with the understanding that a common sense approach will be used as necessary so that the Contract Documents produce the intended response.

2.1.2 Contract Documents Complementary. The Contract Documents are complementary, and what is required by one is as binding as if required by all. Anything mentioned in the Specifications and not shown on the Drawings, or shown on the Drawings and not mentioned in the Specifications, are of like effect as if shown or mentioned in both.

2.1.3 Intent to Require Completed Project. The intent of the Contract Documents is to require that CONTRACTOR provide all materials and labor, including tools, equipment and supervision, necessary for the proper execution and completion of the Work as a functioning whole or required for a completed Project.

2.1.4 Work Required if Reasonably Inferable. Performance by CONTRACTOR is required to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results. Where no explicit quality or standards for materials or workmanship are established for the Work, the Work is to be of good quality for the intended use and consistent with the quality of surrounding Work which conforms to the requirements of the Contract Documents and to the standards for construction of the Project generally.

2.1.5 Organization of Drawings and Specifications. Organization of the Drawings around professional disciplines such as civil, architectural, structural, plumbing, mechanical, and electrical, and of the Specifications into divisions, sections, and articles, does not control CONTRACTOR in dividing the Work among sub-contractors or in establishing the extent of Work to be performed by any trade or excuse CONTRACTOR of its obligation to properly allocate and provide for the performance of all Work under the Contract.

2.1.6 Documents Excluded from the Contract. The Contract Documents do not include the Site-Related Reports referenced herein or other documents issued or provided to CONTRACTOR for the information of CONTRACTOR or for reference purposes and which are not specifically incorporated in the Contract Documents.

2.1.7 Titles, Headings, and Capitalization. The titles and headings of the various sections and subsections of these General Conditions and other Contract Documents are intended only as a matter of reference and convenience and in no way define, limit, or prescribe the scope or intent of the Contract Documents. The use,

or inadvertent failure to use, capitalization of terms used in the Contract Documents is not intended to define or limit the meaning of the term.

2.1.8 Other Interpretive Rules.

2.1.8.1 Provisions of the Contract Documents that use the active voice-imperative mood writing style are directions to CONTRACTOR and are intended as commands. In such instance, the subject “the Bidder” or “CONTRACTOR” is understood.

2.1.8.2 Provisions of the Contract Documents that use the passive voice writing style are also directions to CONTRACTOR and intended as commands unless logic clearly dictates otherwise.

2.1.8.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

2.2 Referenced Standards.

2.2.1 Standards Incorporated. All Referenced Standards are incorporated into the Contract as fully as if printed and bound with the Specifications, but only to the limited extent that such standards are applicable to the Work.

2.2.2 Availability of Referenced Standards. CONTRACTOR is responsible for obtaining and having available at the Project Site a copy of each Referenced Standard insofar as it is applicable to the Work.

2.2.3 Precedence of Contract Documents Over Referenced Standards. No provision of a Referenced Standard is effective to change (i) the procedures established in the Contract Documents or by any applicable laws or regulations, or (ii) the duties and responsibilities of the OWNER, E/A or CONTRACTOR from those set forth in the Contract Documents; nor is any provision of a Referenced Standard effective to assign to the OWNER or the E/A any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the Contract.

ARTICLE 3 - PRELIMINARY MATTERS

3.1 Pre-Contract Submittals. The OWNER reserves the right to require certain Submittals before executing the Contract. Submittals required before execution of the Contract include, but are not limited to insurance certificates acceptable to the OWNER as provided in the Contract and any other submittals required by the Bid Documents. Bidders are requested to provide copies of MBE/WBE subcontracts and purchase orders from subcontractors and suppliers listed on Attachment D from the Bid Proposal Letter documenting subcontractor and supplier minority and women employment levels,

3.2 Project Information. Within ten days after the Effective Date, the OWNER will furnish CONTRACTOR free of charge, two signed, sealed, hard copies and one electronic copy of the Plans in AutoCAD and the Technical Provisions in PDF format, and one copy of each of the Site Related Reports, if any. All Site Related Reports are given to CONTRACTOR for information only, are not warranted as to accuracy, and are not a part of the Contract Documents. CONTRACTOR will not be entitled to rely on the accuracy or the completeness of any information contained in these Reports in performing the Work required herein, or in seeking claims for Contract Price or Contract Time adjustments. It is the CONTRACTOR's responsibility to determine and verify all information provided by OWNER including, but not limited to grades and elevations.

3.3 CONTRACTOR's Review of Contract Documents and Site Related Reports. Before undertaking a project, CONTRACTOR will carefully study the Contract Documents and any Site Related Reports provided by OWNER, to check and verify pertinent figures shown thereon compares accurately to all applicable field measurements. CONTRACTOR will promptly report in writing to the Contract Administrator any conflict, error, ambiguity, or discrepancy that CONTRACTOR discovers and will obtain a written interpretation or clarification from the Contract Administrator before proceeding with any Work affected thereby. CONTRACTOR will be liable to the

OWNER for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents or Site Related Reports of which CONTRACTOR knew or reasonably should have known.

3.4 Pre-Construction Submittals.

3.4.1 CONTRACTOR will prepare and submit all required pre-construction submittals within 15 Days after the Effective Date, except where the Contract Administrator extends time for submittal in writing. The submittals will include each of the following:

3.4.1.1 A proposed Progress Schedule, developed using Microsoft Project software unless otherwise approved by the Contract Administrator. The Progress Schedule will (i) indicate the times (number of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract, (ii) identify the Critical Path for completing the Work, (iii) identify when all subcontractors will be utilized, and (iv) take into consideration any Working Hours limitations. The Progress Schedule will contain sufficient detail to indicate that CONTRACTOR has identified all required Work elements and tasks, has provided for a sufficient and proper workforce and integration of subcontractor, has provided sufficient resources and has considered the proper sequencing of the Work required to result in a successful Project that can be completed in accordance with any Milestones and within required completion deadlines.

3.4.1.2 A proposed Schedule of Values, except where the Contract Price is based solely on Unit Prices set forth in the Bid Schedule. The Schedule of Values will be prepared in such a manner that each item of Work is shown as one or more line items on AIA Document G703, Continuation Sheet (latest ed.) or such other form as the OWNER may prescribe, and will contain such detail and be supported by such data as to allow the OWNER and the E/A to substantiate accuracy. Upon approval by the OWNER, the Schedule of Values will be used as the basis for reviewing progress payment requests. After the OWNER has approved the initial Schedule, CONTRACTOR will revise and resubmit for the OWNER's approval, amended Schedules of Values as necessary to reflect adjustments in the Contract Price resulting from approved Change Orders. A schedule of values may be required if a substantial portion of the contract price is a lump sum bid item.

3.4.1.3 An organizational chart showing the principals and management personnel who will be involved with the Work, including each one's responsibilities for the Work.

3.4.1.4 Preliminary Shop Drawings. Shop Drawings will be neat, legible, and drawn to scale. CONTRACTOR will specifically identify any proposed deviations from dimensions, details, and other requirements as provided by the Plans and specifications. When submitting Shop Drawings, CONTRACTOR will also provide a written narrative explanation itemizing each proposed deviation from the Specifications or other Contract requirements. No such deviations will be deemed to be accepted unless they are specifically approved in accordance with the procedures for substitutes and Change Orders.

3.4.1.5 To the extent not set forth in the Contract, a letter designating the Superintendent and, if such designation is required by the Supplemental General Conditions, the Project Manager.

3.4.1.6 A letter designating CONTRACTOR's safety representative, who will be responsible for general safety and excavation safety measures along with certifications or other documentation of the safety representative's qualifications.

3.4.1.7 If applicable, an excavation safety system plan.

3.4.1.8 If applicable, a plan illustrating proposed locations of temporary facilities.

3.4.1.9 A completed Non-Use of Asbestos Affidavit (prior to construction).

3.4.1.10 A map of proposed "haul routes" for delivery of materials and transportation of equipment to the Project Site.

3.4.1.11 A letter designating the Florida Registered Professional Land Surveyor for layout of the Work, if the Work requires the services of a surveyor.

3.4.1.12 Any other documents as required by the OWNER, consistent with the terms of the Contract.

The Supplemental General Conditions (if any) or the Technical Provisions may amplify, waive, or otherwise amend requirements for the above-referenced submittals.

3.4.2 The OWNER will have the right to accept or reject each of the required submittals. The OWNER will provide CONTRACTOR written notice as to any submittals that are rejected, in which instance CONTRACTOR will promptly resubmit them. Alternatively in such instance, the OWNER will have the right but not the obligation to schedule a preconstruction meeting; provided that the preconstruction meeting is scheduled no later than 30 days after the Effective Date, and the OWNER may delay issuance of the Notice to Proceed until the OWNER and CONTRACTOR have held the meeting.

3.4.3 The OWNER's acceptance of the above-referenced submittals will be deemed to be general only relating solely to their sufficiency and compliance with the intent of the Contract. Such acceptance does not constitute the OWNER's adoption, affirmation, or direction of CONTRACTOR's means and methods, and does not constitute a Change Instrument. OWNER's acceptance of the Progress Schedule will not impose on the OWNER, responsibility or liability for the sequencing, scheduling, or progress of the Work, and will not relieve CONTRACTOR from CONTRACTOR's responsibility for complying with the terms and conditions of this Contract. CONTRACTOR will at all times remain responsible for the factual accuracy of all such submittals.

3.5 Notice to Proceed. No work will proceed until the OWNER has issued a written Notice to Proceed. The OWNER will issue a Notice to Proceed within 60 days after the Effective Date, provided that CONTRACTOR has submitted all required documents, including insurance and, where applicable, Performance Security. The OWNER in its sole discretion may delay issuing the Notice if CONTRACTOR has not completed its preconstruction submittals within that time, or with CONTRACTOR's written concurrence for any other or no reason.

3.6 Limitations on Custody and Use of Plans. CONTRACTOR will not re-use the Plans and Technical Provisions, including modifications thereto, on any other project or for any other client. CONTRACTOR may not own or claim a copyright in the Site-Related Reports, or the Plans or any other Contract Documents. With the exception of the signed Contract Documents, all sets of the above-referenced documents are the property of the OWNER, and will be returned to the OWNER on request or at the completion of the Work prior to issuance of Final Payment.

3.7 Availability of Lands. The OWNER will provide access to the Project Site, secure any easements necessary therefore, and notify CONTRACTOR of any restrictions in such access. The OWNER may identify in the Contract Documents encumbrances or restrictions not of general application which are known by the OWNER and specifically related to use of the Site, but which are not of public record. CONTRACTOR will comply with such encumbrances and restrictions in performing the Work. Permanent easements for the completed facility or for changes in existing facilities will be obtained and paid for by the OWNER, unless otherwise provided in the Contract Documents.

ARTICLE 4 – OWNER'S RESPONSIBILITIES

4.1 Contract Administrator. The Contract Administrator is authorized to administer the Contract on behalf of the OWNER, commencing on the Effective Date and terminating on the date CONTRACTOR performance is completed (including final payment) or terminated.

4.1.1 The Contract Administrator's authority is limited as follows:

- .1** Provide direction to CONTRACTOR to ensure satisfactory and complete performance;
- .2** Issue Field Directives;

- .3 Monitor and inspect CONTRACTOR performance to ensure acceptable timeliness and quality;
- .4 Maintain necessary documentation and records regarding CONTRACTOR performance and other pertinent matters;
- .5 Furnish timely written notice of CONTRACTOR performance failures to the City Manager and to the City Attorney, as appropriate;
- .6 Determine acceptance or rejection of CONTRACTOR's performance;
- .7 Approve or reject applications for payment, other than application for final payment;
- .8 Furnish necessary reports to the City Manager;
- .9 Recommend Change Instruments or stop work orders to the City Manager; and
- .10 Recommend termination of Contract or work authorizations for default or convenience to the City Manager.

4.1.2 The authority of the Contract Administrator is limited to the functions set forth above. In particular, the Contract Administrator is NOT authorized to make determinations (as opposed to recommendations) that:

- .1 Alter or modify Contracts;
- .2 Terminate or cancel Contracts;
- .3 Approve, as opposed to recommend, Change Orders or Contract Amendments;
- .4 **Except as expressly provided herein**, interpret ambiguities in Contract language; or
- .5 Approve final applications for payment; or
- .6 Waive the OWNER's contract rights.

4.2 City Manager. The City Manager has all of the authority of the Contract Administrator. The City Manager has authority to approve final applications for payment except where approval also requires approval of a change order that is not within the City Manager's authority, below. In addition, the City Manager is authorized to issue (i) Change Orders increasing Contract Price or Contract Time as provided in the Purchasing Code or as specifically authorized by the City Commission; (ii) Change Orders reducing Contract Price or Contract Time; and (iii) stop work orders where reasonably necessary to preserve property or prevent injury.

4.3 Authority Reserved in City Commission. All administrative authority not specifically conferred upon the Contract Administrator or City Manager is reserved to the City Commission. Modifications to the Contract required to be approved by the Commission may be in the form of Change Orders or formal amendments, as appropriate.

4.4 General Obligation to Avoid Delays. Information or services under the OWNER's control will be furnished by the OWNER with reasonable promptness to avoid delay in orderly progress of the Work. The OWNER will have a reasonable amount of time to investigate site conditions, review submittals, analyze requests for changes, and to make other decisions in the orderly administration of the Contract. CONTRACTOR will notify the OWNER in writing, if the time for the investigation, review, analysis of any submittals, required for changes or otherwise required for the OWNER's decision, impacts in any way the Critical Path of the current approved Progress Schedule.

4.5 Owner-Provided Inspectors. The OWNER will provide persons to perform OWNER-required inspections.

ARTICLE 5 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS

CONTRACTOR will obtain any additional temporary construction facilities, stockpiling or storage sites not otherwise provided. CONTRACTOR will be responsible for providing at his own expense and without liability to the OWNER, any additional land and access thereto that may be required for temporary construction facilities, or for storage of materials. CONTRACTOR will be required to obtain approval of any private property owner for such additional lands and access unless specifically provided otherwise in the Contract Documents.

5.1 Subsurface and Physical Conditions.

5.1.1 CONTRACTOR affirms that CONTRACTOR has carefully examined the Plans and the Site-Related Reports, if any. CONTRACTOR acknowledges that the Site-Related Reports are **not** a guarantee of specific site conditions which may vary between boring locations, and that the Project Site is unwarranted.

5.1.2 CONTRACTOR affirms that prior to executing this Contract, CONTRACTOR has had the opportunity to become familiar with the Project Site and the local conditions under which the Project is to be constructed and operated, and to undertake its own geotechnical studies to the extent that CONTRACTOR deems appropriate. CONTRACTOR will not be entitled to any additional time or compensation as a result of any conditions at the Project Site which would have been disclosed to CONTRACTOR by a site visit or by undertaking its own geotechnical studies.

5.1.3 CONTRACTOR will provide the OWNER written notice as soon as reasonably possible, but no later than three days, if unforeseen conditions are encountered at the Project Site which are subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents, or unknown physical conditions of an unusual nature that differ materially from those normally encountered in the type of work being performed under this Contract. CONTRACTOR may not disturb the conditions until the OWNER conducts an investigation. The OWNER will promptly investigate such conditions.

5.1.3.1 If it is determined that such conditions differ materially and cause an increase or decrease in CONTRACTOR's cost of or time required for performance of any part of the Work, the Contract Administrator will recommend an equitable adjustment in the Contract Price or Contract Time, or both. If it is determined that such conditions are not materially different from those indicated in the Contract Documents, the Contract Administrator will notify CONTRACTOR in writing of such findings and the Contract will not be adjusted.

5.1.3.2 CONTRACTOR will be liable to the OWNER for failure to report any such conflict, error, ambiguity, or discrepancy of which CONTRACTOR knew or reasonably should have known, and for CONTRACTOR's failure to report any conflict, error, ambiguity or discrepancy in the Contract Documents within said three-day period, and for any increases in Project costs, or damages accruing, in association with CONTRACTOR's disturbance of the conditions pending OWNER's investigation.

5.1.4 Notwithstanding any other provision of this Contract, CONTRACTOR is solely responsible for the location and protection of any and all public utility lines and utility customer service lines in the Work area. "Public utility lines" means the utility distribution and supply system, and "utility customer service lines" means the utility lines connecting customers to the utility distribution and collection system. Generally, existing utility customer service line connections are not shown on the Plans. CONTRACTOR will notify "One Call" and exercise due care to locate, mark, uncover and otherwise protect all such lines in the construction zone and any of CONTRACTOR's work or storage areas. CONTRACTOR's responsibility for the location and protection of utilities is primary and non-delegable. CONTRACTOR will indemnify or reimburse such expenses or costs (including fines that may be levied against the OWNER) that may result from unauthorized or accidental damage to all public lines and utility customer service lines in the work area. The OWNER reserves the right to repair any damage CONTRACTOR causes to such utilities at CONTRACTOR's expense. If a public or customer service line is damaged by CONTRACTOR, CONTRACTOR will give verbal notice within one hour and written notice within 24 hours, to the OWNER and to the utility representatives identified on the Plans.

5.1.5 CONTRACTOR will take reasonable precaution to avoid disturbing primitive records and antiquities of archaeological, paleontological or historical significance. No objects of this nature will be disturbed without written permission of the OWNER and the FDHR. When such objects are uncovered unexpectedly, CONTRACTOR will stop all Work in close proximity and notify the OWNER and the FDHR of their presence and will not disturb them until written permission and permit to do so is granted. All primitive rights and antiquities uncovered on the OWNER's property will remain property of FDHR conforming to applicable provisions of Florida Statutes. If the OWNER, in consultation with the FDHR, determines that exploration or excavation of primitive records or antiquities on Project Site is necessary to avoid loss, CONTRACTOR will perform salvage work attendant to preservation. If the Work stoppage or salvage work causes an increase in CONTRACTOR's cost of, or time required for,

performance of the Work, the Contract Price or Contract Time will be equitably adjusted subject to compliance with the provisions herein for Changes and Delays.

5.2 Protection of Reference Points. Unless otherwise specified, the OWNER will furnish a base line and a suitable number of bench marks adjacent to the work. From the information provided by the OWNER, CONTRACTOR will develop and make all detailed surveys, stakes, lines, and elevations, as CONTRACTOR deems necessary. CONTRACTOR will carefully protect and preserve benchmarks, reference points, and stakes. If these benchmarks, reference points, or stakes are disturbed or destroyed due to CONTRACTOR's failure to comply with the above-referenced requirement, CONTRACTOR will bear the cost of expenses of relocating and replacing them, including the costs of a Registered Professional Land Surveyor if the OWNER determines the same to be necessary.

5.3 Hazardous Materials.

5.3.1 To the extent provided by applicable law, the OWNER will be responsible for any pre-existing hazardous material uncovered or revealed at the Project Site which was not shown, indicated or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work.

5.3.1.1 CONTRACTOR will immediately stop Work in the affected area and will take all necessary precautions to avoid further disturbance of the materials. CONTRACTOR will also will immediately notify the OWNER and, if required by applicable law or regulations, all government or quasi-government entities with jurisdiction over the Project or Project Site.

5.3.1.2 Upon receiving notice of the presence of suspected Hazardous Materials, the OWNER will take the necessary measures required to ensure that the Hazardous Materials are remediated or rendered harmless. Such necessary measures will include the OWNER retaining qualified independent experts to (i) ascertain whether Hazardous Materials have actually been encountered, and, if they have been encountered, (ii) prescribe the remedial measures that the OWNER will take either to remove the Hazardous Materials or render the Hazardous Materials harmless.

5.3.1.3 CONTRACTOR will be obligated to resume Work at the affected area of the Project only after the OWNER provides written certification that (i) the Hazardous Materials have been removed or rendered harmless and (ii) all necessary approvals have been obtained from all government and quasi-government entities having jurisdiction over the Project or Site. CONTRACTOR will be responsible for continuing the Work in the unaffected portion of the Project and the Project Site.

5.3.1.4 CONTRACTOR will be entitled, in accordance with these General Conditions, to an adjustment in its Contract Price or Contract Time(s) to the extent CONTRACTOR's cost or time of performance have been adversely impacted by the presence of Hazardous Materials.

5.3.2 CONTRACTOR will maintain at the Project Site, available to the OWNER, appropriate information pertaining to all Hazardous Materials brought to the Project Site by CONTRACTOR or any subcontractor, and as may be required by the Supplemental General Conditions, if any. CONTRACTOR will ensure that all such materials are properly labeled or identified, and will properly store, handle and use them at all times. In accordance with federal Hazard Communication Standard (29 CFR § 1910.1200) and all other applicable Legal Requirements, manufacturers and distributors are required to label each Hazardous Material or chemical container, and to provide Material Safety Data sheets to the purchaser. CONTRACTOR will comply with these laws and will provide the OWNER with copies of all relevant documents, including Material Safety Data sheets prior to performance or services or contemporaneous with delivery of goods. CONTRACTOR will provide and designate appropriate and secure areas for their storage and will notify the OWNER of their presence and location at Project Site. CONTRACTOR will not store Hazardous Materials at the Project Site in excess of those reasonably needed for CONTRACTOR's prosecution of the Work, and will properly remove or dispose of all Hazardous Materials, including combustible waste, as soon as possible after completion of the operations in which they are utilized.

5.3.3 No asbestos-containing materials will be incorporated into the Work or brought on Project Site without prior approval of the OWNER. CONTRACTOR will not knowingly use, specify, request or approve for use any asbestos containing materials or lead-based paint without the OWNER's written approval. When a specific

product is specified, CONTRACTOR will endeavor to verify that the product does not include asbestos containing material.

5.3.4 CONTRACTOR will be solely responsible for use, storage and remediation of any Hazardous Materials brought to Project Site by CONTRACTOR, subcontractors, sub-subcontractors, suppliers, and anyone else for whom CONTRACTOR is responsible. CONTRACTOR will indemnify, defend and hold harmless the OWNER and the OWNER's officers, directors, employees and agents from and against all claims, losses, damages, liabilities and expenses, including attorneys' fees and expenses, arising out of or resulting from those Hazardous Materials introduced to Project Site by CONTRACTOR, subcontractors, sub-subcontractors, suppliers, or anyone for whose acts they may be liable.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.1 General Responsibilities.

6.1.1 Scope of Work. CONTRACTOR will provide, perform, and complete all necessary work, labor, services, transportation, equipment, materials, apparatus, machinery, tools, fuels, gas, electric, water, waste disposal, information, data and other means and items necessary to accomplish the Project at the Work Site, including measures for sediment control, storm water management, and waste disposal, in compliance with this Contract. CONTRACTOR is required to perform all Work specified in the Contract Documents and reasonably inferable from these Documents as being necessary to produce the intended results.

6.1.2 Quality. All materials and Work will be of good quality for the intended use and consistent with the quality of surrounding Work, and will conform to the requirements of the Contract Documents and to the standards for construction of the Project generally. All materials will be new.

6.1.3 Construction Means and Methods. CONTRACTOR will provide continuous on-site supervision and direction of the Work using CONTRACTOR's best efforts. CONTRACTOR will have control over construction means, methods, techniques, sequences, and procedures, unless the Contract Documents give other specific instructions concerning these matters, and is solely responsible therefore.

6.1.4 Discipline at the Project Site. CONTRACTOR will enforce strict discipline and good order among CONTRACTOR's employees and other persons for whose Work CONTRACTOR is responsible, including CONTRACTOR's employees, subcontractors, sub-subcontractors, and suppliers, and the agents and employees of any of them.

6.1.5 Responsibility for Subordinates. CONTRACTOR is responsible for the acts and omissions of all persons performing portions of the Work at the Project Site, including but not limited to CONTRACTOR's employees, subcontractors, sub-subcontractors, and suppliers, and the agents and employees of any of them.

6.1.6 Assignment, Scheduling and Coordination. CONTRACTOR is solely responsible for and has control over assigning, scheduling and coordinating all portions of the work under the Contract performed by CONTRACTOR's own forces and by its subcontractors, sub-subcontractors, and suppliers, in accordance with the approved Progress Schedule, unless the Contract Documents give other specific instructions concerning these matters.

6.1.7 Obligations Not Relieved. CONTRACTOR is not relieved of its obligations to perform the Work in accordance with the Contract Documents, by the activities or duties of the OWNER or the E/A in the administration of the Contract or of construction, or by tests, inspections, or approvals required or performed by persons other than CONTRACTOR.

6.1.8 Ongoing Duty to Report Problems with Contract Documents. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between any Contract Document and any Legal Requirement or of any such standard, specification, manual, or code or instructions of any manufacturer or supplier, CONTRACTOR will within three days of such discovery report it to the OWNER in writing, and CONTRACTOR will not proceed with the Work affected thereby until a Change

Order has been issued. CONTRACTOR will be liable to the OWNER for failure to report any such conflict, error, ambiguity, or discrepancy of which CONTRACTOR knew or reasonably should have known. CONTRACTOR will be liable to the OWNER for CONTRACTOR's failure to report any conflict, error, ambiguity or discrepancy in the Contract Documents within said three-day period.

6.1.9 Inspection of Work. CONTRACTOR will make frequent inspections during the progress of the Work to confirm that work previously performed by CONTRACTOR is in compliance with the requirements of this Contract, and that any portion of Work previously performed by CONTRACTOR or by others is in proper condition to receive subsequent Work.

6.2 Diligent Prosecution. CONTRACTOR will at all times be responsible for the diligent prosecution of the Work so as to complete the Work within the Contract Time.

6.2.1 CONTRACTOR will have an affirmative obligation to rearrange Milestones, notwithstanding the manner in which they are scheduled in the current approved Progress Schedule, as circumstances may require. If in order to meet this obligation CONTRACTOR rearranges the order of Work in a manner that materially departs from the current approved Progress Schedule, CONTRACTOR will within 3 days thereafter provide notice to the OWNER, who may require CONTRACTOR to submit a revised Progress Schedule reflecting the rearrangement. No revised Progress Schedule extending the Contract Time will be approved without the issuance of a Change Order in compliance with the Contract Documents.

6.2.2 CONTRACTOR will carry on the Work and adhere to the current approved Progress Schedule, including during all disputes or disagreements with the OWNER. No Work will be delayed or postponed pending resolution of any disputes or disagreements, except as the OWNER and CONTRACTOR may otherwise agree through a Change Order or Contract amendment.

6.3 Supervision and Superintendence.

6.3.1 CONTRACTOR will supervise the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.

6.3.2 CONTRACTOR will have an English-speaking, competent Superintendent on the Work at all times that work is in progress. The Superintendent will be CONTRACTOR's representative on the Work and will have the authority to act on the behalf of CONTRACTOR. All communications given to the Superintendent will be as binding as if given to CONTRACTOR, even where written notice is otherwise required. Either CONTRACTOR or the Superintendent will provide a cellular telephone number and an emergency and home telephone number at which one or the other may be reached if necessary when Work is not in progress. The Superintendent will be an employee of CONTRACTOR, unless waived in writing by the OWNER. If CONTRACTOR proposes a management structure with a Project Manager supervising, directing, and managing construction of the work in addition to or in substitution of a Superintendent, the requirements of these Construction Documents with respect to the Superintendent will likewise apply to any such Project Manager.

6.3.2.1 CONTRACTOR will present the resume of the proposed Superintendent to the OWNER showing evidence of experience and successful superintendence and direction of work of a similar scale and complexity. The OWNER may reject the proposed Superintendent if the OWNER determines that the proposed Superintendent does not have sufficient experience in line with the Work, in which instance CONTRACTOR will propose a different Superintendent for OWNER approval.

6.3.2.2 CONTRACTOR will not replace the Superintendent without written notice to the OWNER. If CONTRACTOR deems it necessary to replace the Superintendent, CONTRACTOR will provide the necessary information for approval, as stated above, on the proposed new Superintendent.

6.3.2.3 CONTRACTOR may designate a qualified substitute Superintendent if the designated Superintendent is temporarily away from the Work, subject to OWNER approval.

6.3.2.4 CONTRACTOR will replace the Superintendent upon the OWNER's request, if the Superintendent is unable to perform to the OWNER's satisfaction.

6.4 Labor, Materials, and Equipment.

6.4.1 CONTRACTOR will employ only orderly and competent workers, skillful in performance of the type of Work required under this Contract. CONTRACTOR will prohibit the use and possess any alcoholic or other intoxicating beverages, illegal drugs, or controlled substances while on the job or on the OWNER's property. Subject to the applicable provisions of Florida law, neither CONTRACTOR, nor subcontractors, suppliers, or other agents of CONTRACTOR, may use or possess any firearms or other weapons while on the job or on the OWNER's property. If the OWNER notifies CONTRACTOR that any officer, employee, subcontractor, supplier, or other agent is incompetent, disorderly, abusive, or disobedient, has knowingly or repeatedly violated safety regulations, has possessed any firearms in contravention of the applicable provisions of Florida law, or has possessed or was under the influence of alcohol or drugs on the job, CONTRACTOR will immediately remove that person from performing Contract Work, and may not employ that person again on the Work without the OWNER's prior written consent. CONTRACTOR will at all times maintain good discipline and order on- and off-Project Site in all matters pertaining to the Project. CONTRACTOR will pay workers no less than the wage rates established by law, and maintain weekly payroll reports as evidence thereof.

6.4.2 CONTRACTOR will not use any preexisting facilities of the OWNER without the specific written consent of the OWNER, except as indicated in the Contract Documents. CONTRACTOR is solely responsible for temporary facilities and services provided or utilized by CONTRACTOR and will remove those not required to remain at the completion of the Work or any portion thereof, will promptly correct any damage caused by the erection, use or removal of temporary facilities; and will restore the Project Site and any adjacent areas to their original condition or that required by the Contract Documents upon completion of the Work.

6.4.3 CONTRACTOR will store, handle, install, and test all materials in accordance with the manufacturer's or suppliers' most recent instructions and recommendations. CONTRACTOR will promptly notify the OWNER if these instructions and recommendations are in conflict with any provision of the Contract Documents.

6.4.4 All materials and equipment will be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with instructions of the applicable manufacturer and supplier, except as otherwise provided in the Contract Documents. The Contract Administrator or E/A may require CONTRACTOR to furnish one or more of the following:

6.4.4.1 Satisfactory evidence (i.e., reports of required tests, manufacturer's certificates of compliance with material requirements, mill reports, etc.) as to the kind and quality of materials and equipment.

6.4.4.2 Samples of required equipment and materials prior to having such equipment and materials delivered to the Project Site. Each sample submitted by CONTRACTOR will carry a label giving the name of CONTRACTOR, the Project, and the name of the producer. The accompanying certificate or letter from CONTRACTOR will state that the sample complies with the contract requirements, will give the name and brand of the product, its place of origin, the name and address of the producer and all specifications or other detailed information which will assist the OWNER in reviewing the sample promptly. It will also include the statement that all materials or equipment furnished for use in the Project will comply with the samples or certified statements. In addition, the accompanying certificate will include a written narrative explanation itemizing the extent to which the sample deviates from the Specifications or other Contract requirements.

6.4.5 The OWNER will not be required to consider delays in the Work caused by delivery of non-complying materials or equipment, or by late or improper submission test reports or manufacturer's certificates for OWNER approval, as just cause for an extension of the Contract Time. The OWNER's acceptance of any test report, certificate, or sample will be general only and will not constitute a waiver of the OWNER's right to demand full compliance with Contract requirements, nor relieve CONTRACTOR from ensuring full compliance with the Contract.

6.4.6 CONTRACTOR will assign to the OWNER, any rights CONTRACTOR may have to bring antitrust suits against suppliers for overcharges on materials incorporated in the Project growing out of illegal price fixing agreements. CONTRACTOR will cooperate with the OWNER should the OWNER wish to prosecute suits against suppliers for illegal price fixing.

6.4.7. Upon CONTRACTOR's request and the Contract Administrator's written approval, CONTRACTOR may locate stored materials off-site, so long as they are in a bonded and insured facility, accessible to the OWNER, and are clearly marked as OWNER's property.

6.4.8 Title to materials delivered to the Project Site or stored off-site will not be deemed to pass to the OWNER until the OWNER accepts such title by paying for same. The OWNER will be entitled but is not required to request title documentation. Risk of loss will not pass to the OWNER until title passes.

6.5 Concerning Subcontractors, Suppliers, and Others.

6.5.1 CONTRACTOR will retain direct control of and give direct attention to the fulfillment of this Contract. CONTRACTOR agrees not to assign this Contract, by power of attorney or otherwise, without the OWNER's prior written consent.

6.5.2 Unless the Supplemental General Conditions provide otherwise, CONTRACTOR will not subcontract the performance of the entire Project or the supervision and direction of the Work without the OWNER's prior written consent. CONTRACTOR will not employ any subcontractor or other person or organization, whether initially or as a substitute, against whom the OWNER may have reasonable objection. The OWNER will communicate such objections by written notice. CONTRACTOR will not substitute any subcontractor that has been accepted by the OWNER, unless the OWNER first accepts the substitute in writing.

6.5.3 CONTRACTOR will enter into written agreements with all subcontractors and suppliers which specifically bind the subcontractors and suppliers to the applicable terms and conditions of the Contract Documents for the OWNER's benefit. The OWNER reserves the right to specify that certain requirements will be adhered to by all subcontractors and sub-subcontractors as indicated in other portions of the Contract Documents, in which instance these requirements will be made a part of the written agreement between CONTRACTOR and each subcontractor. CONTRACTOR's standard subcontract form is subject to the OWNER's review and approval. Within five working days of the OWNER's request for subcontractor contract documents, CONTRACTOR will provide them to the OWNER.

6.5.3.1 CONTRACTOR is asked to provide copies of all subcontracts and purchase orders issued to MBE/WBE subcontractors and suppliers. MBE/WBE subcontractors or suppliers may not be replaced without good cause. CONTRACTOR shall make a good faith effort to replace any terminated MBE/WBE subcontractor or supplier with another MBE/WBE certified subcontractor or supplier.

6.5.4 CONTRACTOR will be fully responsible to the OWNER for all acts and omissions of the subcontractors, suppliers, and other persons and organizations performing or furnishing any of the Work under contract with CONTRACTOR and under contract with CONTRACTOR's subcontractors or suppliers, just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents will create for the benefit of any such subcontractor or other person or organization any contractual relationship between the OWNER and any such subcontractor or other person or organization, nor will it create any obligation on the part of the OWNER or E/A to pay or to see to the payment of any moneys due any such subcontractor or other person or organization except as may otherwise be required by Legal Requirements.

6.5.5 CONTRACTOR will be solely responsible for efficiently scheduling and coordinating the Work of subcontractors and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR in order to avoid any delays or inefficiencies in the prosecution of the Work. CONTRACTOR will require all subcontractors and such other persons and organizations performing or furnishing any of the Work to communicate with the OWNER through CONTRACTOR.

6.5.6 The divisions and sections of the Technical Provisions and the identification of any Plans will not control CONTRACTOR in dividing or delineating the Work to be performed by any specific trade.

6.5.7 CONTRACTOR will pay each subcontractor their appropriate share of payments made to CONTRACTOR not later than ten days of CONTRACTOR's receipt of payment from the OWNER.

6.5.7.1 CONTRACTOR will submit Attachment E, MBE/WBE Usage, outlining the payments made to MBE/WBE subcontractors and suppliers pursuant to each progress payment.

6.5.8 To the extent allowed by Florida law, the OWNER will be deemed to be a third party beneficiary to each subcontract and may, if the OWNER elects, following a termination of CONTRACTOR, require that the subcontractor(s) perform all or a portion of unperformed duties and obligations under its subcontract(s) for the benefit of the OWNER, rather than CONTRACTOR; however, if the OWNER requires any such performance by a subcontractor for the OWNER's direct benefit, then the OWNER will be bound and obligated to pay such subcontractor the reasonable value for all Work performed by such subcontractor to the date of the termination of CONTRACTOR, less previous payments, and for all Work performed thereafter. If the OWNER elects to invoke the OWNER's right under this Section, the OWNER will provide notice of such election to CONTRACTOR and the affected subcontractor(s).

6.6 Patent Fees and Royalties.

6.6.1 CONTRACTOR will be responsible at all times for compliance with applicable patents and copyrights encompassing, in whole or in part, any design, device, material, or process utilized, directly or indirectly, in the performance of the Work or the formulation or presentation of its Bid.

6.6.2 CONTRACTOR will pay all royalties and license fees and will provide, prior to commencement of Work hereunder and at all times during the performance of same, for lawful use of any design, device, material or process covered by letters, patent or copyright by suitable legal agreement with the patentee, copyright holder, or their duly authorized representative whether or not the OWNER specifies a particular design, device, material, or process.

6.6.3 CONTRACTOR will defend all suits or claims for infringement of any patent or copyright and will save the OWNER harmless from any loss or liability, direct or indirect, arising with respect to CONTRACTOR's process in the formulation of its Bid or the performance of the Work or otherwise arising in connection therewith. The OWNER reserves the right to provide its own defense to any suit or claim of infringement of any patent or copyright in which event CONTRACTOR will indemnify and save harmless the OWNER from all costs and expenses of such defense as well as satisfaction of all judgments entered against the OWNER.

6.6.4 The OWNER will have the right to stop the Work or terminate this Contract at any time if CONTRACTOR fails to disclose to the OWNER that CONTRACTOR's work methodology includes the use of any infringing design, device, material, or process.

6.7 Permits, Fees. CONTRACTOR will secure and pay for at CONTRACTOR's expense, all permits and licenses of a temporary nature that are required for the prosecution of the Work; provided, however, that the OWNER will reimburse CONTRACTOR for any CITY-required permits unless specified otherwise in the Supplemental General Conditions.

Unless the Supplemental General Conditions provide otherwise, the OWNER will obtain licenses and easements for permanent structures and or permanent changes in existing facilities.

6.8 Construction Operations.

6.8.1 CONTRACTOR will confine operations at the Project Site to those areas permitted by all Legal Requirements, and will not unreasonably encumber the Project Site with materials and equipment. CONTRACTOR will assume full responsibility for any damage to any portion of the Project Site, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work. If an adjacent property owner or

occupant files a claim because of or in connection with the performance of the Work, CONTRACTOR will promptly settle the claim by negotiation or as otherwise provided by law. CONTRACTOR will indemnify, defend and hold harmless the OWNER and anyone directly or indirectly employed by the OWNER, from and against all claims, costs, losses, and damages (including court costs and reasonable attorney's fees) arising out of or resulting from any claim or action, legal or equitable, brought by any such the owner or occupant against the OWNER, E/A or any other party indemnified hereunder to the extent caused by or based upon performance of the Work or failure to perform the Work.

6.8.2 CONTRACTOR will establish the exterior lines and elevations of all buildings and structures to be erected on the Project Site, and lines and grades of site work such as roads, utilities, and site grading, based on reference points, the location of existing structures and improvements, or benchmarks identified in the site surveys provided by the OWNER. CONTRACTOR will provide a professional certification by a professional engineer or land surveyor as to the actual location of building lines prior to constructing any foundations. CONTRACTOR will establish the building grades, lines, and levels, and column, wall, and partition lines required by subcontractors in laying out the Work. At the completion of the Work, CONTRACTOR will provide another professional certification by a registered engineer or land surveyor as to the location of completed improvements in relation to property lines, building lines, easements, and other boundaries.

6.8.3 CONTRACTOR will not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor will CONTRACTOR subject any part of the Work, the Project Site, or adjacent property to stresses or pressures that will endanger it.

6.8.4 All Work will be performed solely during Working Hours, unless (i) more restrictive hours are required by CITY ordinances or other Legal Requirements governing CONTRACTOR's performance of the Work, or (ii) the Contract Administrator approves expanded Working Hours in writing, such as in the event of emergencies, in which instance the Contract Administrator's approval may be terminated at any time and for any reason without recourse to CONTRACTOR. The OWNER has the right to impose further restrictions on working hours reasonably related to the use of occupied facilities. No delays resulting from compliance with applicable Legal Requirements may form the basis for any claim by CONTRACTOR for delay damages or additional compensation or for any extensions of the Contract Time; any delays arising from restrictions related to the use of occupied facilities are non-compensable and any claims for extensions of the Contract Time relating to them will be filed in accord with Article 11 or the same will be conclusively deemed to have been waived. CONTRACTOR will not permit Work outside of Working Hours without the written consent of the OWNER; such consent, if given, may be conditioned upon payment by CONTRACTOR of the OWNER's additional costs and fees incurred in monitoring such off-hours Work. CONTRACTOR will notify the OWNER as soon as possible if Work will be performed outside such times in the interest of the safety and protection of persons or property at the Project Site or adjacent thereto, or in the event of an emergency. In no event will CONTRACTOR permit Work to be performed at the Project Site without the presence of CONTRACTOR's Superintendent and person responsible for the protection of persons and property at the Project Site and compliance with all Legal Requirements, if different from the Superintendent.

6.8.5 Temporary Utilities. CONTRACTOR, at its own expense, will:

6.8.5.1 Furnish all temporary heat, cooling ventilation, and humidity control including all required apparatus and fuel as may be necessary to protect the Work fully, both during its execution and until Final Completion and acceptance. CONTRACTOR will not use any method of heating, cooling, ventilation, or humidity control of the building unless approved by the OWNER in advance.

6.8.5.2 Provide all temporary on-Site water service required to perform the Work, to assure safety at the Site, and as otherwise required. All temporary services will be removed by CONTRACTOR.

6.8.5.3 Furnish all temporary electric service required to perform the Work, to assure safety at the Site, and as otherwise required.

6.8.5.4 CONTRACTOR will provide and maintain in a neat, sanitary condition such accommodations for the use of CONTRACTOR's employees, subcontractors, and others for whom CONTRACTOR may be responsible, as may be necessary to comply with Legal Requirements, and will commit no public nuisance.

6.8.6 Site Maintenance. During the progress of the Work and on a daily basis, CONTRACTOR will keep the Project Site free from accumulation of waste materials, rubbish, and other debris resulting from the Work. If CONTRACTOR fails to do so in a manner reasonably satisfactory to the OWNER within 48 hours after notice or as otherwise required by the Contract Documents, the OWNER may clean the Project Site and back charge CONTRACTOR for all costs associated with the cleaning. At Substantial Completion, CONTRACTOR will leave the Project Site clean, including but not limited to the cleaning of manholes, inlets, and gravity underground piping systems, and ready for the OWNER's occupancy, and will at this point also remove all temporary buildings, waste, trash, debris, and surplus materials. At Final Completion, CONTRACTOR will remove all tools, appliances, construction equipment, and machinery, in addition to the above-referenced materials, and leave the Project Site clean and ready for OWNER's occupancy. This requirement will not apply to property used for permanent disposal of rubbish or waste materials in accordance with permission for such disposal granted to CONTRACTOR by the OWNER. CONTRACTOR will, at a minimum, restore to original condition all property not designated for alteration by the Contract Documents. If CONTRACTOR fails to clean up at the completion of the Work, the OWNER may do so and the cost thereof will be charged against CONTRACTOR.

6.8.7 Risk of Performance. If CONTRACTOR performs any work involving an apparent error, inconsistency, ambiguity, construction impracticality, omission, or violation of Legal Requirements in the Contract Documents of which CONTRACTOR is aware, or which could reasonably have been discovered by the review required by CONTRACTOR by this Contract, without prompt written notice to the OWNER and the E/A and request for correction, clarification or additional information, as appropriate, CONTRACTOR does so at its own risk and expense and all claims relating thereafter are specifically waived.

6.9 Legal Requirements.

6.9.1 CONTRACTOR will diligently and promptly call for locates required, in accordance with Sunshine State One Call of Florida requirements.

6.9.2 CONTRACTOR will give all other notices and comply with all other Legal Requirements, including arranging for and obtaining any required inspections, tests, approvals or certifications from any public body having jurisdiction over the Work or any part thereof. Except where these Legal Requirements provide otherwise, neither the OWNER nor the E/A will be responsible for monitoring CONTRACTOR's compliance with any Legal Requirements.

6.9.3 Maintaining clean water, air, and earth or improving thereon will be regarded as of prime importance. CONTRACTOR will plan and execute its operations in compliance with all applicable Legal Requirements concerning control and abatement of water pollution and prevention and control of air pollution, including where applicable the terms and conditions of the CITY's current National Pollutant Discharge Elimination System (NPDES) permit.

6.10 Taxes.

6.10.1 CONTRACTOR will pay only those sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with the laws and regulations of the State of Florida in the performance of this Contract.

6.10.2 The OWNER is an exempt organization as defined by Florida Statutes and is therefore exempt from payment of sales and use taxes.

6.11 Maintenance of Records and Documents.

6.11.1 CONTRACTOR will maintain at the Site, available to the OWNER for reference during the progress of the Work, a copy of the current approved Progress Schedule and any approved revisions thereto. CONTRACTOR will keep current records of and mark on a copy of the current approved Progress Schedule the actual commencement date, progress, and completion date of each scheduled activity indicated on the Progress Schedule.

6.11.2 CONTRACTOR will maintain in a safe place at the Project Site, or other location acceptable to the OWNER, one record copy of all Drawings, Specifications, Addenda, Change Instruments and written interpretations and clarifications issued pursuant to this Contract (collectively, "Record Documents") in good order and annotated to show all changes made during construction. The Record Documents and all final samples and final Shop Drawings will be available to the OWNER and E/A for reference during performance of the Work. Upon Substantial Completion of the Work, CONTRACTOR will deliver these Record Documents, and final samples and Shop Drawings, to the OWNER.

6.11.3 To the extent applicable, CONTRACTOR will comply with the requirements of Florida Statutes Section 119.0701, which include the following:

6.11.3.1 Keeping and maintaining public records that the CITY requires for performance of the service provided herein.

6.11.3.2 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.

6.11.3.3 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, and following such completion if CONTRACTOR fails to transfer such records to the CITY.

6.11.3.4 Upon completion of this Contract, keep and maintain public records required by the CITY to perform the service. CONTRACTOR will meet all applicable requirements for retaining public records. All records stored electronically must be provide to the CITY upon request from the CITY Clerk, in a format that is compatible with the CITY's information technology systems.

6.11.3.5 IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONTRACTOR'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT, CONTRACTOR 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

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

6.12 Safety and Protection.

6.12.1 CONTRACTOR will be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Upon request, and prior to installation of measures, CONTRACTOR will submit a site security plan to the OWNER. By reviewing the plan or making recommendations or comments, the OWNER will not assume liability nor will CONTRACTOR be relieved of liability for damage, injury, or loss. CONTRACTOR will take all necessary precautions for the safety of and will provide the necessary protection to prevent damage, injury, and loss to:

6.12.1.1 The public;

6.12.1.2 All persons on the Project Site or who may be affected by the Work;

6.12.1.3 All the Work and materials and equipment to be incorporated therein, whether in storage on or off Project Site; and

6.12.1.4 Other personal property, fixtures and other items at the Project Site or adjacent thereto, including, but not limited to, trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and underground facilities not designated for removal, relocation, or replacement in the course of construction.

6.12.2 CONTRACTOR will comply with the Occupational Safety and Health Administration's (OSHA) Excavation Safety Standard, 29 U.S.C § 651 et seq., 29 C.F.R. 1926.650 Sub Part P., and the Trench Safety Act, Section 553.60 et seq. In addition CONTRACTOR will comply with all other applicable laws and regulations of any public body having jurisdiction for safety of persons or property or to protect them from damage, injury or loss, and will erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR will notify owners of adjacent property and of underground facilities, and utility owners when prosecution of the Work may affect them, and will cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to in Subparagraphs 6.12.1.3 and 6.12.1.4, above, caused, directly or indirectly, in whole or in part, by CONTRACTOR, any subcontractor, or any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, will be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of the OWNER, or E/A, or anyone employed by any of them or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the faults or negligence of CONTRACTOR or any subcontractor, supplier or other person or organization directly or indirectly employed by any of them). CONTRACTOR's duties and responsibilities for safety and protection of the Work will continue until such time as all the Work is completed and the OWNER has issued a Certificate of Final Completion (except as otherwise expressly provided in connection with Substantial Completion). Without limitation, CONTRACTOR will comply with the following specific provisions:

6.12.3 CONTRACTOR will designate in writing a qualified and experienced safety representative at Project Site whose duties and responsibilities will be the prevention of accidents and the maintaining and supervising of safety precautions and programs. Upon request of the OWNER, CONTRACTOR will provide certifications or other documentation of the safety representative's qualifications.

6.12.4 CONTRACTOR will be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at Project Site in accordance with Legal Requirements.

6.12.5 CONTRACTOR will comply with the following requirements in emergencies:

6.12.5.1 In emergencies affecting the safety or protection of persons or the Work at Project Site or adjacent thereto, CONTRACTOR, without special instruction or authorization from the OWNER or E/A, is obligated to act reasonably to prevent threatened damage, injury or loss and to mitigate damage or loss to the Work. CONTRACTOR will give the OWNER telephone notification as soon as reasonably practical and a prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the express provisions of this Contract Documents have been caused thereby. If the OWNER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Change Order will be issued; otherwise the OWNER will not be responsible for CONTRACTOR's emergency action.

6.12.5.2 Authorized agents of CONTRACTOR will respond immediately to call-out at any time of any day or night when circumstances warrant the presence on Project Site of CONTRACTOR or his agent to protect the Work or adjacent property from damage, restriction or limitation or to take such action or measures pertaining to the Work as may be necessary to provide for the safety of the public. Should CONTRACTOR or CONTRACTOR's agent fail to respond and take action to alleviate such an emergency situation, the OWNER may direct other forces to take action as necessary to remedy the emergency condition, and the OWNER will deduct any cost of such remedial action from the funds due CONTRACTOR under this Contract.

6.12.5.3 If there is an accident involving injury to any individual or damage to any property on or near the Work, CONTRACTOR will provide to the Contract Administrator verbal notification within one hour and written notification within 24 hours of the event and will be responsible for recording the location of the event and the circumstances surrounding the event through photographs, interviewing witnesses, obtaining medical reports, police accident reports and other documentation that describes the event. CONTRACTOR will provide the OWNER copies of such documentation within 48 hours of the event.

6.12.5.4 CONTRACTOR will cooperate with the OWNER in any investigation of any such incident. CONTRACTOR will immediately report such incidents to any other governmental or quasi-governmental authorities having jurisdiction over safety-related matters as may be required by law.

6.13 Indemnification.

6.13.1 Any obligation of CONTRACTOR to indemnify or hold harmless under this Contract will not be limited in any way by any limitation on the amount or type of damages, or compensation or benefits payable by or for CONTRACTOR or any such subcontractor, supplier, or other person or organization for whom CONTRACTOR may be responsible under workers' compensation acts, disability benefit acts, or other employee benefit acts.

6.13.2 Any obligation of CONTRACTOR to indemnify and hold harmless under this Contract, will not extend to the liability of the OWNER, E/A, E/A's consultants, and their officers, directors, partners, employees or agents, when caused primarily by negligent preparation of maps, drawings, surveys, designs or specifications upon which is placed the applicable state-authorized design professional seal of the OWNER, E/A, or OWNER's or E/A's consultant's, officers, directors, partners, employees or agents.

6.13.3 If CONTRACTOR fails to follow the OWNER's directives concerning use of Project Site, scheduling or course of construction, or engages in other conduct which proximately causes damage to property based on inverse condemnation or otherwise, then and in that event, CONTRACTOR will indemnify the OWNER against all costs resulting from such claims.

6.13.4 If CONTRACTOR unreasonably delays progress of the Work being done by others on Project Site so as to cause loss for which the OWNER becomes liable, then CONTRACTOR will indemnify the OWNER from and reimburse the OWNER for such loss.

6.14 Survival of Obligations. All representations, indemnifications, warranties and guarantees made in, required by or given in accordance with this Contract, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Contract.

6.15 Losses from Natural Causes. Unless otherwise specified, all loss or damage to CONTRACTOR arising out of the nature of the Work to be done or from action of the elements, floods or from unforeseeable circumstances in prosecution of the Work or from unusual obstructions or difficulties which may be encountered in prosecution of the Work, will be sustained and borne by CONTRACTOR at its own cost and expense.

6.16. Notice of Claim. Should CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of OWNER or of any of OWNER's employees or agents or others for whose acts OWNER is liable, CONTRACTOR must file a claim within 30 calendar days of the event giving rise to such injury or damage. The provisions of this Section will not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or statute of repose.

6.17 Financial Records.

6.17.1 For purposes of this Section 6.17, "financial records" means all records generated by or on behalf of CONTRACTOR and each Subcontractor and supplier of CONTRACTOR, whether paper, electronic, or other media, which are in any way related to performance of or compliance with this Contract, including, without limitation:

- .1 Accounting records;

- .2 Written policies and procedures;
- .3 Subcontract files (including proposals of successful and unsuccessful Bidders, Bid recaps, etc.);
- .4 Original estimates and estimating work sheets;
- .5 Correspondence;
- .6 Change Order files (including documentation covering negotiated settlements);
- .7 Back charge logs and supporting documentation;
- .8 General ledger entries detailing cash and trade discounts earned, insurance rebates and dividends;
- .9 Lump sum agreements between CONTRACTOR and any Subcontractor or supplier;
- .10 Records necessary to evaluate: Contract compliance, Change Order pricing, and any Claim submitted by CONTRACTOR or any of its payees; and
- .11 Any other CONTRACTOR record that may substantiate any charge related to this Contract.

6.17.2 CONTRACTOR will allow the OWNER, and the OWNER's authorized representatives, to inspect, audit, and reproduce all Records generated by or on behalf of CONTRACTOR and each subcontractor and supplier, upon the OWNER's written request. Further, CONTRACTOR will allow the OWNER, and the OWNER's authorized representatives, to interview any of CONTRACTOR's employees, all Subcontractors, all suppliers, and all of their respective employees.

6.17.3 CONTRACTOR will retain all its Records, and require all its subcontractors and suppliers to retain their respective Records, during this Contract and for three years after final payment, until all audit and litigation matters that the OWNER has brought to the attention of CONTRACTOR are resolved, or as otherwise required by law, whichever is longer. The OWNER's right to inspect, audit, or reproduce Records, or interview employees of CONTRACTOR or its respective subcontractors or suppliers, exists during this Contract, and for three years after final payment, until all audit and litigation matters that the OWNER has brought to CONTRACTOR's attention are resolved, or as otherwise required by law, whichever is longer, and at no cost to the OWNER, either from CONTRACTOR or any of its subcontractors or suppliers that may furnish Records or make employees available for interviewing.

6.17.4 CONTRACTOR must provide sufficient and accessible facilities during its normal business hours for the OWNER to inspect, audit, or reproduce Records, or all three, and to interview any person about the Records.

6.17.5 CONTRACTOR must insert these requirements in each written contract between CONTRACTOR and any subcontractor or supplier and require each subcontractor and supplier to comply with these provisions.

ARTICLE 7 - OTHER WORK

7.1 Coordinating Other Work. The OWNER may perform other work related to the Project at Project Site by the OWNER's own forces, or let other contracts for the Project or Project Site, or have other work performed by utility owners. CONTRACTOR and the OWNER agree to and will use best efforts to cooperate and coordinate the Work with others performing work and other work related to the Project in order to avoid conflicts and delays in the Work. If CONTRACTOR believes that delay or additional cost is involved because of such action by the OWNER, CONTRACTOR may make a Claim as provided in Article 11.

7.2 Proper and Safe Access by Other Contractors. CONTRACTOR will afford other contractors and each utility owner (and the OWNER, if the OWNER is performing the additional work with the OWNER's employees) proper and safe access to the Project Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and will properly connect and coordinate the Work with theirs. CONTRACTOR will do all cutting, fitting, patching, and finishing of the Work that may be required to make its several parts come together properly and integrate with such other work. CONTRACTOR will not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written

consent of the OWNER and the other contractors whose work will be affected. CONTRACTOR will promptly remedy damage wrongfully caused by CONTRACTOR to completed or partially completed construction or to property of the OWNER or separate contractors.

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

7.4 Progress Schedules. The OWNER will provide for coordination of the activities of the OWNER's own forces, of each separate CITY contractor, and of any other utility owners performing work in relation to the Work of CONTRACTOR, who will cooperate with them. CONTRACTOR will participate with the OWNER any other contractors retained by the OWNER, in reviewing their construction progress schedules when directed to do so. On the basis of such review, CONTRACTOR will make any revisions to the current approved Progress Schedule deemed necessary after a joint review and mutual agreement. The agreed-upon progress schedules will then constitute the progress schedules to be used by CONTRACTOR, the OWNER, and any other contractor retained by the OWNER until subsequently revised.

7.5 Improper Timing or Delays. Costs caused by delays or by improperly timed activities or defective construction will be borne by the party responsible therefore.

ARTICLE 8 – WARRANTIES

8.1 General Warranty.

CONTRACTOR warrants that the Work and all of its components will be free from defects and flaws in design, workmanship, and materials for the duration of the General Warranty Period described below; will strictly conform to the requirements of the Contract; and will be fit, sufficient and suitable for the purposes expressed in, or reasonably inferred from, the Contract. This general warranty is in addition to any other warranties expressed or implied by law, which are hereby reserved unto the OWNER.

8.1.1 General Warranty Period. The General Warranty Period will be one year from Substantial Completion, except for those items of equipment or those aspects of work placed in service or approved by the OWNER after Substantial Completion, in which instance the warranty for the particular equipment or aspect of work will be one year from the date of OWNER approval; provided, however, that the General Warranty Period for particular equipment placed in continuous service before Substantial Completion may start to run from an earlier date, if expressly provided in this Contract.

8.1.2 Duty to Correct. CONTRACTOR will correct any and all defects that defects in material or workmanship which may appear during the General Warranty Period, even if discovered after the General Warranty Period, by repairing (or replacing with new items or new materials, if necessary) any such defect at no cost to the OWNER, within a reasonable period of time, and to the OWNER's satisfaction.

8.1.3 General Warranty is Absolute. The only exceptions to the General Warranty will be defects or damage caused by abuse, modification or improper maintenance or operation by persons other than CONTRACTOR or CONTRACTOR's subcontractors, sub-subcontractors or suppliers; or normal wear and tear under normal usage. In all other respects the General Warranty will be absolute.

8.2 Special Warranties. CONTRACTOR will furnish all additional special warranties required by this Contract no later than Substantial Completion. The OWNER may require special warranties in connection with the approval of accepted equals and other substitute materials, equipment, methods, and procedures, and in connection with Work which is defective or nonconforming.

8.3. Limitation as to Certain Equipment. As to any equipment which the OWNER has reserved the sole right to have installed, the Warranties under this Article 8 will extend to ensure that the equipment is installed according to the Plans and Technical Provisions, and that any manufacturer or product warranties are conveyed to the OWNER; but in such instance CONTRACTOR will not be held liable for the operating performance of such equipment.

8.4 Relation to Specific Correction Provisions and Other Remedies. CONTRACTOR's general warranty and any additional or special warranties are not limited by CONTRACTOR's obligations to specifically correct Defective/Nonconforming Work, nor are they limited by any other remedies provided in the Contract Documents. CONTRACTOR will also be liable for any damage to property or persons (including death), including consequential and direct damages, relating to any breach of the General Warranty or any additional or special warranties required.

8.5 Third Party Warranties. CONTRACTOR will obtain and assign or transfer to the OWNER, all product warranties available from manufacturers or suppliers of materials to be used in the Project. CONTRACTOR will also obtain and assign or transfer to OWNER, any additional third party warranties as to materials or methods as specified in the Contract Documents. The OWNER's acceptance of any assigned warranties or guaranties will be a precondition to final payment and will not relieve CONTRACTOR of any of CONTRACTOR's guaranty or warranty obligations under this Contract.

ARTICLE 9 – E/A'S STATUS DURING CONSTRUCTION

9.1 Applicability. The provisions of this Article will apply only where the Contract Documents specifically authorize a consultant of the OWNER to act as the E/A to review and modify Technical Provisions, Plans, and other technical specifications associated with the Work. In all instances in which there is no such specific authorization, the provisions of this Article will have no effect, and any authorization or delegation within the Contract Documents to the E/A, will be deemed to be to the Contract Administrator. In addition, where the Contract Documents contain language specifically authorizing a consultant of the OWNER to act as E/A, the OWNER retains the right to assign or assume such authority upon written notice to CONTRACTOR.

9.2 The OWNER's Sole Benefit. The assignment, if any, of any authority, duties or responsibilities to the E/A under this Contract, or under any agreement between the OWNER and the E/A, or any undertaking, exercise or performance thereof by the E/A, is intended to be for the sole and exclusive benefit of the OWNER and not for the benefit of CONTRACTOR, subcontractor, supplier, or any other person or organization, or for any surety or employee or agent of any of them.

9.3. CONTRACTOR Remains Responsible. The E/A will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto. The E/A is not responsible for any failure of CONTRACTOR to comply with laws and regulations applicable to the furnishing or performing the Work. The E/A is not responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with this Contract. Failure or omission of the E/A to discover, or object to or condemn any defective Work or material will not release CONTRACTOR from the obligation to properly and fully perform the Contract.

9.3.1 The E/A is not responsible for the acts or omissions of CONTRACTOR, or of any subcontractor, any supplier, or of any other person or organization performing or furnishing any of the Work.

9.3.2 If the OWNER and E/A agree, the E/A will review each Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds and certificates of inspection, tests and approvals and other documentation required to be delivered, but only to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests and approvals that the results certified indicate compliance with, this Contract.

9.4 Applicability to E/A's Agents. The limitations upon authority and responsibility set forth in this Article 9 will also apply to the E/A's consultants, Resident Project Representative and assistants.

9.5 Visits to Project Site. If the OWNER and E/A agree, the E/A will make visits to the Project Site at intervals appropriate to the various stages of construction as E/A deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR's executed Work. Based on information obtained during such visits and observations, the E/A will endeavor for the benefit of the OWNER to determine, in general, if the Work is proceeding in accordance with this Contract. The E/A will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The E/A's efforts will be directed toward providing for the OWNER a greater degree of confidence that the completed Work will conform generally to this Contract. On the basis of such visits and on-site observations, E/A will keep the OWNER informed of the progress of the Work and will endeavor to guard the OWNER against Defective Work. The E/A's visits and on-site observations are subject to all the limitations on the E/A's authority and responsibility set forth in this Article 9.

9.6 Resident Project Representative. If the OWNER and E/A agree, E/A will furnish a Resident Project Representative to assist the E/A in providing more continuous observation of the Work. The responsibilities and authority and limitations of any such Resident Project Representative and assistants will be as provided in this Article 9 and in the Supplemental General Conditions. The OWNER may designate another representative or agent to represent the OWNER at Project Site who is not the E/A, E/A's consultant, agent or employee.

9.7 Clarifications and Interpretations. The E/A may determine that written clarifications or interpretations of the requirements of the Technical Provisions (in the form of drawings or otherwise) are necessary. Such written clarifications or interpretations will be consistent with the intent of and reasonably inferable from the Contract Documents, will be issued with reasonable promptness by the OWNER and will be binding on the OWNER and CONTRACTOR. If the OWNER or CONTRACTOR believes that a written clarification or interpretation justifies an adjustment in the Contract Price or the Contract Times, the OWNER or CONTRACTOR may make a Claim therefore as provided in these General Conditions.

9.8 Recommendations as to Defective Work. The E/A will recommend that the OWNER disapprove or reject Work which the E/A believes to be defective, or believes will not produce a completed Project that conforms to this Contract or will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by this Contract.

ARTICLE 10 – ACCEPTED EQUALS AND SUBSTITUTIONS

10.1 Accepted Equals. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item, the specification or description is intended to require the item named, unless the Contract Documents, in specifying the name, specifically authorize the use of functionally equivalent item through the use of terms such as "as equal," "or equal," or "equivalent." For purposes herein, an item is only "functionally equivalent" if it is available at the same or lower cost, and if it is sufficiently similar to the item specified, including as to durability, warranty, acquisition time, and availability, so that no change in related Work will be required, and no change in the useful life, maintenance, repair cost, or quality of the completed work is anticipated.

10.2 CONTRACTOR May Propose Substitutions. CONTRACTOR may propose a substitution for any item of material or equipment, and for any means, method, technique, sequence, or procedure of construction, specified in the Contract Documents. CONTRACTOR's will propose such substitutes at CONTRACTOR's sole cost and expense, and at CONTRACTOR's sole risk as to disruptions to the Critical Path of the current approved Progress Schedule. CONTRACTOR will provide OWNER sufficient data and documentation to allow the OWNER to review the proposal.

10.3 OWNER's Evaluation. The OWNER will be allowed a reasonable time within which to evaluate each proposal made by CONTRACTOR pursuant to this Section. The OWNER will be the sole judge of acceptability. No accepted equal or substitute will be ordered, installed, or utilized until the OWNER's review is complete, which will be evidenced by a Change Instrument. The OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety bond with respect to any accepted equal or substitution or for any other delay or disruption to the Critical Path of the Project Schedule attributable to any such substitution. The OWNER will not be responsible for any delay due to review time for any proposed

substitution, unless such an extension is due to CONTRACTOR, consistent with the requirements of this Contract for changes and delays. The OWNER will not be responsible for increased costs associated with the review or approval of a proposed substitution, unless the increase is required as provided in association with changes and delays. In any event, no such extension or increase will be deemed provided unless specified in the Change Instrument approving the substitution.

10.4 CONTRACTOR to Remain Responsible. The OWNER's acceptance of a substitution will not relieve CONTRACTOR from primary responsibility and liability for the suitability and performance of any proposed substitute item or substituted method or procedure, and will not relieve CONTRACTOR from its primary responsibility and liability for curing Defective Work and performing warranty work, which CONTRACTOR will cure and perform, regardless of any claim CONTRACTOR may choose to advance against the OWNER or manufacturer.

ARTICLE 11 – DELAYS AND ADJUSTMENTS TO CONTRACT TIME AND CONTRACT PRICE

11.1 Delay. Delays are classified in one of the following categories:

11.1.1 An excusable delay is a delay caused by a Force Majeure event. An excusable delay may entitle CONTRACTOR to an extension of Contract Time but not an increase in Contract Price.

11.1.2 A compensable delay is a delay which is caused solely and exclusively by acts or omissions of the OWNER, excepting actions taken by the OWNER to protect the public health or safety or to conform to law. A compensable delay may entitle CONTRACTOR to both an extension of Contract Time and an increase in Contract Price.

11.1.3 An unexcused delay is any delay other than an excusable or compensable delay. An unexcused delay entitles CONTRACTOR to no adjustment to Contract Time or Contract Price.

11.2 Events Not Constituting a Delay. The following events will not be considered an excusable delay of any kind even though they are not anticipated by CONTRACTOR, not within CONTRACTOR's control, and are not reasonably foreseeable:

11.2.1 Events that pose no delay to items of Work on the Critical Path of the current approved Progress Schedule.

11.2.2 Events that would not prevent CONTRACTOR from achieving Final Completion before the expiration of the Contract Time, where CONTRACTOR may otherwise accelerate other items of Work without undue expense.

11.2.3 Weather, unless the weather is more severe than the adverse weather normally anticipated for the Project Site for the month in question, based on a generally accepted source of data such as the National Weather Service.

11.2.4 Events, including actions of the OWNER, that impact Critical Path activity, because the activity was previously delayed due to unexcused delays.

11.3 Notice of Delay Required. CONTRACTOR will provide written notice of any actual or prospective delay promptly, and in no event later than ten days after the occurrence of the event giving rise to such delay. CONTRACTOR will give the notice to both the E/A and the Contract Administrator within the specified time. In the case of a continuing delay, CONTRACTOR will provide an initial notice and a further notice at each progress meeting throughout the duration of the delay. The notice will contain all of the specific information required in the following Subsection.

11.4 Contents/Supporting Documents. CONTRACTOR's notice of delay will identify those portions of the current approved Progress Schedule affected by the delay and will include an estimate of the cost and probable effect of the delay, if any, on the progress of the Work. Supporting documentation will include, but is not limited to:

11.4.1 A written detailed statement of the reasons and causes for the delay;

11.4.2 Inclusive dates of the delay;

11.4.3 Specific trades and portions of the Work affected by the delay;

11.4.4 Status of Work affected before commencement of the delay;

11.4.5 Effect of the delay on available "float" time;

11.4.6 A Critical Path Method (CPM) analysis demonstrating that the delay has affected an activity then on the Critical Path at the time of the occurrence of the delay as shown on the most current approved Progress Schedule; and

11.4.7 If CONTRACTOR claims that the delay is an excusable delay or compensable delay, evidence that the delay was unforeseeable, beyond CONTRACTOR's control, and without the fault or negligence of CONTRACTOR or the negligence of anyone for whose acts CONTRACTOR is responsible including any subcontractor, sub-subcontractor or supplier; and in the case of a compensable delay, was caused solely and exclusively by the acts or omissions of the OWNER (excepting actions taken by the OWNER to protect the public health or safety or to conform to law) or anyone for whose acts the OWNER is responsible, and which are unreasonable under the circumstances involved and not reasonably within the contemplation of the parties.

11.5 Failure to Comply with Notice Requirements. The notice required by this Article 11 operates as a condition precedent to the assertion of any claim for extension of Contract Time, increase in Contract Price, or damages by CONTRACTOR. If CONTRACTOR fails to give the OWNER timely written notice of a claim as required by this Article 11, CONTRACTOR will be deemed to have waived the claim, and the OWNER will have no further liability respecting the claim.

11.6 Review and Adjustment of Schedules. Upon receipt of a notice from CONTRACTOR of the occurrence of a delay complying with the requirements of this Article, the OWNER will review the current approved Progress Schedule to determine (i) whether the delay is in fact an excusable or compensable delay, and (ii) whether any adverse effects of the delay can be overcome by an adjustment in the Progress Schedule, including the application of any unused "float" time available in the Schedule. The OWNER may require CONTRACTOR to submit a more detailed Progress Schedule than previously required in order to permit the OWNER to evaluate the delay. Based on such review, CONTRACTOR will, if required by the OWNER, submit for the OWNER's approval a revised Progress Schedule, which minimizes the adverse effects of the delay.

11.7 Limitation on Adjustments Due to Delays Generally. No extension of the Contract Time or increase in the Contract Price will be allowed for an unexcused delay. No extension of the Contract Time or increase in the Contract Price will be made to the extent that performance is, was or would have been suspended, delayed or interrupted by another cause for which CONTRACTOR is responsible. No increase in the Contract Price will be made to the extent performance was or would have been suspended, delayed or interrupted by another cause for which the OWNER is not solely and exclusively responsible.

11.8 Additional Limitations on Adjustments to Contract Time Due to Delays. No extension of Contract Time will be provided where, notwithstanding a Force Majeure event or other claimed delay, CONTRACTOR may achieve Final Completion within the Contract Time through adjustments to the current approved Progress Schedule.

11.9 Additional Limitations on Adjustments to Contract Price Due to Delays. Any obligation on the part of the OWNER to pay CONTRACTOR for compensable delay is solely intended to reimburse CONTRACTOR for actual expense arising out of the compensable delay. No consequential damages will be allowed to CONTRACTOR in connection with any claimed delays. Damages for compensable delay will be determined by the Force Account method set forth in Subsection 13.3.2.

11.9.1 Standby equipment costs will not be allowed during periods when the equipment would have otherwise been idle. Standby equipment time will not exceed more than eight hours per day, 40 hours per week,

and 176 hours per month. Standby equipment costs will be paid at 50 percent of the applicable Rental Rate Blue Book rates and calculated by dividing the monthly rate by 176, multiplying the result by the number of standby hours and multiplying that number by the regional adjustment factor and the rate adjustment factor contained in the Blue Book. Operating costs will not be allowed.

11.10 Liquidated Damages Due to CONTRACTOR's Delays. Liquidated Damages, if any, are set forth in the Contract form.

11.11 No Damages are Due to CONTRACTOR for Prevention of Early Completion. CONTRACTOR represents that its Bid includes all costs, overhead and profit which may be incurred throughout the Contract Time, including the period between Substantial and Final Completion. Accordingly, CONTRACTOR may not make any claim for delay damages based in whole or in part on the premise that CONTRACTOR would have completed the Work prior to the expiration of the Contract Time but for any claimed delay.

11.12 Acceleration to Avoid Delays. If CONTRACTOR's progress is not maintained in accordance with the current approved Progress Schedule, or the OWNER determines that CONTRACTOR is not diligently proceeding with the Work or has evidence reasonably indicating that CONTRACTOR will not be able to conform to the current approved Progress Schedule, CONTRACTOR will, promptly and at no additional cost to the OWNER, take all measures necessary to accelerate its progress to overcome the delay and ensure that there will be no further delay in the progress of the Work and notify the OWNER thereof. Any extension of working hours requires approval of the OWNER, which will not be unreasonably withheld but may be subject to reasonable conditions including payment for additional or overtime services of the OWNER the Architect/Engineer and any other applicable consultants, testing or regulatory agency costs.

ARTICLE 12 – CHANGES

12.1 Materially Different Site Conditions. For purposes herein, "materially different site conditions" means conditions that are different from those indicated in the Contract Documents, that are unknown to CONTRACTOR, and that could not be reasonably anticipated based upon on the following: (i) typical soil or subsurface conditions for the area in which the Project Site is located; (ii) site visits CONTRACTOR made, or was encouraged or permitted to make by the Bid Documents, prior to Bid submission; or (iii) a careful review of any Site-Related Reports.

12.1.1 CONTRACTOR may be entitled to an increase in Contract Time for materially differing site conditions as an excusable delay as provided in Article 11, subject to the exclusions and conditions of that article including notice requirements.

12.1.2 CONTRACTOR may also be entitled to an increase in Contract Price for materially different site conditions, where these conditions will require additional labor or materials, or both, exceeding the amount estimated in the Schedule of Values or Bid Schedule, as applicable, by 5% or more, provided, that CONTRACTOR complies with the notice requirements in Section 12.3. In such instance, the basis for adjusting Contract Price is set forth in Section 13.3.

12.2 Materially Different Structural Conditions (Remodeling or Renovation Contracts). If this is a Contract for a remodeling or renovation of an existing structure and CONTRACTOR encounters materially different conditions in the structure (not as to the Site or subsurface conditions) from those indicated in the Contract Documents provided by the OWNER as part of the Bid or Proposal Documents, CONTRACTOR will give written notice thereof to the OWNER and the E/A promptly before conditions are disturbed and in no event later than ten days after first observing such conditions. Failure of CONTRACTOR either (i) to provide notice before disturbing the existing conditions or (ii) failure to give notice within ten days of first observing such conditions is conclusively deemed a waiver of any claim relating to such conditions.

12.2.1 Investigation and Determination. The E/A will promptly investigate any alleged differing conditions as to the structure (but not as to the Site or subsurface conditions) and provide a written report of its findings to the OWNER. If the OWNER finds that the conditions of the structure differ materially and require a change in the Work and cause an increase or decrease in CONTRACTOR's cost of, or time required for, performance of any part of the Work, the OWNER may make an adjustment in the amount payable to

CONTRACTOR or the Contract Time, as applicable. If the OWNER determines that the conditions of the structure are not materially different or that no change in the terms of the Contract is justified, the OWNER will so notify CONTRACTOR in writing.

12.3 Constructive Changes and Disputed Adjustments.

12.3.1 Notice to the OWNER and E/A. CONTRACTOR will advise the OWNER and the E/A in writing promptly and in no event later than ten days after (i) issuance of any interpretation, clarification, instruction, direction or order whether orally or in writing from either the OWNER or the E/A, or (ii) the occurrence of any event or discovery of any condition (including any condition as provided in Section 12.1 and if applicable, 12.2), which CONTRACTOR believes or has reason to believe entitles CONTRACTOR to an increase in the amount payable to CONTRACTOR or an extension of the Contract Time; and except in the case of an emergency involving possible loss of life or bodily injury or significant property damage, the required written notice will be provided prior to proceeding with the Work. Failure of CONTRACTOR to provide such notice constitutes an acceptance of the interpretation, clarification, instruction, direction, order, event, or condition without adjustment to the Contract Price or the Contract Time and a conclusive waiver of any claim relating to the same. In order to be valid, a claim for an adjustment of Contract Price or Contract Time must contain the specific adjustment requested and must be supported by a detailed explanation of the basis for the claim. In addition to be valid, a claim for increase in Contract Time must be supported by the documentation specified in Subsection 11.4, and a claim for an increase in the Contract Price must be documented and calculated as specified in Subsection 13.3.2. Failure of CONTRACTOR to object as and when specified in this Subsection is deemed an acceptance of interpretation, clarification, instruction, direction or order as issued and a waiver of any claim by CONTRACTOR to any adjustment to the Contract Price or the Contract Time.

12.3.2 Disputed Adjustments. All disputed adjustments under this Contract will be determined in accordance with the Contract, Article IX if, as conditions precedent thereto, CONTRACTOR has timely provided all notices and objections required under the terms of the Contract.

ARTICLE 13 - CHANGE INSTRUMENTS

13.1 Introduction.

13.1.1 The OWNER may issue a Change Instrument to require changes in the Work without invalidating the Contract.

13.1.1.1 A Field Directive may be issued to require minor changes in the Work that, in the OWNER's view, do not change the Scope of Work, present a delay, or require an adjustment to Contract Time or Contract Price. Examples of such situations where Field Directives may be appropriate are unanticipated field conditions or unavailability of specified materials and equipment.

13.1.1.2 All other changes to the Work will require the issuance of a Change Order issued in conformance with these General Conditions.

13.2 Change Order Required for Contract Time and Contract Price Adjustments. Adjustments to Contract Time or Contract Price will be granted only through a properly-issued Change Order.

13.3 Change Orders Adjusting Contract Price. All Change Orders adjusting Contract Price will be invalid unless approved in accordance with the authority provided by the Purchasing Code.

13.3.1 Basis for Contract Price Adjustment. Subject to any federal procurement standards that may apply if the Project is a federally funded project, in which case the standards will govern to the extent of conflict, a Change Order may provide for an adjustment in the Contract Price based only on one of the following methods:

- .1 Unit Prices as stated in the Bid Schedule.

.2 A fixed not-to-exceed or lump sum agreed to by the OWNER and CONTRACTOR and stated in the Change Order, properly itemized and supported by sufficient substantiating data to permit evaluation which will be limited to estimated costs of labor, materials, supplies and equipment, rental cost of machinery and equipment, additional bond cost, plus a fixed fee for profit and overhead (which includes office overhead and site-specific overhead and general conditions) of 10% if the Work is performed by CONTRACTOR, or 5% if the Work is performed by a subcontractor or sub-subcontractor. The subcontractors' or sub-subcontractors' overhead and profit in turn will not exceed 10%. The total percentage of overhead and profit payable by the OWNER (to both CONTRACTOR and all sub tier subcontractors), regardless of the sub-tier which performs the work, will not exceed 15%.

.3 Actual costs, properly itemized, plus a profit factor, using the Force Account method set forth in Section 13.3.2.

.4 In the absence of an agreement between the OWNER and CONTRACTOR, the OWNER will determine the amount of the Contract Price Adjustment using any of the methods outlined in Subsections 13.3.1.1 – 13.3.1.3, above, whichever will result in the lowest cost to the OWNER.

.5 No cost will be included in a Change Order for time spent preparing the Change Order, nor will costs be included for an estimate of time to negotiate the Change Order costs for machinery, tools, or equipment.

13.3.2 Force Account Method for Contract Price Increases. Before using the Force Account method provided for herein, the OWNER and CONTRACTOR agree to negotiate a Change Order using the other methods identified in Subsection 13.3.1, above, as appropriate, to determine the adjustment in the Contract Price. If neither of these methods can be agreed upon before a change in the Work is commenced which will result in an adjustment in the Contract Price, then the change in the Work will be performed by a Change Order using the Force Account method, and payment will be made as follows:

13.3.2.1 For all personnel, CONTRACTOR will receive actual field cost wage rates for each hour that said personnel are actually engaged in such Work, as substantiated by its certified payroll, to which will be added an amount equal to 15% of the sum thereof as compensation for CONTRACTOR's and any effected subcontractor's total overhead and profit. No separate charge will be made by CONTRACTOR or its subcontractor(s) for organization or overhead expenses. CONTRACTOR will also receive an amount equal to 55% of the wages paid personnel, excluding the 15% compensation provided above, for CONTRACTOR's and any effected subcontractor's cost of premiums on liability insurance, workers' compensation insurance, social security and unemployment insurance. The actual cost of CONTRACTOR's bond(s) on the extra Work will be paid based on invoices from surety. No charge for superintendence will be made unless considered necessary and ordered by the OWNER.

13.3.2.2 CONTRACTOR will receive the actual cost, including freight charges, of the materials used and installed on such Work, to which costs will be added a sum equal to 20% thereof as compensation for CONTRACTOR's and any effected subcontractor's total overhead and profit. In case material invoices indicate a discount may be taken, the actual cost will be the invoice price minus the discount.

13.3.2.3 For machinery, trucks, power tools, or other similar equipment (the "equipment") agreed to be necessary by the OWNER and CONTRACTOR, the OWNER will allow CONTRACTOR the applicable daily, weekly or monthly rate as given in the latest edition of the "Rental Rate Blue Book" as published by EquipmentWatch (1-800-669-3282) for each hour that said equipment is in use on such work, which rate includes the cost of fuel, lubricants and repairs. The established equipment rates will be paid for each hour that the equipment is utilized in the Work. If the equipment is used intermittently during the Work, full payment for an eight-hour day will be made if the equipment is not idle more than four hours of the day. If the equipment is idle more than four hours in a day, then payment will be made only for the actual hours worked. No additional compensation will be allowed on the equipment for CONTRACTOR's or any affected subcontractor's overhead and profit. The OWNER may accept an actual rental invoice in lieu of the method of calculation set forth in this Paragraph for equipment rented exclusively for Force Account Work or for equipment not included in the Rental Rate Blue Book.

13.3.2.4 The compensation provided for herein, will be received by as payment in full for work done pursuant to the Change Order and will include use of small tools, and total overhead expense and profit. CONTRACTOR and the OWNER will compare records of work done by Change Order at the end of each day. Copies of these records will be made upon forms provided for this purpose by the OWNER and signed by both the OWNER and CONTRACTOR, with one copy being retained by the OWNER and one by CONTRACTOR. Refusal by CONTRACTOR to sign these records within two working days of presentation does not invalidate the accuracy of the record.

13.3.3 Additional Performance Security in Conjunction with Change Order. The CITY may require CONTRACTOR to increase or supplement previously-provided Performance Security to cover any additional costs of performing services required under a Change Order that increases Contract Price, commensurate with such additional cost. In such instance, any compensation due CONTRACTOR for CONTRACTOR's cost of providing such increase or supplement will be reflected in the Change Order or otherwise borne by CONTRACTOR.

13.4 Payment for Work Covered by Change Order. Additional monies due CONTRACTOR pursuant to a valid Change Order providing for an adjustment to the Contract Price, will be paid for in accordance with the Progress Payment schedule established by the Contract, in which case payment will be subject to retainage requirements set forth in the Contract; or at the time of Final Payment.

13.5 Absence of Proposed Adjustments. If a Change Instrument is silent as to any adjustment to the Contract Price or the Contract Time, it will be conclusively presumed that none is intended and none will be allowed unless CONTRACTOR files an objection as and when specified in the following Subsection.

13.6 Action upon Receipt of Change Instrument. Upon receipt of a Change Instrument, CONTRACTOR will promptly proceed with the change in the Work involved.

13.6.1 CONTRACTOR will advise the OWNER in writing, promptly and in any event no later than ten days after issuance of the Unilateral Change Instrument, of CONTRACTOR's objection (i) to the amount or method, if any, provided for in the Change Instrument for adjustment to Contract Price or Contract Time, or (ii) to the absence of any adjustment to the Contract Price or Contract Time. In order to be valid, a claim for an adjustment of Contract Price or Contract Time, must contain the specific adjustment requested, must be supported by a detailed explanation of the basis for the claim. In addition, to be valid a claim for increase in Contract Time must be supported by the documentation specified in Subsection 11.4, and a claim for an increase in the Contract Price must be documented and calculated as specified in Subsection 13.3.1. Failure of CONTRACTOR to object as and when specified in this Subsection is deemed an acceptance of the Unilateral Change Order as issued and a waiver of any claim by CONTRACTOR to any adjustment to the Contract Price or the Contract Time.

13.7 Waiver of Claim. Except for emergencies involving possible loss of life or bodily injury or significant property damage, CONTRACTOR's commencement of the Work that is subject to a Change Instrument will constitute a complete waiver by CONTRACTOR as to such claim regardless of whether CONTRACTOR has within the ten-day period notified the OWNER of a claim consistent with the requirements of Subsection 13.6.1.

13.8 OWNER's Right to Use Third Parties for Additional Work. If the OWNER and CONTRACTOR are unable to negotiate the terms of a Change Order for the performance of additional Work, the OWNER may, at its election, perform such additional Work with its own forces or with another CONTRACTOR and such work will be considered "Other Work."

13.9 OWNER's Right to Accelerate Schedule. The OWNER reserves the right to issue a Change Instrument to accelerate the Work which may be subject to an appropriate adjustment, if any, in the Contract Price. If the OWNER requires an acceleration of the Project Schedule and no adjustment is made in the Contract Price, or if CONTRACTOR disagrees with any adjustment made, any claim an adjustment must comply with the requirements of Subsection 13.6.1 or be deemed to be conclusively waived.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTIONS, REMOVAL AND ACCEPTANCE OF DEFECTIVE WORK

14.1 Access to Work. The OWNER, including the Contract Administrator and other employees and agents, including E/A and E/A's consultants, independent testing laboratories, and governmental agencies having jurisdiction, will each have access to the Work at reasonable times for observing, inspecting and testing. CONTRACTOR will provide them proper and safe conditions for such access, and advise them of CONTRACTOR's site safety procedures and programs so that they may comply therewith as applicable.

14.2 Tests and Inspections.

14.2.1 CONTRACTOR will give timely notice of readiness of the Work for all required inspections, tests or approvals, and will cooperate with inspection and testing personnel to facilitate required inspections or tests. All testing will be performed by the CONTRACTOR. Only verification testing will be performed by the CITY. CONTRACTOR is not required to enter test results into MAC.

14.2.2 The OWNER will employ and pay for services of an independent testing laboratory to perform all inspections, tests or approvals required by the Contract Documents except:

- .1 For inspections, tests or approvals covered by Paragraph 14.2.3 below;
- .2 That costs incurred with tests or inspections conducted pursuant to Paragraph 14.3.3 below will be paid as provided in Paragraph 14.3.3;
- .3 For re-inspecting or re-testing Defective Work; and
- .4 As otherwise specifically provided in the Contract Documents. All testing laboratories will meet the requirements of ASTM E-329.

14.2.3 If Legal Requirements specifically require any Work (or part thereof) to be inspected, tested, or approved by an employee or other representative of a governmental or related authority, CONTRACTOR will assume full responsibility for arranging and obtaining such inspections, tests or approvals, pay all costs in connection therewith and furnish the OWNER the required certificates of inspection or approval.

14.2.4 CONTRACTOR will also be responsible for arranging and obtaining and will pay all costs in connection with any inspections, tests or approvals required for the OWNER's and E/A's review of materials or equipment to be incorporated in the Work, or of materials, mix designs or equipment submitted for review prior to CONTRACTOR's purchase thereof for incorporation in the Work.

14.3 Uncovering Work.

14.3.1 If any Work (or the work of others) that is to be inspected, tested or approved is covered by CONTRACTOR without written concurrence of the Contract Administrator, or if any Work is covered contrary to the written request of the Contract Administrator, it will, if requested by the Contract Administrator, be uncovered and recovered at CONTRACTOR's expense.

14.3.2 Uncovering Work as provided in Paragraph 14.3.1 above, will be at CONTRACTOR's expense unless CONTRACTOR has given the OWNER timely notice of CONTRACTOR's intention to cover the same and the OWNER has not acted within five working days to such notice.

14.3.3 If the OWNER considers it necessary or advisable that covered Work be observed, inspected or tested, CONTRACTOR will uncover, expose or otherwise make available for observation, inspection or testing that portion of the Work in question, furnishing all necessary labor, material and equipment. If the OWNER determines that such Work is defective, CONTRACTOR will pay all claims, costs, losses and damages caused by, arising out of or resulting from such uncovering, exposure, observation, inspection and testing and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and the OWNER will be entitled to an appropriate decrease in the Contract Price, and may make a Claim therefore as provided in these General Conditions. However, if such Work is not found to be defective, CONTRACTOR will be allowed an increase in the Contract Price or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement and reconstruction; and CONTRACTOR may make a Claim therefore as provided in these General Conditions.

14.4 The OWNER May Stop the Work.

14.4.1 If the Work is defective, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to this Contract, the OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the OWNER to stop the Work will not give rise to any duty on the part of the OWNER to exercise this right for the benefit of CONTRACTOR or any surety or other party.

14.4.2 If CONTRACTOR fails to correct Defective Work or submit a satisfactory plan to take corrective action, with procedure and time schedule, the OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until cause for such order has been eliminated, or take any other action permitted by this Contract. A notice to stop the Work, based on defects, will not stop calendar or Working Days charged to the Project.

14.5 Correction or Removal of Defective Work. If required by the OWNER, CONTRACTOR will promptly, as directed, either correct all Defective Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by the OWNER, remove it from Project Site and replace it with Work that is not defective. CONTRACTOR will correct or remove and replace Defective Work, or submit a plan of action detailing how the deficiency will be corrected, within the time frame identified in the notice of Defective Work. CONTRACTOR will pay all claims, costs, losses and damages caused by or resulting from such correction or removal (including but not limited to all costs of repair or replacement of work of others).

14.6 Correction Required. If within the Warranty Period, or such longer period of time as may be prescribed by Legal Requirements or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work, including Work performed after the Substantial Completion date, is found to be defective, CONTRACTOR will promptly, without cost to the OWNER and in accordance with the OWNER's written instructions:

14.6.1 Correct such Defective Work, or, if it has been rejected by the OWNER, remove it from Project Site and replace it with Work that is not defective, and

14.6.2 Satisfactorily correct or remove and replace any damage to other Work or the work of others resulting from the Defective Work.

If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, the OWNER may have the Defective Work corrected or the rejected Work removed and replaced, and all claims, costs, losses and damages caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by CONTRACTOR. The warranty period will be deemed to be renewed and recommenced in connection with the completed items of Work requiring correction.

14.7 Coordination with OWNER. If correction of Defective Work will affect the function or use of the facility, CONTRACTOR will not proceed with correction of Defective Work without prior coordination and approval of the OWNER.

14.8 Acceptance of Defective Work. If, instead of requiring correction or removal and replacement of Defective Work, the OWNER decides to accept it, the OWNER may do so. CONTRACTOR will pay all claims, costs, losses and damages attributable to the OWNER's evaluation of and determination to accept such Defective Work. For purposes of this Section, the OWNER's acceptance of sample materials or equipment will not be deemed to be acceptance of Defective Work. If any such acceptance occurs prior to recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents and compensating the OWNER for the diminished value of the Defective Work. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to the OWNER after a calculation by the OWNER of the diminution in value of the Defective Work.

14.9 The OWNER May Correct Defective Work. If CONTRACTOR fails within a reasonable time after written notice of the OWNER to correct Defective Work, or to remove and replace rejected Work, or if CONTRACTOR fails to perform the Work in accordance with this Contract, or if CONTRACTOR fails to comply with any other provision of this Contract, the OWNER may, after seven days' written notice to CONTRACTOR, correct and remedy any such deficiency. If, in the opinion of the Contract Administrator, significant progress has not been made during this seven-day period to correct the deficiency, the OWNER may exercise any actions necessary to remedy the deficiency. In exercising the rights and remedies under this paragraph, the OWNER will proceed expeditiously. In connection with such corrective and remedial action, the OWNER may exclude CONTRACTOR from all or part of Project Site, take possession of all or part of the Work, and suspend CONTRACTOR's services related thereto, and incorporate in the Work all materials and equipment stored at Project Site or for which the OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR will allow the OWNER, its agents and employees, the OWNER's other contractors, E/A and E/A's consultants access to Project Site to enable the OWNER to exercise the rights and remedies under this paragraph. All claims, costs, losses and damages incurred or sustained by the OWNER in exercising such rights and remedies will be charged against CONTRACTOR and a Change Order will be issued incorporating the necessary revisions to this Contract with respect to the Work. Such claims, costs, losses and damages will include but not be limited to all costs of repair or replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's Defective Work. CONTRACTOR will not be allowed an extension of the Contract Times (or Milestones), or claims of damage because of any delay in the performance of the Work attributable to the exercise by the OWNER of the OWNER's rights and remedies hereunder.

14.10 Testing and Inspections Outside of Working Hours. This Contract contemplates that all testing and inspections will be done during Working Hours as defined herein. Whenever the OWNER is required to test or inspect outside of Working Hours, on weekends, or during Holidays observed by the OWNER, the OWNER will be entitled to a reduction in the Contract Price to the extent of any overtime costs incurred by the OWNER, unless such testing or inspection is required to be performed at that time due to:

14.10.1 Emergency conditions that are not the fault of CONTRACTOR, and subcontractors, sub-subcontractors, suppliers, or other persons for whom CONTRACTOR is responsible;

14.10.2 A Force Majeure event, the OWNER's disruption, or other events which, pursuant to this Contract, would otherwise require an extension of the Contract Time.

14.11 CONTRACTOR Remains Responsible for the Work. The following will not be deemed to be a release of CONTRACTOR's obligation to perform the Work in accordance with this Contract:

14.11.1 Observations by the E/A;

14.11.2 The issuance of a Certificate of Substantial Completion or any payment by the OWNER to CONTRACTOR under this Contract;

14.11.3 Partial use or occupancy of the Work or any part thereof by the OWNER;

14.11.4 Any acceptance by the OWNER or any failure to do so;

14.11.5 Any review of a Shop Drawing or sample submittal;

14.11.6 Any inspection, test or approval by others; or

14.11.7 Any correction of Defective Work by the OWNER.

ARTICLE 15 – PROGRESS PAYMENTS, PARTIAL UTILIZATION AND FINAL COMPLETION

15.1 General Method of Payment. Payment of the Contract Price will be made in a series of Progress Payments and after Final Completion, a Final Payment, in accordance with this Article.

15.1.1 If CONTRACTOR has provided Payment and Performance Bonds, no payment will be made unless and until CONTRACTOR records the bonds and provides the OWNER certified copies of the recorded bonds in accordance with Florida Statutes Section 255.05(b).

15.2 Application for Payment. CONTRACTOR may submit to the OWNER, no more than once a month and no sooner than 30 days following commencement of the Work, an application for payment for those portions of the Work completed as of the date of the application. The OWNER may, by notice, designate a specific day of each month for submission of the application for payment. Each application for payment will be in a form acceptable to the OWNER, and will include the following documentation and information:

15.2.1 The current approved Progress Schedule;

15.2.2 If applicable, the Schedule of Values;

15.2.3 Unless CONTRACTOR has provided payment and performance bonds and recorded them in the public records as provided in Florida Statutes Section 255.05, releases of liens from subcontractors or suppliers;

15.2.4 CONTRACTOR's written certification (i) as to the value of the Work completed, (ii) that partial or final waivers of lien have been received covering all such Work, (iii) and that all prior Progress Payments have been properly applied to the payment or reimbursement of the costs with respect to which they were paid;

15.2.5 If payment is requested on the basis of materials or equipment not incorporated in the Work but delivered and suitably stored at Project Site or at another location agreed to in writing, the application for payment by such bills of sale, data, and other procedures satisfactory to the OWNER substantiating the OWNER's title to such materials or equipment or otherwise protecting the OWNER's interest;

15.2.6 A completed Minority and Women-Owned Business Enterprise (MBE/WBE) Usage Report, using forms provided by the OWNER. CONTRACTOR will complete all blank spaces shown on these Report forms. If no amounts have been paid to MBE/WBE subcontractors, the completed form will so indicate; and

15.2.7 The consent of the surety, if any, to the requested payment.

15.2.8 Documentation of payments made to MBE and WBE subcontractors and suppliers, on Attachment E, Minority and Women Owned Business Enterprise Usage Form.

Each application for payment will be deemed to be a warranty and guarantee by CONTRACTOR that title to all Work, materials and equipment covered by the application, whether incorporated in the Project or not, will pass to the OWNER free and clear of all liens no later than the time of payment to CONTRACTOR.

15.3 Review of Application for Payment. As soon as practicable after receipt of an application for Payment, and within the 20-day period following receipt of the application as provided by the Prompt Payment Act, the OWNER will approve, partially approve, or reject the application. The OWNER will provide written notice if payment is rejected or partially rejected, specifying the deficiency in the application for payment and the action necessary to make the request proper. In addition to rejecting payment of all or a portion of the application for failure to comply with submittal requirements referenced above, the OWNER will have the right to reject all or a portion of the application for any of the following reasons:

15.3.1 Defective Work not remedied;

15.3.2 Third party Claims filed or reasonable evidence indicating probable filing of such Claims;

15.3.3 Unless CONTRACTOR has provided payment and performance bonds and complied procedurally with Florida Statutes Section 255.05, failure of CONTRACTOR to make payments properly to subcontractor or for labor, materials or equipment;

15.3.4 Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Price;

15.3.5 Damage to the OWNER or another CONTRACTOR;

15.3.6 Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;

15.3.7 Failure of CONTRACTOR to submit a Schedule of Values in accordance with the Contract Documents, if one is required;

15.3.8 Failure of CONTRACTOR to submit a submittal schedule in accordance with the Contract Documents;

15.3.9 Failure of CONTRACTOR to submit and update a Progress Schedule in accordance with the Contract Documents;

15.3.10 Failure of CONTRACTOR to maintain a record of changes on drawings and documents;

15.3.11 Failure of CONTRACTOR to maintain weekly payroll reports and, as applicable, provide copies of reports in a timely manner upon request of the OWNER;

15.3.12 CONTRACTOR's neglect or unsatisfactory prosecution of the Work, including failure to clean up; or

15.3.13 CONTRACTOR's failure to comply with the submittal requirements of Section 15.2, above, or with any other provision of this Contract.

If any portion of the application is rejected the OWNER will provide CONTRACTOR a written notice as to the reasons for rejection, within the time frame provided in the Prompt Payment Act. CONTRACTOR will then make the necessary corrections and re-submit the application or portion of application rejected.

15.4 Progress Payments. The OWNER will make payment on an approved or partially approved application, less amounts set aside for retainage within the deadlines provided by the Prompt Payment Act. If CONTRACTOR and the OWNER disagree on the basis or amount of the payment, or if CONTRACTOR is unwilling to make the necessary corrections or modifications and re-submit the Request as to those items rejected by the OWNER, then the OWNER may approve and process the Request by making such adjustments thereto as the OWNER deems appropriate so that CONTRACTOR receives without delay, payment of the amount determined by the OWNER to have been earned and owing to CONTRACTOR. Each payment application will be accompanied by Attachment E, Minority and Women Owned Business Enterprise Usage Form.

15.5 Amounts Withheld from Progress Payments. The OWNER will withhold an amount from each such approved progress payment, as follows:

15.5.1 If the Contract Price is \$200,000 or more, the amount of retainage will be determined by the Prompt Payment Act, which as of the Effective Date provides for a 10% retainage until 50-Percent Completion, and a 5% retainage thereafter.

15.5.2 In all other instances, the amount of retainage will be ten percent for each progress payment.

Subject to any limitations that may be imposed by the Prompt Payment Act if applicable, the OWNER will hold all retainage until Final Payment. However, if the Work is near Substantial or Final Completion and delay occurs due to no fault or neglect of CONTRACTOR, the OWNER may pay a portion of the retained amount to CONTRACTOR. CONTRACTOR, at the OWNER's option, may be relieved of the obligation to complete the Work and thereupon, CONTRACTOR will receive payment of the balance due for the work completed and accepted, subject to the conditions applicable to OWNER's termination of work without cause.

15.6 Delayed Payments. Should the OWNER fail to make payment to CONTRACTOR of the amount approved for any application for payment within the time frames provided in the Prompt Payment Act, the OWNER will pay to

CONTRACTOR, in addition to amount approved, interest thereon at the rate specified in the Act, from date due until fully paid, which will fully liquidate any injury to CONTRACTOR growing out of such delay in payment.

15.7 Substantial Completion.

15.7.1 When CONTRACTOR considers that the Work, or a portion thereof which the OWNER agrees to accept separately, is substantially complete, CONTRACTOR will notify the OWNER and request a determination as to whether the Work or designated portion thereof is substantially complete. If the OWNER does not consider the Work substantially complete, the OWNER will notify CONTRACTOR giving reasons therefore. After performing any required Work, CONTRACTOR will then submit another request for the OWNER to determine Substantial Completion. If the OWNER considers the Work substantially complete, the OWNER will prepare and deliver a certificate of Substantial Completion which will establish the date of Substantial Completion, will include a punch list of items to be completed or corrected before Final Payment, will establish the time within which CONTRACTOR will finish the punch list, and will establish responsibilities of the OWNER and CONTRACTOR for security, maintenance, heat, utilities, damage to the Work, warranty and insurance. Failure to include an item on the punch list does not alter the responsibility of CONTRACTOR to complete all Work in accordance with this Contract. The Work will not be deemed to be substantially or finally complete until any certificates of occupancy required to occupy the Project are issued. The OWNER and CONTRACTOR will both sign the certificate of Substantial Completion, to evince acceptance of the responsibilities assigned to them in such certificate.

15.8 Partial Utilization. The OWNER will have the option to use any portion of the Work prior to Substantial Completion of the Project where:

15.8.1 The Contract Documents specifically provide for such portion to be partially utilized prior to Substantial Completion; or

15.8.2 Upon the OWNER's request, if CONTRACTOR agrees and, upon joint inspection, the parties agree that the portion of the Work in question is Substantially Complete. In such instance, the OWNER will issue a certificate of Substantial Completion, attaching thereto a punch list of items to be completed or corrected before Final Payment and fixing the responsibility between the OWNER and CONTRACTOR for maintenance, heat and utilities as to that part of the Work.

The OWNER will have the right to exclude CONTRACTOR from any part of the Work which is so certified to be Substantially Complete but the OWNER will allow CONTRACTOR reasonable access to complete or correct items on the punch list.

15.9 Final Inspection and Final Completion. CONTRACTOR will provide the OWNER the Notice of Completion sufficiently in advance of the Completion Date to allow for scheduling of the final inspection and for completion or correction of all Punch List Work before the Completion Date. Upon receipt of CONTRACTOR's Notice of Completion, the OWNER will make a review of the Work and notify CONTRACTOR in writing of all Punch List Work, if any, to be completed or corrected. Following CONTRACTOR's completion or correction of all Punch List Work, the OWNER again review the Work and prepare and deliver to CONTRACTOR either a written notice of additional Punch List Work to be completed or corrected or a written Certificate of Final Completion, signifying final acceptance of the Work.

15.9.1 If the sole remaining unfinished item to complete the Work is the reestablishment of vegetation, at the OWNER's option the OWNER may issue a Certificate of Final Completion on the condition that CONTRACTOR executes a re-vegetation letter, with letter of credit or other guarantee in form and amount satisfactory to the OWNER, to ensure completion of this item. This Work will be accomplished within 120 days of the date of Final Completion of the Work. When permanent erosion control has been established, the OWNER will initiate an inspection for final acceptance of the erosion controls. If the re-vegetation is not completed within the 120 days, the OWNER, at its option, may complete the Work using the posted guarantee.

15.9.2 In all other instances, the OWNER will only be obligated to issue a Certificate of Final Completion accepting the Work as finally complete, when the whole and all parts thereof will have been completed to the satisfaction of the OWNER in full compliance with this Contract.

15.10 Final Application for Payment. As soon as practical after the OWNER's issuance of the Certificate of Final Completion, CONTRACTOR will submit to the OWNER a properly completed application for Final Payment in the form approved or provided by the OWNER. The application will include or attach the following:

15.10.1 Three complete manuals containing all maintenance and operating instructions, warranties, and other associated documents for equipment or other materials that have been installed or otherwise included in the Work;

15.10.2 Record documents (as provided in Paragraph 6.11.2 of these General Conditions);

15.10.3 Unless CONTRACTOR has provided payment and performance bonds and procedurally complied with Florida Statutes, Section 255.05:

15.10.3.1 Legally effective final releases or waivers of liens from CONTRACTOR, and from all subcontractors and sub-subcontractors which performed services for CONTRACTOR and all suppliers of material or equipment to CONTRACTOR;

15.10.3.2 An affidavit that all of CONTRACTOR's debts, and claims, including from all subcontractors, subcontractors, and suppliers in connection with the Work, have been paid or otherwise satisfied;

15.10.4 Complete and legally effective releases or waivers satisfactory to the OWNER of all claims other than claims of subcontractors, Sub-subcontractors, and suppliers, filed in association with the Work;

15.10.5 The consent of the surety, if any, to final payment;

15.10.6 Non-Use of Asbestos Affidavit (After Construction);

15.10.7 Certificate evidencing that required insurance will remain in force after final payment and through the warranty period; and

15.10.8 Any other documentation required pursuant to this Contract.

15.11 If Final Application is Rejected. If the OWNER rejects the request for Final Payment, the OWNER will provide CONTRACTOR written notice stating the reasons therefore within the time required by the Prompt Payment Act.

15.12 Final Payment; Waiver of Claims. Final Payment will be deemed to have taken place when CONTRACTOR or any of its representatives negotiates the OWNER's final payment check, whether labeled final or not, for cash or deposits check in any financial institution for its monetary return. The making and acceptance of Final Payment will constitute:

15.12.1 A waiver of claims by the OWNER against CONTRACTOR, except claims arising from unsettled claims, from Defective Work appearing after final inspection, from failure to comply with this Contract or the terms of any warranty specified therein, or from CONTRACTOR's continuing obligations under this Contract; and

15.12.2 A waiver of all claims by CONTRACTOR against the OWNER other than those which were made in writing through the date that the check for final payment was issued and which are unsettled.

15.13 Partial Final Payment in Extenuating Circumstances. If the OWNER determines that after CONTRACTOR has achieved Substantial Completion, Final Completion is materially delayed through no fault of CONTRACTOR, the OWNER may without terminating this Contract, make payment of balance due for that portion of the Work fully completed and accepted. Such payment will be made under the terms and conditions governing Final Payment, except that it will not constitute a waiver of claims by the OWNER, and will not cause a transfer of title or relieve CONTRACTOR for responsibility for the Substantially Completed Work.

ARTICLE 16 - SUSPENSION OF WORK AND TERMINATION

16.1 The OWNER May Suspend Work Without Cause. At any time and without cause, the OWNER may suspend the Work or any portion thereof for a period of not more than 90 days by written notice to CONTRACTOR which will fix the date on which the Work will be resumed. CONTRACTOR will resume the Work on the date so fixed. CONTRACTOR will be allowed an adjustment in the Contract Price or an extension of the Contract Time, or both, directly attributable to any such suspension if CONTRACTOR makes an approved Claim for such an adjustment as provided herein.

16.2 The OWNER May Terminate Without Cause. Upon seven days' notice to CONTRACTOR, the OWNER may, without cause and without prejudice to any right or remedy of the OWNER, elect to terminate the Contract. In such case, CONTRACTOR will be paid for completed and acceptable Work executed in accordance with this Contract prior to the date of termination, and if the Contract Price is **NOT** based on unit prices, the following:

16.2.1.1 Reasonable demobilization costs;

16.2.1.2 Reasonable anticipated profits on completed and accepted Work not previously paid and not included in separate pay items calculated to date of termination but not for anticipated profit on the entire Contract not previously paid, unabsorbed overhead, or lost opportunity; and

16.2.1.3 All claims incurred in settlement of terminated contracts with subcontractor and others, including for anticipated profits on completed and accepted Work not previously paid and not included in separate pay items calculated to date of termination but not for anticipated profit on the entire Contract not previously paid, unabsorbed overhead, or lost opportunity. CONTRACTOR agrees to negotiate in good faith with subcontractors and others to mitigate the OWNER's cost.

16.3 The OWNER May Terminate With Cause.

16.3.1 Upon the occurrence of any one or more of the following events:

- .1 If CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents
- .2 If CONTRACTOR disregards or fails to comply with Legal Requirements;
- .3 If CONTRACTOR disregards the authority of the Contract Administrator or the City Manager;
- .4 If CONTRACTOR makes fraudulent statements;
- .5 If CONTRACTOR fails to maintain a work force adequate to accomplish the Work within the Contract Time;
- .6 If CONTRACTOR fails to make adequate progress and endangers successful completion of the Contract; or
- .7 If CONTRACTOR otherwise materially breaches the Contract;

The OWNER may, after giving CONTRACTOR (and the surety, if any) seven days' notice terminate the Contract. The OWNER, at its option, may proceed with negotiation with surety for completion of the Work. Alternatively, the OWNER may under these circumstances exclude CONTRACTOR from the Project Site and take possession of the Work (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at Project Site or for which the OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as the OWNER may deem expedient. In such case CONTRACTOR will not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses and damages sustained by the OWNER arising out of or resulting from completing the Work, such excess will be paid to CONTRACTOR. If such claims, costs, losses and damage exceed such unpaid balance, CONTRACTOR or surety will pay the difference to the OWNER. If a termination for cause is found to be wrongful,

the termination will be converted to a termination without cause, and CONTRACTOR's remedy for wrongful termination is limited to the recovery of the payments permitted for termination without cause.

16.3.2 Where CONTRACTOR's services have been so terminated by the OWNER, the termination will not affect any rights or remedies of the OWNER against CONTRACTOR and surety then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by the OWNER will not release CONTRACTOR from liability.

16.4 CONTRACTOR May Stop Work or Terminate. If through no act or fault of CONTRACTOR, the Work is suspended for a period of more than 90 days by the OWNER or under an order of court or other public authority, or (except during disputes) the Contract Administrator fails to forward for processing any mutually acceptable Application for Payment within 30 days after it is submitted, or (except during disputes) the OWNER fails for 60 days after it is submitted to pay CONTRACTOR any sum finally determined by the OWNER to be due, then CONTRACTOR may, upon seven days' written notice to the OWNER, and provided the OWNER does not remedy such suspension or failure within that time, terminate the Agreement and recover from the OWNER payment on the same terms as if OWNER terminated without cause pursuant to this Contract. In lieu of terminating the Agreement and without prejudice to any other right or remedy, if (except during disputes) the Contract Administrator has failed to forward for processing any mutually acceptable Application for Payment within 30 days after it is submitted, or (except during disputes) the OWNER has failed for 60 days after it is submitted to pay CONTRACTOR any sum finally determined by the OWNER to be due, CONTRACTOR may upon seven days' written notice to the OWNER stop the Work until payment of all such amounts due CONTRACTOR, including interest thereon. The provisions of this Section are not intended to preclude CONTRACTOR from making a Claim for an increase in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to CONTRACTOR's stopping Work as permitted by this Section.

16.5 Discretionary Notice to Cure. In its complete discretion, the OWNER may, but is not required to, provide a Notice to Cure to CONTRACTOR and its surety to cure any of the conditions constituting a breach of Contract or an anticipatory breach of contract and, if required by the OWNER, to attend a meeting with the OWNER, regarding the Notice to Cure, the event of default or the anticipatory breach of contract. The Notice to Cure will set forth the time limit in which the cure is to be completed or commenced and diligently prosecuted. Upon receipt of any Notice to Cure, CONTRACTOR will prepare a report describing its program and measures to affect the cure of the event of default or anticipatory breach of contract within the time required by the Notice to Cure. The CONTRACTOR's report will be delivered to the OWNER at least three days prior to any requested meeting with the OWNER and surety.

16.6 Bankruptcy. If CONTRACTOR declares bankruptcy or is adjudged bankrupt or makes an assignment for the benefit of creditors or if a receiver is appointed for the benefit of creditors or if a receiver is appointed by reason of CONTRACTOR's insolvency, CONTRACTOR may be unable to perform this Contract in accordance with the Contract requirements. In such an event, the OWNER may demand CONTRACTOR or its successor in interest provide the OWNER with adequate assurance of CONTRACTOR's future performance in accordance with the terms and conditions of the Contract. If CONTRACTOR fails to provide adequate assurance of future performance to the OWNER's reasonable satisfaction within ten days of such a request, the OWNER may terminate the Contract for cause or without cause, as set forth above. If CONTRACTOR fails to provide timely adequate assurance of its performance and actual performance, the OWNER may prosecute the Work with its own forces or with other contractors on a time and material or other appropriate basis and the cost of which will be charged against the balance of the Contract Price otherwise due to CONTRACTOR.

16.7 Duty to Mitigate. If the OWNER terminates this Contract or suspends CONTRACTOR's work, CONTRACTOR agrees to and will take all reasonable actions to mitigate its damages and any and all claims which may be asserted against the OWNER.

16.8 Responsibility during Demobilization. While demobilizing, CONTRACTOR will take all necessary and reasonable actions to preserve and protect the Work, the Project Site and other property of the OWNER or others at the Project Site.

16.9 CONTRACTOR to Remove Equipment. In the case of termination of this Contract before completion for any cause whatsoever, CONTRACTOR, if notified to do so by the OWNER, will promptly remove any part or all of his equipment or supplies from the property of the OWNER; failing to, the OWNER will have the right to remove such equipment and supplies at the expense of CONTRACTOR.

16.10 CONTRACTOR to Clean Up Project Site. If either OWNER or CONTRACTOR terminates the Contract before Substantial or Final Completion, CONTRACTOR will leave the Project Site in a clean condition as if Final Completion had been achieved, unless OWNER directs otherwise; and if CONTRACTOR fails to comply clean up the Project Site as required, the OWNER may do so and the cost thereof will be charged against CONTRACTOR.

END OF GENERAL CONDITIONS SECTION

SUPPLEMENTAL GENERAL CONDITIONS

SG 1: CONSTRUCTION AT THE WESTSIDE REGIONAL WATER RECLAMATION FACILITY:

The CONTRACTOR will supply information on each employee, including subcontractors, accessing the Westside Regional Water Reclamation Facility (WRWRF). The following requirements must be met in order to perform work at the WRWRF:

- CONTRACTOR must provide confirmation that a background check is performed on employees, including subcontractors via the FDLE website: <https://www.fdle.state.fl.us/Criminal-History-Records/Record-Check>. Background checks must include a review for violent felonies.
- All employees, including subcontractors, must wear an ID badge when on site at the WRWRF. At a minimum, ID badges must include company name, contact information and name of employee.
- CONTRACTOR must provide a list of all employees, including subcontractors, accessing the Site. CONTRACTOR must notify the City immediately of any personnel changes.
- CONTRACTOR must provide a single, reachable point of contact for all issues regarding construction at the WRWRF. This contact is responsible for keeping a log of who is on site at all times.
- Before the end of the previous work week, CONTRACTOR must provide a scheduled start and stop time for each work day for the following work week to the CITY for approval. CITY staff will check the CONTRACTOR in at the WRWRF each work day. This is the only way the CONTRACTOR will access the WRWRF.

CONTRACTOR will be notified of any worker determined to be problematic or deemed to be in the CITY's best interest for restriction. CONTRACTOR must remove said worker from the WRWRF immediately.

The required information can be provided by e-mail, fax or US mail. Contact information will be provided at the pre-construction meeting.

SG 2: OWNER DIRECT PURCHASE POLICY: The OWNER reserves the right to issue OWNER Purchase Orders directly to suppliers of materials to be incorporated into the Work of Project as described in the Contract, in order to obtain the exemption from sales taxes available under Florida Statutes § 212.08(6), in accordance with the procedures listed below. For purposes of this policy, the term, "materials," means all items of tangible personal property which OWNER may be eligible to directly purchase tax free in accordance with Florida Statutes § 212.08(6), and implementing administrative regulations; and all other terms will have the meaning provided or suggested in the Contract, where applicable.

1. The CONTRACTOR will provide to the OWNER a list of all materials to be used in the Work, including those items of material required to be used by the Design Engineer, and will denote on that list any items that the CONTRACTOR deems suitable for OWNER to purchase directly. CONTRACTOR will also denote those items that are to CONTRACTOR's knowledge likely to have long lead times or that are available from only one or a severely limited number of suppliers.

2. The OWNER may accept or reject the CONTRACTOR's recommendations and will at OWNER's discretion directly purchase those items that OWNER deems suitable for direct purchase. The OWNER's election to make direct purchases under this policy will not eliminate or affect the CONTRACTOR's responsibilities under the Contract except as specifically noted herein. Among other things, CONTRACTOR will remain responsible for controlling the means and methods by which the Work is to proceed; working diligently to complete the Work in accordance with applicable deadlines; and for tracking ordering and delivery of materials so as to maintain the critical path. Neither the procedures herein, nor the OWNER's election to directly purchase certain materials, will alter or the applicability of the procedures and standards to be used under the Contract for claims for delay or change orders.

3. The CONTRACTOR will require that all quotes for materials received by CONTRACTOR for tangible personal property to be incorporated into the Project: (i) itemize sales tax as a separate item; (ii) include language that the quotations are assignable to the OWNER; and (iii) include language stating that if assigned to OWNER, no sales tax will be charged upon provision of OWNER's sales tax exemption certificate. Nothing herein will prohibit the OWNER from requiring the supplier of materials to be directly purchased by OWNER, from requiring the supplier to issue a written quotation directly to OWNER, even where CONTRACTOR has provided OWNER with an assignable quotation as provided herein.

4. OWNER will provide CONTRACTOR a list of items of tangible personal property to be purchased directly by OWNER. CONTRACTOR will remain responsible for directly purchasing all items of such property that OWNER does not elect to purchase directly.

5. For those items of tangible personal property that OWNER elects to directly purchase, CONTRACTOR will prepare City Purchase Order request form, consistent with the quotes provided by the suppliers and this policy.

6. CONTRACTOR will forward the completed Purchase Order request form to the OWNER's Account Clerk, and provide a copy to the Contract Administrator.

7. The Purchasing Agent will issue a purchase order to the supplier based on the information provided by the CONTRACTOR and the supplier's written quotation. The Purchasing Agent will provide a copy of the purchase order to the CONTRACTOR.

8. Upon receipt of the OWNER's purchase order, CONTRACTOR will issue a deductive contract adjustment to the supplier that will account for the value of the material and the sales tax as it pertains to that supplier's contract with the sub-contractor. All sales tax savings will be credited to the OWNER through a deductive change order under the OWNER's contract with CONTRACTOR.

9. OWNER will acquire title to and assume responsibility for materials directly purchased by OWNER under this policy, upon delivery to the Job Site.

10. Suppliers will directly invoice the OWNER. Invoices will be forwarded to the CONTRACTOR for verification. Immediately as materials directly purchased by OWNER are delivered to the Job Site, the CONTRACTOR will review the condition of the materials delivered for conformity with contract specifications and the supplier's invoice for conformity with this policy, including confirmation that the invoice references OWNER's purchase order and is billed to OWNER, not CONTRACTOR. CONTRACTOR will promptly advise the OWNER of any deficiencies in the materials or invoice. The intent of this requirement is to require CONTRACTOR

to act diligently to allow OWNER to meet its obligations to the supplier under Florida's Prompt Payment Act, Florida Statutes § 218.70 *et seq.* Nothing herein will prohibit the CONTRACTOR from requiring a Subcontractor of CONTRACTOR's to conduct a similar review for CONTRACTOR's benefit; however, CONTRACTOR will remain responsible to OWNER for promptly reviewing the materials and invoice in accordance with this Section.

11. Upon being satisfied that directly purchased materials and the accompanying invoice from the supplier are satisfactory, OWNER will pay the supplier for the items purchased. Under no circumstances will CONTRACTOR be responsible for paying the supplier. The OWNER will issue a check for the approved invoice amount and mail this check directly to the supplier, accompanied by the Certificate of Entitlement. A copy of the check will be forwarded to the CONTRACTOR so that CONTRACTOR can accurately track and summarize all OWNER Direct Purchase payments.

In the event the OWNER does not timely execute the appropriate documents submitted by the CONTRACTOR for direct purchase, the CONTRACTOR may, upon timely notice to the OWNER, order such materials irrespective of loss of sales tax savings. It is the intent of these provisions to implement the cost savings afforded by the sales tax exemption without delay of the Work and that the CONTRACTOR retain complete control of the Project Schedule. While the OWNER'S direct purchase of materials or supplies will not relieve the CONTRACTOR of responsibility to maintain and safeguard such materials and supplies until they are incorporated into the Work and accepted by the OWNER, the OWNER will assume liability for the materials at the time they are delivered to the jobsite. The CONTRACTOR will not be entitled to a time extension in the event that delay is occasioned by the OWNER'S direct purchase of materials.

12. The OWNER will bear the economic burden of obtaining insurance covering damage or loss or will directly enjoy the economic benefit of the proceeds of any such insurance. Nothing herein will prohibit the OWNER from requiring CONTRACTOR to supply additional coverage, such as through a builder's risk policy or installation floater, to insure materials directly purchased by OWNER from damage and risk of loss.

13. The OWNER does hereby defend, hold harmless, and indemnify the CONTRACTOR from any and all liability for unpaid sales taxes which the CONTRACTOR may suffer as a result of claims, demands, costs, interest, penalties or judgments against the CONTRACTOR made by or in favor of the State of Florida on account of failure to pay Florida State Sales Taxes on materials purchased by the OWNER under this policy. The OWNER agrees to defend against any such claims or actions brought against the CONTRACTOR whether rightfully or wrongfully brought or filed. The CONTRACTOR agrees that it will promptly notify the OWNER of any such claim, demand, or action. Furthermore, the CONTRACTOR expressly agrees that, if and when requested by the OWNER, it will enter into such amendments to this Contract as the OWNER, upon consultation with its legal counsel, may deem necessary or useful to preserve or ensure its right under Florida law to the sales tax exemption contemplated by this subsection. OWNER's obligation to indemnify and hold harmless CONTRACTOR as provided herein is subject to limitations, including monetary limitations, contained in Florida Statutes § 768.28.

SG 3: EPA PUBLIC AWARENESS SRF SIGNAGE REQUIREMENTS: The CONTRACTOR will be responsible for providing project signage that meets EPA's "Enhancing Public Awareness of SRF Assistance Agreements" requirements. For the purposes of this project, the CONTRACTOR will provide a sign that meets the "Standard Signage" requirement. A summary of the signage details and language requirements is listed below. However, the CONTRACTOR shall review the

requirements to ensure all sign aspects are met. Requirements, along with examples, can be found at: <https://floridadep.gov/wra/srf/content/state-revolving-fund-resources-and-documents>

Signage Details & Language

States selecting projects that will implement this requirement through use of a traditional sign should ensure the following:

(1) The U.S. EPA Logo must appear on the sign (2) The sign should be placed in a prominent location at or near the construction site, and (3) The sign should remain in place for the duration of construction.

States are required to ensure that recipients comply with the sign specifications provided by the EPA Office of Public Affairs (OPA) available at: http://www.epa.gov/ogd/tc/epa_logo_seal_specifications_for_infrastructure_grants.pdf. If the EPA logo is displayed along with logos of other participating entities, the EPA logo must not be displayed in a manner that implies that EPA itself is conducting the project. Instead, the EPA logo must be accompanied with a statement indicating that the recipient received financial assistance from EPA for the project. As provided in the sign specifications from OPA, the EPA logo is the preferred identifier for assistance agreement projects and use of the EPA seal requires prior approval from the EPA. To obtain the appropriate EPA logo graphic file, the recipient should send a request directly to OPA and include the EPA Project Officer in the communication. Instructions for contacting OPA are available at: <http://www2.epa.gov/stylebook/using-epa-seal-and-logo>.

SG 4 ASBESTOS MATERIALS. Should Asbestos Materials be found the CONTRACTOR must follow asbestos removal work in compliance with all Legal Requirements, as defined in the General Conditions, including specifically those Legal Requirements applicable to asbestos materials, including the Department of Environmental Protection's asbestos requirements, 40 CFR Part 61, Subpart M, and OSHA Section 29 CFR 1926.38. Additionally, the CONTRACTOR is responsible for properly licensed and/or certified for asbestos removal as required by Legal Requirements.

SG 5. LEAD PAINT REMOVAL AND DISPOSAL. Should surfaces with paint containing lead in concentrations requiring hazardous material compliance procedures outlined by CFR Titles 29 and 40 be found, CONTRACTOR must determine the location of the lead paint surfaces, have samples tested by a certified laboratory to determine lead concentration as required by 40 CFR 261, and submit a plan for the removal, containment and disposal of lead-based paints and associated debris. The CONTRACTOR will carry out removal, containment, and disposal work in accordance with SSPC Guidelines and Legal Requirements. The CONTRACTOR will assume responsibility for proper utilization of the paint removal method selected; and for handling of, classification, and disposal of lead paint, debris, and associated lead paint removal waste in accordance with Federal and Legal Requirements. Additionally, the CONTRACTOR is properly licensed for/certified for lead paint removal as required by Legal Requirements.

SUPPLEMENTARY CONDITIONS (CONSTRUCTION)

Florida Department of Environmental Protection
State Revolving Fund Program
Supplementary Conditions
for

Formally Advertised
Construction Procurement

TABLE OF CONTENTS FOR THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION SUPPLEMENTARY CONDITIONS

Article Number	Article Title	Page
1	DEFINITIONS	FDEP-1
2	PRIVITY OF AGREEMENT/CONTRACT	FDEP-2
3	PROCUREMENT REQUIREMENTS	FDEP-2
4	RESOLUTION OF PROTESTS AND CLAIMS/DISPUTES	FDEP-2
5	CHANGES TO THE BIDDING AND CONTRACT DOCUMENTS	FDEP-3
6	BONDS AND INSURANCE	FDEP-3
7	AWARD OF AGREEMENT/CONTRACT	FDEP-4
8	ITEMIZED CONSTRUCTION COST BREAKDOWN; CONSTRUCTION AND PAYMENT SCHEDULES	FDEP-4
9	FDEP/USEPA ACCESS TO RECORDS AND PROJECT SITE	FDEP-4
10	DISADVANTAGED BUSINESS ENTERPRISES	FDEP-4
11	DEBARMENT AND SUSPENSION (EXECUTIVE ORDER 12549)	FDEP-5
12	EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)	FDEP-6
13	IMMIGRATION REFORM AND CONTROL ACT OF 1986 STATE OF FLORIDA EXECUTIVE ORDER 11-116)	FDEP-12
14	ENVIRONMENTAL COMPLIANCE	FDEP-12
15	FEDERAL LABOR STANDARDS PROVISION	FDEP-12
16	AMERICAN IRON AND STEEL PROVISION	FDEP-12
17	PROHIBITED LOCAL GOVERNMENT CONSTRUCTION PREFERENCES	FDEP-12

Appendix	Title	Page
A	CERTIFICATION OF COMPLIANCE WITH THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION SUPPLEMENTARY CONDITIONS	FDEP-13
B	GOALS AND TIMETABLES FOR MINORITIES AND FEMALES	FDEP-14
C	FEDERAL LABOR STANDARDS PROVISION	FDEP-15
D	AMERICAN IRON AND STEEL PROVISION	FDEP-23

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION SUPPLEMENTARY CONDITIONS

The intent of the Florida Department of Environmental Protection (FDEP) Supplementary Conditions is to complement and supplement other provisions of the Bidding Documents. However, if there is any conflict between the FDEP Supplementary Conditions and other provisions of the Bidding Documents, the FDEP Supplementary Conditions shall take precedence over the other provisions except when the other provisions are similar to, but more stringent than, the FDEP Supplementary Conditions. When other provisions of the Bidding Documents are similar to, but more stringent than, the FDEP Supplementary Conditions, the more stringent provisions shall apply.

ARTICLE 1 - DEFINITIONS

Wherever used in these Supplementary Conditions (except in the appendices to these Supplementary Conditions), the following terms have the meanings indicated, which are applicable to both the singular and plural thereof.

- 1.1 Addendum - A written or graphic instrument that is issued prior to the opening of bids and that clarifies, corrects, or changes the Bidding Documents.
- 1.2 Agreement or Contract - The written agreement between the Owner and the Contractor covering the Work to be performed and furnished; these Supplementary Conditions and other Contract Documents are attached to the Agreement/Contract and made a part thereof as provided therein.
- 1.3 Bid - The offer or proposal of a bidder submitted on the prescribed form and setting forth the price(s) for the Work to be performed and furnished.
- 1.4 Bidder - Any person, firm, or corporation that submits a bid directly to the Owner.
- 1.5 Bidding Documents - The Advertisement for Bids or the Invitation to Bid, the Instructions to Bidders or the Information for Bidders, the Bid Form, the proposed Contract Documents, and all addenda.
- 1.6 Bond - An instrument of security.
- 1.7 Change Order - A document that is recommended by the Engineer and signed by the Contractor and the Owner; that authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Time; and that is issued on or after the Effective Date of the Agreement/Contract.
- 1.8 Contract Documents - The Agreement/Contract; the Contractor's Bid when attached as an exhibit to the Agreement/Contract; the Performance and Payment Bond(s); the General Conditions; the Supplementary Conditions (including these Supplementary Conditions); the Specifications (written technical descriptions of material, equipment, construction systems, standards, and workmanship as applied to the Work and certain administrative details applicable thereto); the Drawings (drawings that show the character and scope of the Work to be performed and furnished); all addenda that pertain to the Contract Documents; and all change orders.
- 1.9 Contract Time - The number of days or the date stated in the Contract Documents for completion of the Work.
- 1.10 Contractor - The person, firm, or corporation with whom or which the Owner enters into the Agreement/Contract.
- 1.11 Effective Date of the Agreement/Contract - The date indicated in the Agreement/Contract on which the Agreement/Contract becomes effective, or if no such date is indicated in the Agreement/Contract, the date on which the Agreement/Contract is signed and delivered by the last of the two parties to sign and deliver the Agreement/Contract.
- 1.12 Engineer - The person, firm, or corporation named as such in the Contract Documents.
- 1.13 Minority Business Enterprise (MBE) - A historically Black college or university or a business that is (a) certified as socially and economically disadvantaged by the Small Business Administration, (b) certified as an MBE by a state or federal agency, or (c) an independent business concern which is at least 51-percent owned and controlled by minority group members. (A minority group member is an individual who is a citizen of the United States and one of the following: [i] Black American; [ii] Hispanic American [with origins from Puerto Rico, Mexico, Cuba, or South or Central America]; [iii] Native American [American Indian, Eskimo, Aleut, or native Hawaiian]; or [iv] Asian-Pacific American

[with origins from Japan, China, the Philippines, Vietnam, Korea, Samoa, Guam, the U.S. Trust Territories of the Pacific, Northern Marianas, Laos, Cambodia, Taiwan, or the Indian Subcontinent].)

1.14 Notice to Proceed - The written notice given by the Owner to the Contractor fixing the date on which the Contract Time will commence to run and on which the Contractor shall start to perform its obligations under the Contract Documents.

1.15 Owner - The local government (municipality, county, district, or authority; or any agency thereof; or a combination of two or more of the foregoing acting jointly) with which the Florida Department of Environmental Protection (FDEP) may execute, or has executed, a State Revolving Fund loan agreement and for which the Work is to be provided.

1.16 Project - The total construction or facilities described in a State Revolving Fund loan agreement between the FDEP and the Owner, of which the Work to be provided under the Contract Documents may be the whole or a part.

1.17 Sponsor - The recipient of the State Revolving Fund loan agreement that provides funds for the project.

1.18 Subcontract - A direct contract between a subcontractor and the Contractor, or any other subcontractor at any tier, for the furnishing of goods (material and equipment) or the performance of services (including construction) necessary to complete the Work.

1.19 Subcontractor - A person, firm, or corporation having a direct contract with the Contractor, or any other subcontractor at any tier, for the furnishing of goods (material and equipment) or the performance of services (including construction) necessary to complete the Work.

1.20 Successful Bidder - The lowest responsive, responsible bidder to whom or which the Owner intends to award the Agreement/Contract.

1.21 Women's Business Enterprise (WBE) - A business that is (a) certified as a WBE by a state or federal agency or (b) an independent business concern which is at least 51-percent owned and controlled/operated by women. (Determination of whether a business is at least 51-percent owned by women shall be made without regard to community property laws [e.g., an otherwise qualified WBE that is 51-percent owned by a married woman in a community property state will not be disqualified because the married woman's husband has a 50-percent interest in the married woman's share of the business; similarly, a business that is 51-percent owned by a married man and 49-percent owned by women will not become a qualified WBE by virtue of the married man's wife having a 50-percent interest in the married man's share of the business].)

1.22 Work - The entire completed construction or the various separately identifiable parts thereof required to be performed and furnished under the Contract Documents; Work is the result of performing services, furnishing labor, furnishing material and equipment, and incorporating material and equipment into the construction as required by the Contract Documents.

ARTICLE 2 - PRIVACY OF AGREEMENT/CONTRACT

2.1. The Owner expects to finance this Agreement/Contract with assistance from the FDEP, which administers a State Revolving Fund loan program supported in part with funds directly made available by grants from the United States Environmental Protection Agency (USEPA). Neither the State of Florida nor the United States (nor any of their departments, agencies, or employees) will be a party to this Agreement/Contract or any lower-tier subcontract.

ARTICLE 3 - PROCUREMENT REQUIREMENTS

3.1. This Agreement/Contract and the Owner's solicitation and award of this Agreement/Contract are subject to requirements contained in Chapter 62-503 (Revolving Loan Program) and/or Chapter 62-552, Florida Administrative Code as applicable.

ARTICLE 4 - RESOLUTION OF PROTESTS AND CLAIMS/DISPUTES

Resolution of Protests Concerning the Owner's Solicitation and/or Award of this Agreement/Contract:

- 4.1. Protests concerning the Owner's solicitation and/or award of this Agreement/Contract must be filed in writing with the Owner to be considered.
- 4.2. All timely written protests concerning the Owner's solicitation and/or award of this Agreement/Contract are to be resolved in accordance with the Owner's dispute resolution process. A copy of the ordinance(s), resolution(s), or written policy (policies) that set forth the Owner's dispute resolution process is included elsewhere in the Bidding Documents or is to be made available by the Owner upon request.
- 4.3. Neither the (FDEP) nor the USEPA will become a party to, or have any role in resolving, protests concerning the Owner's solicitation and/or award of this Agreement/Contract. Protest decisions made by the Owner cannot be appealed to the FDEP or the USEPA.

Resolution of Claims and Disputes Between the Owner and the Contractor:

- 4.4. Unless otherwise provided in the Contract Documents, all claims and disputes between the Owner and the Contractor arising out of, or relating to, the Contract Documents or the breach thereof are to be decided by arbitration (if the Owner and the Contractor mutually agree) or in a court of competent jurisdiction within the State of Florida.
- 4.5. Neither the FDEP nor the USEPA will become a party to, or have any role in resolving, claims and disputes between the Owner and the Contractor.

ARTICLE 5 - CHANGES TO THE BIDDING AND CONTRACT DOCUMENTS

- 5.1. All changes to the Bidding Documents made subsequent to the FDEP's acceptance of the Bidding Documents and prior to the opening of bids are to be documented via addendum (addenda) to the Bidding Documents; all changes to the Contract Documents made after the opening of bids are to be documented by change order(s) to the Contract Documents. The Owner shall submit all addenda and change orders to the FDEP.

ARTICLE 6 - BONDS AND INSURANCE

Bid Guarantees:

- 6.1. Each bidder's bid is to be accompanied by a bid guarantee made payable to the Owner in an amount at least equal to five percent of the bidder's maximum bid price and in the form of a certified check or bid bond.

Performance and Payment Bond(s):

- 6.2. The Contractor shall furnish a combined performance and payment bond in an amount at least equal to 100 percent of the Contract Price (or, if required elsewhere in the Contract Documents, the Contractor shall furnish separate performance and payment bonds, each in an amount at least equal to 100 percent of the Contract Price) as security for the faithful performance and payment of all the Contractor's obligations under the Contract Documents. This(these) bond(s) are to be delivered to the Owner by the Contractor along with the executed Agreement/Contract. The Owner shall forward a copy of this (these) bond(s) to the FDEP.

Insurance:

- 6.3. The Owner and/or the Contractor (as required elsewhere in the Contract Documents) shall purchase and maintain, during the period of construction, such liability insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims that may arise out of, or result from, the Contractor's performance and furnishing of the Work (whether the Work is to be performed or furnished by the Contractor or any subcontractor at the Work site) and the Contractor's other obligations under the Contract Documents. This insurance is to include workers' compensation insurance, comprehensive general liability insurance, comprehensive automobile liability insurance, and contractual liability insurance applicable to the Contractor's indemnification obligations and is to be written for not less than the limits of liability and coverages determined by the Owner or required by law, whichever is greater.

6.4. The Owner and/or the Contractor (as required elsewhere in the Contract Documents) shall purchase and maintain, during the period of construction, property insurance upon the Work at the Work site in an amount equal to the full replacement cost of the Work or the full insurable value of the Work. This insurance is to include the interests of the Owner, the Contractor, and all subcontractors at the Work site (all of whom are to be listed as insured or additional insured parties); is to insure against the perils of fire and extended coverage; and is to include "all-risk" insurance for physical loss or damage due to theft, vandalism and malicious mischief, collapse, water damage, and/or all other risks against which coverage is obtainable.

6.5. Before any Work at the Work site is started, the Contractor shall deliver to the Owner certificates of insurance that the Contractor is required to purchase and maintain in accordance with Paragraphs 6.3 and 6.4 of this Article and other provisions of the Contract Documents, and the Owner shall deliver to the Contractor certificates of insurance that the Owner is required to purchase and maintain in accordance with Paragraphs 6.3 and 6.4 of this Article and other provisions of the Contract Documents.

ARTICLE 7 - AWARD OF AGREEMENT/CONTRACT

7.1. If this Agreement/Contract is awarded, it is to be awarded to the lowest responsive, responsible bidder. A fixed price (lump sum or unit price or both) agreement/contract is to be used. A clear explanation of the method of evaluating bids and the basis for awarding this Agreement/Contract are included elsewhere in the Bidding Documents. All bids may be rejected when in the best interest of the Owner. After the contract has been awarded, the Owner shall give the Contractor a notice to proceed fixing the date on which the Contract Time will commence to run. The Owner shall forward a copy of this notice to proceed to the FDEP.

ARTICLE 8 - ITEMIZED CONSTRUCTION COST BREAKDOWN; CONSTRUCTION AND PAYMENT SCHEDULES

8.1. The Contractor shall submit to the Owner, within ten calendar days after the Effective Date of this Agreement/Contract, an itemized construction cost breakdown and construction and payment schedules.

8.1.1. The itemized construction cost breakdown, or schedule of values, is to include quantities and prices of items aggregating the Contract Price and is to subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices are to include an appropriate amount of overhead and profit applicable to each item of Work.

8.1.2. The construction, or progress, schedule is to indicate the Contractor's estimated starting and completion dates for the various stages of the Work and is to show both the projected cost of Work completed and the projected percentage of Work completed versus Contract Time.

8.1.3. The payment schedule is to show the Contractor's projected payments cumulatively by month.

ARTICLE 9 – FDEP/USEPA ACCESS TO RECORDS AND PROJECT SITE

9.1. Authorized representatives of the Owner, the FDEP, and the USEPA shall have access to, for the purpose of inspection, the Work site(s), any books, documents, papers, and records of the Contractor that are pertinent to this Agreement/Contract at any reasonable time. The Contractor shall retain all books, documents, papers, and records pertinent to this Agreement/Contract for a period of five years after receiving and accepting final payment under this Agreement/Contract.

NOTE: ARTICLE 10 ONLY APPLIES TO FEDERAL CAP GRANT PROJECTS

ARTICLE 10 - DISADVANTAGED BUSINESS ENTERPRISES

10.1 A goal of five percent of the Contract Price is established for Minority Business Enterprise (MBE) participation in the Work, and a goal of five percent of the Contract Price is established for Women's Business Enterprise (WBE) participation in the Work. If bidders or prospective contractors (including the Contractor) intend to let any lower-tier goods

or services (including construction) subcontracts for any portion of the Work, they shall physically include these percentage goals for MBE and WBE participation in all solicitations for subcontracts and shall take good faith efforts to assure that MBEs and WBEs are utilized, when possible, as sources of goods and services. Good faith efforts are to include the following:

10.1.1. Require Disadvantaged Business Enterprises (DBEs) are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. For Indian Tribal, State and Local and Government recipients, this will include placing DBEs on solicitation lists and soliciting them whenever they are potential sources.

10.1.2. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.

10.1.3. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. For Indian Tribal, State and local Government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.

10.1.4. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.

10.1.5. Use the services and assistance of the Small Business Administration and the Minority Business Development Agency of the Department of Commerce.

10.1.6. If the prime contractor awards subcontracts, require the prime contractor to take the steps in paragraphs 10.1.1 through 10.1.5 of this section.

10.2. Within ten calendar days after being notified of being the apparent Successful Bidder, the apparent Successful Bidder shall submit to the Owner documentation of the affirmative steps it has taken to utilize Minority and Women's Business Enterprises (MBEs and WBEs) in the Work and documentation of its intended use of MBEs and WBEs in the Work. The Owner shall keep this documentation on file and shall forward to the FDEP a copy of the apparent Successful Bidder's documentation concerning its intended use of MBEs and WBEs in the Work.

ARTICLE 11 - DEBARMENT AND SUSPENSION (EXECUTIVE ORDER 12549)

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions

11.1. The bidder certifies, by submission of this proposal, that neither the bidder nor its principals, nor the bidder's subcontractors nor their principals, are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department or agency.

11.2. Where the bidder is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

11.3. The bidder also certifies that it and its principals and the bidder's subcontractors and their principals:

11.3.1. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state or local) transaction or contract under a public transaction; violation of federal or state anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

11.3.2. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state or local) with commission of any of the offenses enumerated in paragraph 11.3.1 of this certification; and

11.3.3. Have not within a three-year period preceding this proposal had one or more public transactions (federal, state or local) terminated for cause or default. Where the bidder is unable to certify to any of the above, such owner shall attach an explanation to this proposal.

11.3.4. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the federal government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

11.3.5. The bidder shall incorporate the foregoing requirements 11.1 through 11.3 in all subcontracts.

ARTICLE 12 - EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)

12.1. Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246). (Applicable to contracts/subcontracts exceeding \$10,000)

12.1.1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.

12.1.2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in Florida, are as follows:

Goal for female participation: 6.9 percent statewide

Goal for minority participation: (See Appendix B at FDEP-20 for goals for each county)

These goals are applicable to all the Contractor's construction work (whether or not it is federal or federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and non-federally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

12.1.3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

12.1.4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is the State of Florida.

12.1.5. Contractors shall incorporate the foregoing requirements in all subcontracts.

12.2. Equal Opportunity Clause (Applicable to contracts/subcontracts exceeding \$10,000)

During the performance of this contract, the contractor agrees as follows:

12.2.1. The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor shall take affirmative action to ensure that applicants for employment are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

12.2.2. The Contractor shall post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause. The notice can be obtained online at http://www.eeoc.gov/employers/upload/eeoc_self_print_poster.pdf. The Contractor shall state that all qualified applicants be considered without regard to race, color, religion, sex or national origin.

12.2.3. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive considerations for employment without regard to race, color, religion, sex, or national origin.

12.2.4. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

12.2.5. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

12.2.6. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

12.2.7. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

12.2.8. The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs 12.2.1 through 12.2.8 in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

12.3. The Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246)

12.3.1. As used in these specifications:

- a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;
- b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
- c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
- d. "Minority" includes:
 - (i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
 - (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
 - (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

(iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

12.3.2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

12.3.3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

12.3.4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a through p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered construction Contractors performing construction work in geographical areas where they do not have a federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the FEDERAL REGISTER in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

12.3.5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

12.3.6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

12.3.7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

- a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
- b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

- c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore, along with whatever additional actions the Contractor may have taken.
- d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.
- e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 12.3.7b above.
- f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
- g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
- h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.
- i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
- j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.
- k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.
- l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
- m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

- n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
- o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
- p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

12.3.8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (12.3.7a through 12.3.7p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

12.3.9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

12.3.10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

12.3.11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12.3.12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

12.3.13. The Contractor, in fulfilling its obligation under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

12.3.14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

12.3.15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

12.4. Pursuant to 41 CFR 60-1.7, if the price of this bid exceeds \$10,000, the bidder, by signing and submitting this proposal, certifies the following:

- 12.4.1. Affirmative action programs pursuant to 41 CFR 60-2 have been developed and are on file;
- 12.4.2. Documentation of a previous contract or subcontract subject to the equal opportunity clause is available;
- 12.4.3. All reports due under the applicable filing requirements have been filed with the Joint Reporting Committee, the Deputy Assistant Secretary or the Equal Employment Opportunity Commission; and
- 12.4.4. Each prospective construction subcontractor that may be awarded a lower-tier construction subcontract with a price exceeding \$10,000 shall meet the above requirements 12.4.1 through 12.4.3.

12.5. Pursuant to 41 CFR 60-1.8, if the price of this bid exceeds \$10,000, the bidder, by signing and submitting this proposal, certifies the following:

- 12.5.1. That he/she does not maintain or provide for his/her employees any segregated facility at any of his/her establishments;
- 12.5.2. That he/she does not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained;
- 12.5.3. That he/she will not maintain or provide for employees any segregated facilities at any of his/her establishments;
- 12.5.4. That he/she will not permit employees to perform their services at any location under his/her control where segregated facilities are maintained;
- 12.5.5. That a breach of this certification is violation of the Equal Opportunity Clause of this contract; and
- 12.5.6. That he/she will obtain identical certifications from proposed Subcontractors prior to the award of Subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause, and that he will retain such certifications in his/her files.

As used in this certification, the term "segregated facilities" means any waiting rooms, work eating areas, time clocks, locker rooms, and other storage or dressing areas, transportation and housing facilities provided for employees which are in fact segregated on the basis of race, color, religion, or otherwise.

12.6. If the price of this Agreement/Contract exceeds \$10,000, the Owner shall give written notice to the Director of the Office of Federal Contract Compliance Programs within ten working days of award of this Agreement/Contract. The notice is to include the name, address, and telephone number of the Contractor; the employer identification number of the Contractor; the dollar amount of this Agreement/Contract; the estimated starting and completion dates of this Agreement/Contract; the number of this Agreement/Contract; and the geographical area in which the Work is to be performed.

12.7. If the price of this Agreement/Contract equals or exceeds \$50,000 and if the Contractor has 50 or more employees, the Contractor shall electronically file Standard Form 100 (EEO-1) online at <https://egov.eeoc.gov/eeo1/eeo1.jsp> within 30 calendar days after the award of this Agreement/Contract, unless the Contractor has submitted such a report within 12 months preceding the date of award of this Agreement/Contract. In addition, the Contractor shall ensure that each construction subcontractor having 50 or more employees and a lower-tier construction subcontract with a price equaling or exceeding \$50,000 also electronically files this form within 30 calendar days after the award to it of the lower-tier construction subcontract, unless the construction subcontractor has submitted such a report within 12 months preceding the date of award of the lower-tier construction subcontract.

ARTICLE 13 - IMMIGRATION REFORM AND CONTROL ACT OF 1986 (STATE OF FLORIDA EXECUTIVE ORDER 11-116)

The Immigration Reform and Control Act of 1986 prohibits employers from knowingly hiring illegal workers. The Contractor shall only employ individuals who may legally work in the United States – either U.S. citizens or foreign citizens who are authorized to work in the U.S. The Contractor shall use the U.S. Department of Homeland Security's E-Verify Employment Eligibility Verification system (<http://www.uscis.gov/portal/site/uscis>) to verify the employment eligibility of:

- all new employees, during the term of this Agreement, to perform employment duties within Florida; and,
- all new employees (including subcontractors and subrecipients) assigned by the Contractor to perform work pursuant to this Agreement.

The Contractor shall include this provision in all subcontracts/subgrants it enters into for the performance of work under this Agreement.

ARTICLE 14 – ENVIRONMENTAL COMPLIANCE

The Contractor, and all subcontractors at any tier, shall comply with all applicable standards, orders, or requirements issued under Section 306 of the Clean Air Act (42 U.S.C. 1857[h]), Section 508 of the Clean Water Act (33 U.S.C. 1368), Executive Order 11738 (Administration of the Clean Air Act and the Federal Water Pollution Control Act with Respect to Federal Contracts, Grants, or Loans).

ARTICLE 15 – FEDERAL LABOR STANDARDS PROVISION

Contracts being constructed with assistance from the State Revolving Fund Program are currently required to comply with the Federal Labor Standards Provisions as provided in Appendix C. Signing Appendix A certifies compliance with these provisions.

ARTICLE 16 – AMERICAN IRON AND STEEL PROVISION

Contracts being constructed with assistance from the State Revolving Fund Program are currently required to comply with The American Iron and Steel Provision as provided in Appendix D. Signing Appendix A certifies compliance with these provisions.

ARTICLE 17 - PROHIBITED LOCAL GOVERNMENT CONSTRUCTION PREFERENCES

- A. Pursuant to Section 255.0991, F.S., for a competitive solicitation for construction services in which 50 percent or more of the cost will be paid from state-appropriated funds which have been appropriated at the time of the competitive solicitation, a state, college, county, municipality, school district, or other political subdivision of the state may not use a local ordinance or regulation that provides a preference based upon:
1. The contractor's maintaining an office or place of business within a particular local jurisdiction;
 2. The contractor's hiring employees or subcontractors from within a particular local jurisdiction; or
 3. The contractor's prior payment of local taxes, assessments, or duties within a particular local jurisdiction.
- B. For any competitive solicitation that meets the criteria in Paragraph A., a state college, county, municipality, school district, or other political subdivision of the state shall disclose in the solicitation document that any applicable local ordinance or regulation does not include any preference that is prohibited by Paragraph A.

**APPENDIX A TO THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SUPPLEMENTARY CONDITIONS**

**CERTIFICATION OF COMPLIANCE WITH THE FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION SUPPLEMENTARY CONDITIONS**

This certification relates to a construction contract proposed by _____,
(insert the name of the Owner)

which expects to finance the proposed construction contract with assistance from the Florida Department of Environmental Protection (which administers a State Revolving Fund loan program supported in part with funds directly made available by grants from the United States Environmental Protection Agency). I am the undersigned prospective construction contractor or subcontractor.

I certify that I have read the Florida Department of Environmental Supplementary Conditions and agree to incorporate the following articles into the bid and/or contract:

- ARTICLE 11 DEBARMENT AND SUSPENSION (EXECUTIVE ORDER 12549)
- ARTICLE 12 EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)
- ARTICLE 13 IMMIGRATION REFORM AND CONTROL ACT OF (STATE OF FLORIDA EXECUTIVE ORDER 11-116)
- ARTICLE 14 ENVIRONMENTAL COMPLIANCE
- ARTICLE 15 FEDERAL LABOR STANDARDS PROVISION
- ARTICLE 16 AMERICAN IRON AND STEEL PROVISION

I agree that I will obtain identical certifications from prospective lower-tier construction subcontractors prior to the award of any lower-tier construction subcontracts with a price exceeding \$2,000. I also agree that I will retain such certifications in my files.

(Signature of Authorized Official)

(Date)

(Name and Title of Authorized Official [Print or Type])

(Name of Prospective Construction Contractor or Subcontractor [Print or Type])

(Address and Telephone Number of Prospective Construction Contractor or Subcontractor [Print or Type])

(Employer Identification Number of Prospective Construction Contractor or Subcontractor)

APPENDIX B TO THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION SUPPLEMENTARY CONDITIONS

GOALS AND TIMETABLES FOR MINORITIES AND FEMALES

[Note: These goals and timetables are the goals and timetables referred to in Paragraph 2 of the "Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246)"; these goals and timetables are to be included in all FDEP assisted construction contracts and subcontracts with a price exceeding \$10,000 and in all solicitations for such contracts and subcontracts.]

The following goals and timetables for female utilization shall be included in all federal and federally assisted construction contracts and subcontracts in excess of \$10,000. The goals are applicable to the contractor's aggregate on-site construction workforce whether or not part of that workforce is performing work on a federal or federally assisted construction contract or subcontract.

Area covered: Goals for Women apply nationwide.

Goals and Timetables

Timetable	Goals (percent)
Indefinite	6.9

Goals for minority utilization can be found in the Department of Labor's Technical Assistance Guide for Federal Construction Contractors (May 2009), available on the internet at <http://www.civilrightsusa.gov/pdf/TAG%20-%20Constuction.pdf> . These goals shall be included for each craft and trade in all federal or federally assisted construction contracts and subcontracts in excess of \$10,000 to be performed in the respective geographical areas. The goals are applicable to each nonexempt contractor's total onsite construction workforce, regardless of whether or not part of that workforce is performing work on a federal, federally assisted or non-federally related project, contract or subcontract.

Construction contractors which are participating in an approved Hometown Plan (see 41 CFR 60-4.5) are required to comply with the goals of the Hometown Plan with regard to construction work they perform in the area covered by the Hometown Plan. With regard to all their other covered construction work, such contractors are required to comply with the applicable SMSA or EA goal contained in this Appendix.

APPENDIX C
TO THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SUPPLEMENTARY CONDITIONS

Davis-Bacon Requirements

FEDERAL LABOR STANDARDS PROVISIONS

(Davis-Bacon Act, Copeland Act, and Contract Works Hours & Safety Standards Act)

The Project to which the construction work covered by this contract pertains is being assisted by the United States of America and the following Federal Labor Standards Provisions are included in this Contract pursuant to the provisions applicable to such federal assistance.

1 Minimum Wages.

(i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act, 29 CFR Part 3, the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of 29 CFR 5.5(a)(1)(iv); also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period.

Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR Part 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under 29 CFR Part 5.5(a)(1)(ii) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii) (a) The sponsor, on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The FDEP shall approve a request for an additional classification and wage rate and fringe benefits; therefore, only when the following criteria have been met:

- (1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
- (2) The classification is utilized in the area by the construction industry; and
- (3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(b) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the sponsor(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the sponsor to the FDEP. The FDEP will transmit the request to the Administrator of the Wage and Hour Division, employment Standards Administration, U. S. Department of Labor. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional

classification action within 30 days of receipt and so advise the FDEP or will notify FEDP within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB control number 1215-0140.)

(c) In the event that the Contractor, the laborers or mechanics to be employed in the Classification or their representatives, and the sponsor do not agree on the proposed classification and wage rate (including the amount designed for fringe benefits, where appropriate), the FDEP shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of FDEP, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

(d) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (1)(b) or (c) of this paragraph, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program. Provided, that the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account, assets for the meeting of obligations under the plan or program. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

2. Withholding.

The sponsor shall, upon written request of the EPA or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees and helpers employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the contract, EPA may, after written notice to the contractor, sponsor, applicant, or owners, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and Basic Records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in Section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs. (Approved by the Office of Management and Budget under OMB Control Numbers 1215-0140 and 1215-0017).

(ii) (a) The contractor shall submit weekly for each week in which any contract work is performed, a copy of all payrolls to the sponsor. Such documentation shall be available upon request by FDEP. As to each payroll copy received, the sponsor shall provide a certification that the project is in compliance with the requirements of 29 CFR 5.5(a)(1) with each disbursement request. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR Part 5.5(a)(3)(I), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead, the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site <http://www.dol.gov/whd/forms/wh347instr.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current addresses of each covered worker, and shall provide them upon request to the sponsor for transmission to the FDEP or EPA if requested by EPA, the FDEP, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsor. (Approved by the Office of Management and Budget under OMB Control Number 1215-0149).

(b) Each payroll submitted shall be accompanied by a Statement of Compliance, signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under 29 CFR Part 5.5(a)(3)(ii), the appropriate information is being maintained under 29 CFR Part 5.5 (a)(3)(I), and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(c) The weekly submission of a properly executed certification set forth on the reverse side of Option Form WH-347 shall satisfy the requirement for submission of the Statement of Compliance required by paragraph A. 3(ii)(b) of this section.

(d) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph A.3(I) of this section available for inspection, copying, or transcription by authorized representatives of the FDEP or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FDEP may, after written notice to the contractor, or sponsor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request to make such records available may be grounds for debarment action pursuant to 29 CFR Part 5.12.

4. Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U. S. Department of Labor, the Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio

of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program, shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with the determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U. S. Department of Labor, the Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program the contract will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal Employment Opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

5. Compliance with Copeland Act Requirements.

The contractor shall comply with the requirements of 29 CFR Part 3 which are incorporated by reference in this contract.

6. Subcontracts.

The contractor or subcontractor will insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as EPA determines may be appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR Part 5.5.

7. Contract Termination, Debarment.

A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act Requirements.

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3 and 5 are herein incorporated by referenced in this contract.

9. Disputes Concerning Labor Standards.

Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6 and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the sponsor, FDEP, EPA, the U. S. Department of Labor, or the employees or their representatives.

10. Certification of Eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded government contracts by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded EPA contracts or participate in EPA programs pursuant to Executive Order 12549.

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a government contract by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded EPA contracts or participate in EPA programs pursuant to Executive Order 12549.

(iii) The penalty for making false statements is prescribed in the U. S. Criminal Code, 18 U. S. C. 1001. Additionally, U. S. Criminal Code, Section 1010, Title 18, U. S. C., Federal Housing Administration transactions, provides in part "Whoever, for the purpose of . . . influencing in any way the action of such Administration . . . makes, utters or publishes any statement, knowing the same to be false . . . shall be fined not more than \$5,000 or imprisoned not more than two years, or both".

11. Complaints, Proceedings, or Testimony by Employees.

A. No laborer or mechanic to whom the wage, salary, or other labor standards provisions of this contract are applicable shall be discharged or in any other manner discriminated against by the contractor or any subcontractor because such employee has filed any complaint or instituted or caused to be instituted any proceeding or has testified or is about to testify in any proceeding under or relating to the labor standards applicable under this contract to his employer.

B. Contract Work Hours and Safety Standards Act. The sponsor shall insert the following clauses set forth in paragraphs B.(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by item 3 above or 29 CFR 4.6. As used in the paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in subparagraph (1) of this paragraph, the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in subparagraph (1) of this paragraph, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in subparagraph (1) of this paragraph.

(3) Withholding for unpaid wages and liquidated damages. The sponsor, upon written request of the FDEP or an authorized representative of the Department of Labor, may withhold or cause to be withheld, from any moneys payable on

account of work performed by the contractor or subcontractor under any such contract or any other federal contract with the same prime contract, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in subparagraph (2) of this paragraph.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in subparagraph (1) through (4) of this paragraph and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in subparagraphs (1) through (4) of this paragraph.

C. Health and Safety

(1) No laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health and safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation.

(2) The contractor shall comply with all regulations issued by the Secretary of Labor pursuant to Title 29 Part 1926 (formerly part 1518) and failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act (Public Law 91-54.83 State 96).

(3) The contractor shall include the provisions of this Article in every subcontract so that such provisions will be binding on each subcontractor. The contractor shall take such action with respect to any subcontract as the Secretary of Housing and Urban Development or the Secretary of Labor shall direct as a means of enforcing such provisions.

12. Guidance to Contractor for Compliance with Labor Standards Provisions

a) Contracts with Two Wage Decisions

If the contract includes two wage decisions, the contractor, and each subcontractor who works on the site, must submit either two separate payrolls (one for each wage decision) or one payroll which identifies each worker twice and the hours worked under each wage decision. One single payroll, reflecting each worker once, may be submitted provided the Contractor uses the higher rate in the wage decisions for each identical job classification. However, where a job classification is not listed in a wage decision and is needed for that portion of the work, the classification **must** be added to the wage decision. A worker may not be paid at the rate for a classification using the hourly rate for that same classification in another wage decision. After the additional classification is approved, the contractor may pay the higher of the two rates and submit one payroll, if desired.

b) Complying with Minimum Hourly Amounts

1) The minimum hourly amount due to a worker in each classification is the total of the amounts in the Rates and Fringe Benefits (if any) columns of the applicable wage decision.

2) The contractor may satisfy this minimum hourly amount by any combination of cash and bona fide fringe benefits, regardless of the individual amounts reflected in the Rates and Fringe Benefits columns.

3) A contractor payment for a worker which is required by law is not a fringe benefit in meeting the minimum hourly amount due under the applicable wage decision. For example, contractor payments for FICA or unemployment insurance are not a fringe benefit; however, contractor payments for health insurance or retirement are a fringe benefit. Generally, a fringe benefit is bona fide if (a) it is available to most workers and (b) involves payments to a third party.

4) The hourly value of the fringe benefit is calculated by dividing the contractor's annual cost (excluding any amount contributed by the worker) for the fringe benefit by 2080. Therefore, for workers with overtime, an additional payment may be required to meet the minimum hourly wages since generally fringe benefits have no value for any time worked over 40 hours weekly. (If a worker is paid more than the minimum rates required by the wage decision, this should not be a problem. As long as the total wages received by a worker for straight time equals the hours worked times the minimum hourly rate in the wage decision, the requirement of the Davis-Bacon and Related Acts has been satisfied.)

c) Overtime

For any project work over 40 hours weekly, a worker generally must be paid 150% of the actual hourly cash rate received, not the minimum required by the wage decision. (The Davis-Bacon and Related Acts only establishes minimum rates and does not address overtime. The Contract Work Hours Act contains the overtime requirement and uses basic rate of pay as the base for calculation, not the minimum rates established by the Davis-Bacon and Related Acts.)

d) Deductions

Workers who have deductions, not required by law, from their pay must authorize these deductions in writing. The authorization must identify the purpose of each deduction and the amount, which may be a specific dollar amount or a percentage. A copy of the authorization must be submitted with the first payroll containing the deduction. If deducted amounts increase, another authorization must be submitted. If deducted amounts decrease, no revision to the original authorization is needed. Court-ordered deductions, such as child support, may be identified by the responsible payroll person in a separate document. This document should identify the worker, the amount deducted and the purpose. A copy of the court order should be submitted.

e) Classifications Not Included in the Wage Decision

If a classification not in the wage decision is required, please advise the owner's representative in writing and identify the job classification(s) required. In some instances, the state agency may allow the use of a similar classification in the wage decision.

Otherwise, the contractor and affected workers must agree on a minimum rate, which cannot be lower than the lowest rate for any trade in the wage decision. Laborers (including any subcategory of the laborer classification) and truck drivers are not considered a trade for this purpose. If the classification involves a power equipment operator, the minimum cannot be lower than the lowest rate for any power equipment operator in the wage decision. The owner will provide forms to document agreement on the minimum rate by the affected workers and contractor.

The U.S. Department of Labor (USDOL) must approve the proposed classification and rate. The contractor may pay the proposed rate until the USDOL makes a determination. Should the USDOL require a higher rate, the contractor must make wage restitution to the affected worker(s) for all hours worked under the proposed rate.

f) Supervisory Personnel

Foremen and other supervisory personnel who spend at least 80% of their time supervising workers are not covered by the Davis-Bacon and Related Acts. Therefore, a wage decision will not include such supervisory classifications and their wages are not subject to any minimums under the Davis-Bacon and Related Act or overtime payments under the Contract Work Hours and Safety Standards Act. However, foremen and other supervisory personnel who spend less than 80% of their time engaged in supervisory activities are considered workers/mechanics for the time spent engaged in manual labor and must be paid at least the minimum in the wage decision for the appropriate classification(s) based on the work performed.

g) Sole Proprietorships / Independent Contractors / Leased Workers

The nature of the relationship between a prime contractor and a worker does not affect the requirement to comply with the labor standards provisions of this contract. The applicability of the labor standards provisions is based on the nature of the work performed.

If the work performed is primarily manual in nature, the worker is subject to the labor standards provisions in this contract. For example, if John Smith is the owner of ABC Plumbing and performs all plumbing work himself, then Mr. Smith is subject to the labor standards provisions, including minimum wages and overtime. His status as owner is irrelevant for labor standards purposes.

If a worker meets the IRS standards for being an independent contractor, and is employed as such, this means that the worker must submit a separate payroll as a subcontractor rather than be included on some other payroll. The worker is still subject to the labor standards provisions in this contract, including minimum wages and overtime.

If a contractor or subcontractor leases its workers, they are subject to the labor standards provisions in this contract, including minimum wages and overtime. The leasing firm must submit payrolls and these payrolls must reflect information required to determine compliance with the labor standards provisions of this contract, including a classification for each worker based on the nature of the work performed, number of regular hours worked, and number of overtime hours worked.

h) Apprentices / Helpers

A worker may be classified as an apprentice **only if participating in a federal or state program**. Documentation of participation must be submitted. Generally, the apprentice program specifies that the apprentice will be compensated at a percentage of journeyman rate. For Davis-Bacon Act purposes, the hourly rate cannot be lower than the percentage of the hourly rate for the classification in the applicable wage decision.

If the worker does not participate in a federal or state apprentice program, then the worker must be classified according to duties performed. This procedure may require classification in the trade depending on tools used, or as a laborer if specialized tools of the trade are not used. The contractor may want to consult with the Wage and Hour Division of the U.S. Department of Labor located in most large cities regarding the appropriate classification.

Presently, no worker may be classified as a helper. As with apprentices not participating in a formal apprentice program, the worker must be classified according to duties performed and tools used.

"General Decision Number: FL20200137 01/03/2020

Superseded General Decision Number: FL20190137

State: Florida

Construction Type: Heavy

County: Volusia County in Florida.

HEAVY CONSTRUCTION PROJECTS (Including Sewer and Water Lines)
(EXCLUDING CAPE CANAVERAL AIR FORCE STATION, PATRICK AIR FORCE
BASE, KENNEDY SPACE FLIGHT CENTER AND MALABAR RADAR SITE)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.80 for calendar year 2020 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.80 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2020. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2020

ENGI0673-013 05/01/2013

	Rates	Fringes
OPERATOR: Oiler.....	\$ 20.36	10.85

* IRON0808-003 01/01/2019		

	Rates	Fringes
IRONWORKER, STRUCTURAL.....	\$ 27.28	14.70

LABO0517-002 05/01/2017		

	Rates	Fringes
LABORER: Grade Checker.....	\$ 19.20	7.85

PAIN1010-011 08/01/2019

	Rates	Fringes
Painter - Brush, Roller & Spray.....	\$ 24.71	13.50

SUFL2009-176 06/24/2009

	Rates	Fringes
CARPENTER, Excludes Form Work....	\$ 13.56	1.84
CEMENT MASON/CONCRETE FINISHER...	\$ 12.63	0.00
ELECTRICIAN.....	\$ 16.71	3.51
FORM WORKER.....	\$ 11.36	0.00
LABORER: Common or General.....	\$ 9.03	0.81
LABORER: Landscape.....	\$ 8.44	0.00
LABORER: Pipelayer.....	\$ 11.17	1.27
LABORER: Power Tool Operator (Hand Held Drills/Saws, Jackhammer and Power Saws Only).....	\$ 10.63	2.20
OPERATOR: Asphalt Paver.....	\$ 11.88	0.00
OPERATOR: Backhoe Loader Combo.....	\$ 16.10	2.44
OPERATOR: Backhoe/Excavator.....	\$ 13.12	2.58
OPERATOR: Bulldozer.....	\$ 12.88	0.00
OPERATOR: Crane.....	\$ 14.88	3.17
OPERATOR: Grader/Blade.....	\$ 16.00	2.84
OPERATOR: Loader.....	\$ 13.38	0.00
OPERATOR: Mechanic.....	\$ 13.83	2.19
OPERATOR: Roller.....	\$ 10.50	0.00
OPERATOR: Scraper.....	\$ 11.00	1.74
OPERATOR: Trackhoe.....	\$ 20.92	5.50
OPERATOR: Tractor.....	\$ 10.00	0.00
TRUCK DRIVER, Includes Dump Truck.....	\$ 11.07	0.00
TRUCK DRIVER: Lowboy Truck.....	\$ 11.00	0.00
TRUCK DRIVER: Off the Road Truck.....	\$ 12.21	1.97

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

=====

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

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

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that

no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

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

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor

200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

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

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

=====

END OF GENERAL DECISION

"

APPENDIX D TO THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION SUPPLEMENTARY CONDITIONS

American Iron and Steel Requirement

The Contractor acknowledges to and for the benefit of the _____ ("Owner") and the State of Florida (the "State") that it understands that iron and steel products to be installed as a part of this contract must be in compliance with the requirements in H.R. 3547, "Consolidated Appropriations Act, 2014," (Appropriations Act). H.R. 3547 includes the following language in Division G, Title IV, Sec. 436, under the heading, "Use of American Iron and Steel,":

(a) (1) None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j-12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products used in the project are produced in the United States.

(2) In this section, the term "iron and steel products" means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

(b) Subsection (a) shall not apply in any case or category of cases in which the Administrator of the Environmental Protection Agency (in this section referred to as the "Administrator") finds that--

- (1) applying subsection (a) would be inconsistent with the public interest;
- (2) iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
- (3) inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

(c) If the Administrator receives a request for a waiver under this section, the Administrator shall make available to the public on an informal basis a copy of the request and information available to the Administrator concerning the request, and shall allow for informal public input on the request for at least 15 days prior to making a finding based on the request. The Administrator shall make the request and accompanying information available by electronic means, including on the official public Internet Web site of the Environmental Protection Agency.

(d) This section shall be applied in a manner consistent with United States obligations under international agreements.

Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

For waivers to these requirements based on (2)(b) above, contact Sheryl Parsons at USEPA Region IV. She can be reached by phone at (404) 562-9337.



**CONTRACT DOCUMENTS FOR
CONSTRUCTION OF THE
BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS
AT THE
WESTSIDE REGIONAL WATER RECLAMATION FACILITY**

ISSUED FOR BID

FEBRUARY 2020

**SPECIFICATIONS VOLUME 1
(DIVISIONS 1-13)**



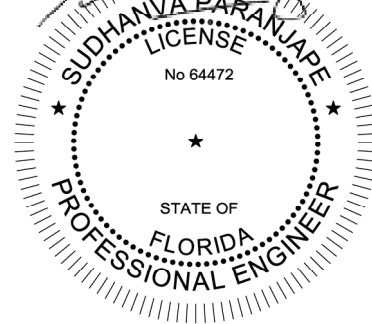
THIS PAGE INTENTIONALLY LEFT BLANK

**CITY OF DAYTONA BEACH
DESIGN OF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS
AT THE
WESTSIDE REGIONAL SLUDGE DEWATERING FACILITY IMPROVEMENTS**

Sudhanva Paranjape, P.E.
FL PE No.64472

Carollo Engineers, Inc.
CA 8571
200 East Robinson St., Ste. 1400
Orlando, Florida 32801
PHONE: (407) 478-4642 • FAX: (407) 478-4643

Digitally signed by Sudhanva Paranjape
Contact Info: Carollo Engineers, Inc.
Date: 2020.02.10 11:33Z -0500

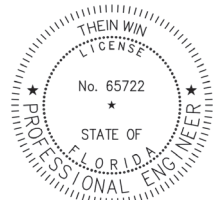


Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Responsible for: 01010, 01140, 01292, 01294, 01312, 01324B, 01329, 01330, 01400, 01410, 01420, 01460, 01568, 01600, 01610, 01710, 01720, 01756, 01770, 01782, 11360, 11362, 13446, 13448, 14555, 15050, 15052, 15061, 15075, 15076, 15110, 15111, 15116, 15120, 15121, 15211, 15247, 15249, 15286, 15812, 15820, 15830, 15852, 15954, 15956, 15958

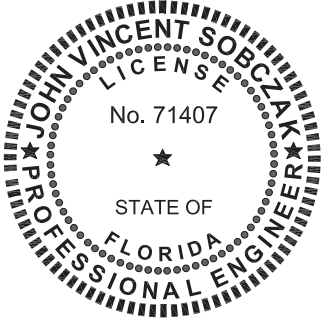
THIS PAGE INTENTIONALLY LEFT BLANK

**CITY OF DAYTONA BEACH
DESIGN OF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS
AT THE
WESTSIDE REGIONAL SLUDGE DEWATERING FACILITY IMPROVEMENTS**

<p style="text-align: center;">Thein Win, P.E. FL PE No. 65722</p> <p style="text-align: center;">Hillers Electrical Engineering, Inc. EB 0006877 23257 State Road 7, Suite 100 Boca Raton, FL 33428 PHONE: (561) 451-9165 • FAX: (561) 451-4886</p>	<div></div> <div><p>Digitally signed by Thein Win Date: 2020.02.07 11:07:10 -05'00'</p></div> <div><p><small>This item has been digitally signed and sealed by Thein Win, PE. on the date adjacent to the seal.</small></p><p><small>Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.</small></p></div>
<p>Responsible for: 16010, 16015, 16050, 16110, 16120, 16405, 16450, 16480, 16485, 16500, 16950, 17000</p>	

THIS PAGE INTENTIONALLY LEFT BLANK

**CITY OF DAYTONA BEACH
DESIGN OF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS
AT THE
WESTSIDE REGIONAL SLUDGE DEWATERING FACILITY IMPROVEMENTS**

<p style="text-align: center;">John Sobczak, P.E. FL PE No. 71407</p> <p style="text-align: center;">Wekiva Engineering, LLC CA 31920 711 N. Orange Ave., Suite A Winter Park, FL 32789 Phone: (321)972-4989</p>	<p style="text-align: center;">John Sobczak c=US, o=Wekiva Engineering LLC, ou=A01410C0000016BC 320B0D400001FCD, cn=John Sobczak 16:09:19 2020.02.07 '00'05- 2019.021.20061</p>  <p style="text-align: center;">Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.</p>
<p>Responsible for: 03055, 03071, 03102, 03150, 03200, 03300, 03366, 03600, 03931, 05120, 05140, 05190, 05500, 07900, 08120, 08710, 09910, 09960</p>	

THIS PAGE INTENTIONALLY LEFT BLANK

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

TABLE OF CONTENTS
VOLUME 1 OF 2

DIVISION 01 – GENERAL REQUIREMENTS

SECTION NO.	TITLE
01010	SUMMARY OF WORK
01140	WORK RESTRICTIONS
01150	MEASUREMENT AND PAYMENT
01292	SCHEDULE OF VALUES
01294	APPLICATIONS FOR PAYMENT
01312	PROJECT MEETINGS
01324B	PROGRESS SCHEDULES AND REPORTS
01329	SAFETY PLAN
01330	SUBMITTAL PROCEDURES
01400	TEMPORARY FACILITIES
01410	REGULATORY REQUIREMENTS
01420	TESTING AND TESTING LABORATORY SERVICES
01460	CONTRACTOR QUALITY CONTROL PLAN
01568	TEMPORARY EROSION AND SEDIMENTATION CONTROL
01600	PRODUCT REQUIREMENTS
01610	PROJECT DESIGN CRITERIA
01710	PROJECT HOUSEKEEPING/CLEANING
01720	AS-BUILTS/RECORD DOCUMENTS
01756	TESTING, TRAINING, AND FACILITY START-UP
01770	CLOSEOUT PROCEDURES
01782	OPERATION AND MAINTENANCE DATA

DIVISION 02 - SITE CONSTRUCTION

SECTION NO.	TITLE
02050	SOILS AND AGGREGATES FOR EARTHWORK
02200	SITE CLEARING
02300	EARTHWORK
02318	TRENCHING
02722	AGGREGATE BASE COURSES
02742	ASPHALTIC CONCRETE PAVING
02952	PAVEMENT RESTORATION AND REHABILITATION

DIVISION 03 - CONCRETE

SECTION NO.	TITLE
03055	ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS
03071	EPOXIES
03102	CONCRETE FORMWORK
03150	CONCRETE ACCESSORIES
03200	CONCRETE REINFORCING
03300	CAST-IN-PLACE CONCRETE
03366	TOOLED CONCRETE FINISHING
03600	GROUTING
03931	EPOXY INJECTION SYSTEM

DIVISION 04 - MASONRY

SECTION NO.	TITLE
04220	CONCRETE UNIT MASONRY

DIVISION 05 - METALS

SECTION NO.	TITLE
05120	STRUCTURAL STEEL
05140	STRUCTURAL ALUMINUM
05190	MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY
05500	METAL FABRICATIONS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION NO.	TITLE
------------------------	--------------

07900	JOINT SEALANTS
-------	----------------

DIVISION 08 - DOORS AND WINDOWS

SECTION NO.	TITLE
------------------------	--------------

08120	ALUMINUM DOORS AND FRAMES
-------	---------------------------

08331	OVERHEAD COILING DOORS
-------	------------------------

08710	DOOR HARDWARE
-------	---------------

DIVISION 09 - FINISHES

SECTION NO.	TITLE
------------------------	--------------

09910	PAINTING
-------	----------

09960	HIGH-PERFORMANCE COATINGS
-------	---------------------------

DIVISION 11 - EQUIPMENT

SECTION NO.	TITLE
------------------------	--------------

11246	POLYMER BLENDING AND FEED EQUIPMENT-LIQUID
-------	--

11313	HORIZONTAL SPLIT-CASE CENTRIFUGAL WASHWATER PUMPS
-------	---

11362	BELT FILTER PRESS
-------	-------------------

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION NO.	TITLE
------------------------	--------------

13446	MANUAL ACTUATORS
-------	------------------

13448	INTELLIGENT ACTUATORS
-------	-----------------------

VOLUME 2 OF 2

DIVISION 14 – CONVEYING SYSTEMS

SECTION NO.	TITLE
14555	SHAFTLESS SCREW CONVEYORS

DIVISION 15 - MECHANICAL

SECTION NO.	TITLE
15050	COMMON WORK RESULTS FOR MECHANICAL EQUIPMENT
15052	COMMON WORK RESULTS FOR GENERAL PIPING
15061	PIPE SUPPORTS
15075	EQUIPMENT IDENTIFICATION
15076	PIPE IDENTIFICATION
15110	COMMON WORK RESULTS FOR VALVES
15111	BALL VALVES
15116	PLUG VALVES
15120	PIPING SPECIALTIES
15121	PIPE COUPLINGS
15211	DUCTILE IRON PIPE: AWWA C151
15247	POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE
15249	POLYVINYL CHLORIDE (PVC) PIPE: SCHEDULE TYPE
15740	HEAT PUMPS
15954	TESTING, ADJUSTING, AND BALANCING FOR HVAC
15956	PIPING SYSTEMS TESTING
15958	MECHANICAL EQUIPMENT TESTING

DIVISION 16 - ELECTRICAL

SECTION NO.	TITLE
16010	BASIC ELECTRICAL REQUIREMENTS
16015	ELECTRICAL SYSTEMS ANALYSIS
16050	BASIC ELECTRICAL MATERIALS AND METHODS
16110	RACEWAYS
16120	CONDUCTORS
16405	ELECTRIC MOTORS

16450	GROUNDING
16480	LOW VOLTAGE MOTOR CONTROL
16485	VARIABLE FREQUENCY DRIVES
16500	LIGHTING
16950	ELECTRICAL TESTING

DIVISION 17 - INSTRUMENTATION AND CONTROLS

SECTION NO.	TITLE
17000	INSTRUMENTATION AND CONTROLS

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Identification and summary description of the Project, the Work, location, coordination, and early occupancy by Owner (City). The word Owner and City are used interchangeably in the entire set of specifications and should be City of Daytona Beach Utilities Department.
- B. Project includes construction of biosolids dewatering system improvements 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 are located on the first floor. Polymer solution is injected into the piping on the first floor as shown on the drawings.
 - 2. The dewatering system improvements project will comprise of furnishing and installing of the following.
 - a. Two (2) 3-belt belt filter presses (BFPs) for dewatering waste activated sludge. See Specification Section 11362 for more details.
 - b. Two (2) washwater pumps (one per BFP). See Specification Section 11313 for more details.
 - c. 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.
 - d. One (1) horizontal, One (1) inclined shaftless screw conveyor complete with supports, chutes and hoppers. See Specification Section 14555 for more details.
 - e. 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.
 - f. All supporting concrete, structural walkways, supports, pipe, valves, pipe supports, and appurtenances.
 - g. All electrical and instrumentation controls as necessary for the project.

1.02 THE WORK

- A. The Work consists of construction of the Sludge Dewatering Improvements at the Westside Regional Water Reclamation Facility, located at 3651 LPGA Blvd., Daytona Beach, FL 32124 as described herein and shown on drawings of the Contract Documents.

- B. Specific items included in the Work 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, odor control ducts, and panels on the first floor of the dewatering building as shown on the drawings.
 - 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, conveyor control panels, and BFP control panels.
 - e. Install new conveyor system.
 - f. Install new 3-belt BFPs and associated washwater pumps and piping as show on the drawings.
 - g. Install new polymer blending units and all associated piping.
 - h. Install new sludge feed piping to each BFP from the existing sludge feed pumps as shown on the drawings. Install a polymer injection ring and mixing valve on the discharge of each sludge feed pump downstream of the existing magnetic flow-meter. Coordinate and follow directions of BFP manufacturer on the type and location of the polymer injection and mixing valve as desired. Install new polymer solution piping to the polymer injection ring.
 - i. Construct new polymer tote storage area as shown on the drawings.
 - j. Integrate BFP and conveyor programming into the new BFP Master Control Panel (PCP-DW).
 - k. Pour new BFP containment area curb walls and new BFP supports per approved shop drawings for the new BFPs.
 - l. Cut existing floor for new floor drains/trenches as shown on the drawings.
 - m. Fill all recessed areas on the 1st floor with concrete as indicated on the drawings.
 - n. Paint walls of the new belt press room on the first floor.
 - o. Contractor shall procure and set up a rental trailer mounted complete biosolids dewatering system (capable of handling a minimum of 300 gallons per minute of waste activated sludge (WAS) at 0.6 percent total suspended solids (TSS) on a continuous basis to handle the biosolids at the plant during such a time that the existing dewatering operation has to be taken off-line for construction inside the dewatering building. The trailer shall have a skid mounted dewatering equipment such as a belt filter press or screw press or high solids centrifuge and equipped with a progressive cavity feed pump, liquid polymer tote storage, blending and feed system, washwater pump and cake loading conveyor to allow for taking the existing dewatering operation at the plant offline for construction modifications. The cake conveyor shall be self-supporting and capable of mounting at a sufficient angle to off-load the dewatered cake into a truck for hauling off-site. The trailer shall be all equipped with necessary interconnecting piping, valves, ancillary supports etc. and all electrical and instrumentation and controls and should be a plug-and-play type ready to dewater municipal WAS. CONTRACTOR shall provide sufficiently long hose pipes of sufficient size for connecting to the WAS source, washwater source and nearby drain and necessary electrical hook-up. This temporary dewatering system shall be capable of producing a minimum dewatered cake of 14 percent cake solids at all time.

CONTRACTOR may need to hire the services of such mobile dewatering system companies to visit the site, to test the WAS and determine the polymer type and quantity and to obtain a guarantee to meet the minimum cake dryness requirements. Submit the guarantee to Owner. The time for the rental unit will be determined by the installing CONTRACTOR.

CONTRACTOR shall make every effort to reduce the rental time by providing a detailed project schedule to the Owner and Engineer for approval. CONTRACTOR shall be required to provide a unit price for monthly rental on the bid form. CONTRACTOR shall coordinate with Owner to find a location for the mobile dewatering system and provide all testing, start-up, and mobilization and de-mobilization services for this unit. The trailer will be operated by the City staff as required. City will provide for and pay for all necessary polymer, water and electrical for operating the temporary dewatering system during this period.

- p. 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.
- q. Remove and demolish existing MCC-3 and other electrical items located on the second floor of the existing building as shown on the drawings.
- r. Demolish existing BFP containment area, and BFP supports, odor control piping, sludge piping, panels etc. on the second floor as shown on the drawings.

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. City 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.

1.03 OWNER DIRECT PURCHASE EQUIPMENT

- A. Owner may elect to direct purchase certain major equipment to purchase tax free in accordance with Fla. Stat. § 212.08(6), and implementing administrative regulations; and all other terms will have the meaning provided or suggested in the Contract, where applicable. Contractor should coordinate with Owner on the list of equipment the Owner may elect to direct purchase. Contractor shall comply with all conditions as described in the General Conditions and/or Contractor Contract as applicable.

- B. Contractor's responsibility for Owner-direct purchase equipment:
 - 1. Deliver supplier's bill of materials to Owner on behalf of Owner.
 - 2. Submit claims for transportation damage on behalf of Owner.
 - 3. Arrange for replacement of damaged, defective, or missing items on behalf of Owner.
 - 4. Arrange for manufacturer's warranties, bonds, service, and inspections.
 - 5. Designating delivery date for each Owner-direct purchase product/equipment.
 - 6. Reviewing shop drawings, O&M manuals, product data, and samples.
 - 7. Transmit all such submittals to Engineer for review and approval.
 - 8. Submitting notification of discrepancies or anticipated problems.
 - 9. Receiving and unloading equipment/products at site.
 - 10. Promptly inspecting products jointly with Owner, Engineer and recording shortages, and damaged or defective items.
 - 11. Handling products at site, including uncrating and storage.
 - 12. Protecting products from damage.
 - 13. Installing, including assembly, connections, adjustments, tests, and finish products in accordance with Contract Documents.
 - 14. Providing operating oils, lubricants, and incidental materials required for complete installation.
 - 15. Repairing or replacing items damaged after receipt until date of Substantial Completion of the Work by Owner.

1.04 ACTIVITIES BY OTHERS

- A. Owner, utilities, and others may perform activities within Project area while the Work is in progress.
 - 1. Schedule the Work with Owner's representative (Plant Superintendent) and any others to minimize mutual interference.
- B. Cooperate with others to minimize interference and delays.
 - 1. When cooperation fails, submit recommendations and perform Work in coordination with work of others as directed.
 - 2. Any interference with plant operations shall be coordinated with Plant Superintendent only.
- C. When the Work depends for proper execution or results upon work performed by others, inspect and promptly report apparent discrepancies or defects in work performed by others.
 - 1. Assume responsibility for work performed by others, except for defects reported as specified in this paragraph and defects, which may become apparent in work performed by others after execution of the Work.

1.05 COORDINATION OF WORK

- A. Maintain overall coordination of the Work.
- B. Obtain construction schedules from each subcontractor, and require each subcontractor to maintain schedules and coordinate modifications.
- C. 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 CONTRACTOR shall be fully responsible

to take field measurements and coordinate with the EQUIPMENT MANUFACTURER, 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. CONTRACTOR 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.

1.06 SUBSTANTIAL COMPLETION

- A. Substantially complete the scope of work described in Part 1.02 above, but not limited to, and as described in the Contract Documents including specified testing, training of Owner's personnel, and other preparations necessary for Owner's occupancy or use.
- B. Certificates of Substantial Completion will be executed prior to Owner occupancy. Such certificate of Substantial Completion will describe the portion of the Work to be occupied by OWNER, items that may be incomplete or defective, date of occupancy by OWNER, and other information required by OWNER and CONTRACTOR.
- C. After Owner occupancy, allow access for Owner's personnel, access for others authorized by Owner, and Owner operation of equipment and systems.
- D. Prior to such occupancy or use, provide written notice to OWNER indicating work that remains to be performed in occupied areas.
- E. When OWNER's use of occupied facilities reveal defective work, correct defects.
- F. No partial acceptance of the Work will be made and no acceptance other than the final acceptance of the completed Work will be made except for those portions of Work designated for early occupancy by OWNER.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01140

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for sequencing and scheduling the Work affected by existing site and facility, work restrictions, and coordination between construction operations and plant operations.
- 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 01010 - Summary of Work.

1.02 SUBMITTALS

- A. Baseline Schedule with MOP tasks.
- B. Method of Procedure (MOP) Form.

1.03 GENERAL CONSTRAINTS ON SEQUENCE AND SCHEDULING OF WORK

- A. Wastewater projects:
 - 1. The Westside Regional Water Reclamation Facility is the City of Daytona Beach's one of the two water reclamation facilities for treating domestic wastewater prior to discharging to either the public access reuse system or to the Halifax River. Impairing the operational capabilities of this treatment plant will result in serious environmental damage and monetary fines.
 - 2. Conduct work in a manner that will not impair the operational capabilities of essential elements of the treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quality of raw wastewater to the water quality limitations specified in the discharge permit.
 - 3. The status of the treatment plant shall be defined as "operational" when it is capable of treating the entire quantity of wastewater received to the water quality limits specified in the discharge permit.
- B. Work sequence and constraints:
 - 1. Utilize description of critical events in work sequence in this Section as a guideline for scheduling and undertaking the Work.

2. Work sequence and constraints presented do not include all items affecting completion of the Work, but are intended to describe critical events necessary to minimize disruption of the existing facilities and to ensure compliance with National Pollutant Discharge Elimination System permit requirements.

1.04 SHUTDOWN AND CONSTRUCTION CONSTRAINTS

- A. General shutdown constraints:
 1. Execute the Work while the existing facility is in operation.
 2. Some activities may be accomplished without a shutdown.
 3. Apply to activities of construction regardless of process or work area.
 4. Activities that disrupt plant or utilities operations must comply with these shutdown constraints.
 5. Organize work to be completed in a minimum number of shutdowns.
 6. Provide thorough advanced planning, including having required equipment, materials, and labor on hand at time of shutdown.
 7. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.
 8. Final determination of the permitting of shutdowns will be the sole judgment of the Owner's representative (Plant Superintendent).
 9. Owner's representative (Plant Superintendent) maintains the ability to abort on the day of the scheduled shutdown.
- B. General maximum plant flow work limitations:
 1. Activities that disrupt plant operations are prohibited during the following flow conditions, unless otherwise approved in writing by the Engineer and Owner's representative (Plant Superintendent).
 - a. Flow condition: Maximum day or maximum load conditions during certain times of the year as determined by the Owner's representative (Plant Superintendent).
- C. Unit process availability work limitations:
 1. Shutdowns and tie-ins or other activities that disrupt plant operations are prohibited unless the following unit process availability conditions exist and unless otherwise approved in writing by the Engineer and the Plant Superintendent.
 2. At a minimum, the following facilities must be in service in order to proceed with a scheduled shutdown.
 - a. Complete Plant headworks.
 - b. One set of three clarifiers and RAS/WAS pump station.
 - c. One entire 5-stage Bardenpho Treatment Train (all five stages).
 - d. ABW Filtration system.
 - e. UV Disinfection system.
 - f. Plant Effluent Pumping system.
 - g. Biosolids Dewatering System.
- D. Shutdown activities:
 1. Scheduling:
 - a. Coordinate with Plant Superintendent.
 2. Unplanned shutdowns due to emergencies are not indicated in this Section.

- E. Process area construction constraints:
 - 1. The following sequences and constraints shall be observed while working in and around each of the following process areas:
 - a. Existing Secondary Clarifiers, Return Activated Sludge and Waste Activated Sludge pumping and dewatering of waste activated sludge.
 - b. Existing on-line 5-Stage Bardenpho Train.
 - c. Existing ABW filtration system.
 - d. Existing UV disinfection system.
 - e. Material hauling operations:
 - 1) Contractor shall comply with restrictions regarding Contractor's use of site and premises as specified in Section 01010.

1.05 METHOD OF PROCEDURE (MOP)

- A. MOP Instructions: See Attachment No. 1.
- B. Prepare MOP for the following conditions:
 - 1. Shutdowns, diversions, and tie-ins to the existing facility.
 - 2. Process start-up activities.
 - 3. Power interruption and tie-ins.
 - 4. Switch over between temporary and permanent facilities, equipment, piping, and electrical and instrumentation systems.
 - 5. Process constraints requiring interruption of operating processes or utilities.
- C. Other Work not specifically listed may require MOPs as determined necessary by the Contractor, Owner, or Engineer.
- D. Submit Baseline Schedule with proposed MOPs.
- E. Submit MOP Log at construction progress meetings.
- F. No consideration will be given to claims of additional time and cost associated to preparing MOPs required by the Owner and Engineer to complete this work in a manner that facilitates proper operation of the facility and compliance with effluent discharge criteria.
- G. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.

1.06 COMPLIANCE WITH NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

- A. The existing facility is operating under the terms of a National Pollutant Discharge Elimination System permit issued by the Florida Department of Environmental Protection (FDEP). This permit specifies the water quality limits that the plant must meet prior to discharge of effluent. A copy of the existing permit is on file for review at the Westside Regional WRF.
- B. Perform work in a manner that will not prevent the existing facility from achieving the finished water quality requirements established by regulations.
- C. Bear the cost of penalties imposed on the Owner for discharge violations caused by actions of the Contractor.

1.07 REQUIREMENTS FOR OPERATION OF PLANT AND MAINTAINING CONTINUOUS OPERATION OF EXISTING FACILITIES

- A. Facilities or conditions required to keep the existing plant operational include, but are not limited to, the following:
 - 1. Electrical power including transformers, distribution wiring, and VFDs.
 - 2. All treatment unit processes including:
 - a. Plant influent raw wastewater conveying pipelines.
 - b. Plant headworks including screens and grit removal system.
 - c. Flow distribution box No. 1 upstream of the Bardenpho basins.
 - d. At any given time, one of the two 5-stage Bardenpho basins complete with all five stage – anaerobic, 1st anoxic, aerobic, 2nd anoxic and reaeration should be operating with no limitations. Please coordinate with Plant Superintendent.
 - e. At any given time, one set of the three secondary clarifiers (either Clarifiers 1, 2, and 3; or 4, 5, and 6) should be operational with no limitations.
 - f. At any given time, the ability to pump return activated sludge and waste activated sludge to the respective treatment processes with no limitations including associated piping.
 - g. At any given time, the ability to dewater the waste activated sludge using the existing four belt filters presses with no limitations.
 - h. Existing automatic backwash (ABW) filters or new deep bed sand filters and UV disinfection system.
 - i. Existing high service pump station, reclaimed water storage tank and associated reuse pump station.
 - 3. Laboratory facilities.
 - 4. Office, toilets, and washrooms.
 - 5. Fencing and gates.
 - 6. Lighting.
 - 7. Heating, ventilation, and air conditioning.
 - 8. Instrumentation, meters, controls, and telemetry equipment.
 - 9. Safety equipment and features.
 - 10. Parking for City employees and vehicles required for operation and maintenance of the Westside Regional WRF.
 - 11. Storm drainage.
- B. Conduct the Work and provide temporary facilities required to keep the existing plant continuously operational.
- C. Do not remove or demolish existing facilities required to keep the existing plant operational at the capacities specified until the existing facilities are replaced by temporary, new, or upgraded facilities or equipment.
 - 1. Test replacement facilities to demonstrate operational success prior to removing or demolishing existing facilities.

1.08 OPERATIONS AND MAINTENANCE ACCESS

- A. Provide safe, continuous access to process control equipment for plant operations personnel.
- B. Provide access on 1-hour advance notice to process control equipment for plant maintenance personnel and associated maintenance equipment.

- C. This does not include emergencies as defined by the Owner's representative (Plant Superintendent).

1.09 UTILITIES

- A. Maintain electrical, telephone, water, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.
- B. New yard utilities were designed using existing facility drawings.
 - 1. Field verification of utilities locations was not performed during design.
 - 2. Services crossed or located nearby by new yard utilities may require relocation and possible shutdowns.
 - 3. Pipe alignments as indicated on the Drawings.

1.10 COORDINATION OF WORK

- A. Maintain overall coordination of the Work.
- B. Obtain construction schedules from subcontractors and suppliers, and assume responsibility for correctness.
- C. Incorporate schedules from subcontractors and suppliers into Progress Schedule to plan for and comply with sequencing constraints.

1.11 WORK BY OTHERS

- A. Where proper execution of the Work depends upon work by others, inspect and promptly report discrepancies and defects.

1.12 WORK SEQUENCE

- A. Provide a detailed work sequence to Engineer and Owner to review and approval before start of any work. In general the following work sequence is recommended.
 - 1. Sludge Dewatering Improvements
 - a. Remove and demolish existing equipment and various piping, conduits, odor control ducts, and panels on the first floor of the dewatering building as shown on the drawings.
 - 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, and control panels.
 - e. Fill all recessed areas on the 1st floor with concrete as indicated on the drawings
 - f. Cut the existing floor for new floor drains/trenches as shown on the drawings.
 - g. Install all new yard piping, tie-in as shown on the drawings.
 - h. Pour new BFP containment area curb walls and new BFP supports per approved shop drawings for the new BFPs.
 - i. Install new horizontal conveyor.
 - j. Install new 3-belt BFPs and associated washwater pumps and piping (inside the dewatering building) as show on the drawings.
 - k. Install new polymer blending units and all associated piping.

- l. Install new sludge feed piping to each BFP from the existing sludge feed pumps as shown on the drawings. Install a polymer injection ring and mixing valve on the discharge of each sludge feed pump downstream of the magnetic flow-meter. Coordinate and follow directions of BFP manufacturer on the type and location of the polymer injection and mixing valve as desired. Install new polymer solution piping to the polymer injection ring.
- m. Construct new polymer tote storage area as shown on the drawings.
- n. Integrate BFP and conveyor programming into the new BFP Master Control Panel (PCP-DW).
- o. 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 the following construction modifications.
 - 1) Coordinate with the Owner a suitable location for parking of the conveyor and coordinating the feed sludge, washwater, filtrate water, cake unloading, power/electrical and other ancillary equipment to operate the trailer mounted BFP while modifications are done to the bring the new dewatering system online.
 - 2) Demolish the existing truck unloading conveyor
 - 3) Install new inclined conveyor and supports and associated control panel.
 - 4) Install new truck unloading conveyor and associated control panel.
 - 5) Paint walls of the new belt press room on the first floor.
 - 6) Perform functional test, followed by start-up and performance testing on the new BFPs, polymer, and conveyor system.
 - 7) After successful start-up of the new BFPs, remove the trailer and associated utilities and other ancillary equipment and clean the site as necessary.
- p. 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.
- q. Remove and demolish existing MCC-3 and other electrical items located on the second floor of the existing building as shown on the drawings.
- r. Demolish existing BFP containment area, and BFP supports, odor control piping, sludge piping, panels etc. on the second floor as shown on the drawings.
- s. Remove and demolish both inclined screw conveyors and both horizontal screw conveyors.
- t. Remove and demolish three conveyor control panels: two on the first floor of the dewatering building in the truck loading area and one in the second floor BFP room by the mezzanine stairs.
- u. Remove and demolish all odor control piping on the second floor of the dewatering building serving the BFP room. Patch all first floor ceiling penetrations. Cut and cap north wall penetrations just inside the dewatering building
- v. Remove and demolish all 4 inch sludge feed piping from the BFP room. Patch floor penetrations. Remove and demolish the sludge feed piping which runs along the first floor ceiling and patch any floor penetrations.
- w. Remove and demolish washwater piping back to floor penetration as seen in the Drawings.

- x. Remove and demolish all PVC drain piping running along the first floor ceiling which is associated with the existing BFP room floor drains. Patch five floor penetrations in the existing BFP containment pit area.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

Attachment No. 1
“Method of Procedure” (MOP)
Instructions and Forms

Definition and Purpose

“Method of Procedure” (MOP) is a detailed document submitted by the Contractor to request process shutdown(s), utility tie-in(s), work in areas that may risk unanticipated outages, or flow diversions to accommodate site construction activities during a project. Such activities may include (but are not limited to) new tie-ins to utilities or structures, mechanical modifications to process piping or equipment, demolition, bulkhead installation, and cleaning processes.

The MOP provides a detailed plan to the Owner and Engineer that describes specific aspects of the work including purpose, time of execution, and anticipated impacts on treatment processes. The MOP also includes contingency measures and provisions for rapid closure in the event that shutdown or work progress difficulties are encountered. Information from relevant trades associated with the requested shutdown, diversion, or tie-in is also included.

The Owner should use the information within the MOP to define operational procedures and methods to safely and successfully assist the Contractor.

MOP Process Summary

WHO	STEP	TIMING
Contractor	1. Identify MOPs needed on MOP Log and Baseline Schedule.	7 days prior to Preconstruction Scheduling Meeting
Contractor, and Owner	2. Pre-MOP Meeting.	More than 28 days prior to work
Contractor	3. Submits MOP.	No later than 28 days prior to work
Owner	4. Reviews MOP.	
Owner	5. MOP finalized.	7 days prior to work
Contractor	6. Complete Readiness Checklist.	5 days prior to work
Contractor	7. Complete Safety Checklist.	Just prior to commencing work
Contractor	8. Complete Work.	
Contractor	9. Update MOP Log and Progress Schedules.	Monthly

MOP Process Detail

STEP 1. Identifies MOPs needed on MOP Log and Baseline Schedule.

Contractor submits a preliminary list of anticipated project MOPs on MOP Log. MOPs identified but not limited to those shutdowns, diversions, or tie-ins described in the Contract Documents. Incorporate MOPs as tasks in Baseline Schedule. Date scheduled MOPs to coincide with the appropriate construction activities.

STEP 2. Pre-MOP Meeting.

Contractor requests a Pre-MOP Meeting with the Owner to discuss the nature of the shutdown, diversion, or tie-in, and to gather the information necessary to complete the MOP Form. The pre-MOP meeting may be waived by the Owner if the work is deemed to be minor.

STEP 3. Submits MOP.

Contractor completes the MOP Form and submit 3 copies for approval to the Owner's Project Manager (OPM).

STEP 4. Reviews MOP.

OPM distributes MOP Form for review by the Owner's Construction Coordinator, O&M Representative, and Engineer's Project Representative. Review MOP Form for completeness, accuracy, compliance with both the construction schedule, constraints defined in contract documents, and to ensure that the requested work does not negatively impact plant operations or other concurrent project activities. Additional information may be requested to better understand the nature of and method for completing the Work.

STEP 5. MOP finalized.

Once the MOP is agreed to by all parties, the MOP will be finalized by signature. Copies are distributed to the Owner, Engineer, and Contractor.

STEP 6. Complete Readiness Checklist.

Contractor verifies everything is ready for the work.

STEP 7. Complete Safety Checklist.

Contractor ensures safety.

STEP 8. Complete work.

Contractor complete work.

STEP 9. Update MOP Log and Progress Schedules.

Contractor updates MOP Log weekly and distributes at the regularly scheduled construction progress meetings.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01150

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Procedures for measurement and payment of Work performed on a unit price basis as outlined on the Bid Form.
- 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. Bid Form.
 - b. General Conditions

1.02 MEASUREMENT OF QUANTITIES

- A. Measurement of lump sum items shall be based on the percent of actual completion as determined by the Contractor and agreed upon by the Engineer.
- B. Where applicable, work paid at a unit price times number of units measured will be measured by Engineer/Owner in accordance with United States Standard Measures.
- C. Measurement of volumes shall be the actual "as-built" volume pertinent to payment items.
- D. Payment will start only after material is delivered to the project site and verified by the Construction Manager.

1.03 PAY ITEMS

- A. General:
 - 1. The pay items are included in Bid Form.
 - 2. Payment procedures as specified in General Conditions.
- B. Item 1: Construction of biosolids dewatering system improvements.
 - 1. Work includes:
 - a. Performance, payment, and other bonds and insurances provided as specified in General Conditions, and all administrative costs associated with maintaining the necessary coverage as described in the Contract Documents.

- b. For mobilization, work as specified in this item shall consist of work preparatory to actual construction at the site. It shall include, but not be limited to, movement of personnel, equipment, supplies, and incidentals to the project site, and for the establishment of temporary offices, buildings, safety equipment and first aid supplies, sanitary and other facilities as required by these Specifications, the submittal of all required insurance certificates and bonds, posting of all OSHA required notices and establishment of safety programs at the jobsite, any additional requirements of the Supplementary Conditions, and state and local laws and regulations. The costs of any other preconstruction expense necessary for the start of the work, excluding the cost of construction materials, shall be included in this item. Also included in this item will be all costs associated with meetings and coordination with the Owner and Engineer for the purpose of discussing project progress or coordination of tie-in locations. Demobilization shall include but not be limited to the following: Removal of all temporary construction facilities, removal of all equipment and excess materials, and cleanup and restoration of the site to conditions existing prior to construction.
- c. Provide signage in accordance with EPA's Public Awareness standard signage requirements.
- d. Performing a certified site survey of the construction area as noted on the Civil Drawings before any work is commenced.
- e. Supply, installation, and successful start-up of three belt filter presses, associated existing sludge feed pumps, new wash water pumps, new polymer blending units, new cake conveyance system, all piping, valves and appurtenances, and associated controls. Includes all concrete supports and modifications to the existing dewatering building floor and building.
- f. Construction of a new electrical room, with new electrical equipment, and necessary HVAC.
- g. Demolition of existing equipment as shown on the drawings.
- h. As specified in Contract specifications and Drawings.
- i. Also includes supply of all spare parts to the Owner.
- 2. Measurement: Lump sum.
- 3. Payment:
 - a. For bonds and insurance, payment will be made upon verification that the required Bonds and Insurances have been acquired. The Contractor shall submit an invoice substantiating the costs for the Bonds and Insurances within a regular pay request. The cumulative total shall not exceed the Lump Sum Pay Item amount
 - b. For mobilization and demobilization, payment will be made as specified in General Conditions. The cumulative total shall not exceed the Lump Sum Pay Item amount. No additional payment will be made for demobilization and remobilization due to shutdowns, suspensions of Work or for other mobilization activities
 - c. For the rest of the work, payment will be based on percentage of work completed during the pay period at the time of the pay application to the nearest 5 percent complete as mutually agreed to by the Contractor and Construction Manager; the cumulative total shall not exceed the Lump Sum Bid Item price.

- C. Item 2: Mobile (trailer mounted) temporary complete Biosolids dewatering system:
1. Work Includes:
 - a. Provide a temporary, mobile (trailer mounted), biosolids dewatering system complete with a dewatering equipment such as a belt filter press or screw press or high solids centrifuge, a sludge feed pump, polymer storage and feed equipment, washwater pump and loading conveyor to allow taking the existing dewatering operation off-line for a period of time during construction of the dewatering improvements. The plug-and-play mobile biosolids dewatering system should be capable of handling a minimum of 300 gallons per minute of waste activated sludge at 0.6% total suspended solids concentration and be able to produce a dewatered cake of minimum 14% cake solids at all times. The trailer should be equipped with all necessary electrical and instrumentation and controls and ready for hook-up. Include 100-ft long 6-inch hoses for connection to sludge, water and drain connections. Include trailer set-up, test and start-up complete with all mobilization and demobilization services.
 - b. Measurement: Rental Cost for the trailer per month.
 - c. Payment: Payment will be based on rental cost per month for every month the trailer is utilized for temporary dewatering needs at the facility and as confirmed by the City's Construction Manager, at the Bid Item Unit Price per month.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK



METHOD OF PROCEDURE (MOP) FORM

Owner: _____ Date: _____
Contractor: _____ Carollo Project No.: _____
Project Name: _____ Submittal No.: _____
Submittal Title: _____ Spec/Dwg. Reference: _____

MOP #	Task Title (Provide <10 word title):	Submittal Date: (No later than 28 days prior to work)					
SCHEDULE OF WORK ACTIVITY START: (Date/Time)		END: (Date/Time)					
REQUESTOR:							
PRIMARY POINT OF CONTACT:		PHONE/PAGER:					
SECONDARY POINT OF CONTACT:		PHONE/PAGER:					
NOTIFY	<input type="checkbox"/> Control Room, Phone	<input type="checkbox"/> Security, Phone					
BUILDING:		LOCATION OF WORK FLOOR/LEVEL:					
DESCRIPTION OF WORK: (Provide sufficient details on process isolation, work sequencing, and safety (i.e., control of significant hazards unique to the work) to demonstrate an understanding of the work and how it will be completed within the constraints, and its impact on the processes and facility.)							
Task Summary: _____							
Processes Affected: _____							
Trades Affected: _____							
WORK PLAN:							
Work Sequencing: _____							
Process Isolation: _____							
Spill Prevention Plan: _____							
Contingency Plans: _____							
CRITICAL EQUIPMENT/TOOLS: (pumps and discharge hoses with correct fittings, blind flanges and pipe plugs, no-hub fittings, properly sized electrical service components, generators, portable lighting, chlorine for potable water pipe breaks, etc.)							
<input type="checkbox"/>	Acoustic Ceiling/or Walls Access	<input type="checkbox"/>	Excavation Permit	<input type="checkbox"/>	Lock Out/Tag Out		
<input type="checkbox"/>	Chemical Use Approval	<input type="checkbox"/>	Fire Sprinkler Impairment	<input type="checkbox"/>	Life Safety Systems		
<input type="checkbox"/>	Confined Space Permit	<input type="checkbox"/>	Flammable Materials	<input type="checkbox"/>	Roof Protocol		
<input type="checkbox"/>	Critical Lift Plan	<input type="checkbox"/>	Flush / Discharge	<input type="checkbox"/>	Work After Dark		
<input type="checkbox"/>	Energized Electrical Work	<input type="checkbox"/>	High Pressure Test	<input type="checkbox"/>			
<input type="checkbox"/>	Elect. Panel Schedules	<input type="checkbox"/>	Hot Work/Open Flame	<input type="checkbox"/>			
EXISTING SERVICE(S) AT RISK:							
<input type="checkbox"/>	Breathing Air	<input type="checkbox"/>	Elect Normal	<input type="checkbox"/>	Process Access	<input type="checkbox"/>	Telephones
<input type="checkbox"/>	Chemical Distribution	<input type="checkbox"/>	Fire Protection	<input type="checkbox"/>	Safety Showers	<input type="checkbox"/>	UPS
<input type="checkbox"/>	City Water	<input type="checkbox"/>	HVAC	<input type="checkbox"/>	SCADA	<input type="checkbox"/>	VAX/DATA
<input type="checkbox"/>	Communication	<input type="checkbox"/>	Inert Gas	<input type="checkbox"/>	Security	<input type="checkbox"/>	
<input type="checkbox"/>	Domestic Drain	<input type="checkbox"/>	Instrument - Air	<input type="checkbox"/>	Solvent Drain	<input type="checkbox"/>	
<input type="checkbox"/>	Elect-Bus Duct	<input type="checkbox"/>	Life Safety System	<input type="checkbox"/>	Specialty Gases	<input type="checkbox"/>	
<input type="checkbox"/>	Elect Emergency	<input type="checkbox"/>	Natural Gas	<input type="checkbox"/>	Storm Drain	<input type="checkbox"/>	
REVIEWER'S INSTRUCTIONS / COMMENTS: _____							
<input type="checkbox"/> PREJOB BRIEFING MUST BE COMPLETED PRIOR TO COMMENCING WORK:							
	Full Name (printed)	Signature	Phone	Date			
Submitted By							
System Owner							
Reviewer (if needed)							
Reviewer (if needed)							

Reviewer (if needed)				
Reviewer (if needed)				

READINESS CHECKLIST
(5 days prior to work)

Checklist provided as a guide but is not all inclusive.

1. Confirm all parts and materials are on site: _____

2. Review work plan: _____

3. Review contingency plan: _____

SAFETY CHECKLIST
(Just prior to commencing work)

Checklist provided as a guide but is not all inclusive.

1. Location awareness:
 - a. Emergency exits: _____
 - b. Emergency shower and eyewash: _____
 - c. Telephones and phone numbers: _____
 - d. Shut-off valve: _____
 - e. Electrical disconnects: _____
2. Inspect work area:
 - a. Take time to survey the area you are working in. Ensure that what you want to do will work. Do you have enough clearance? Is your footing secure? Do you have adequate lighting and ventilation? Are surrounding utilities out of the way for you to perform your work?
3. Safety Data Sheets
4. MSDS (Material Safety Data Sheets):
 - a. Understand the chemicals and substances in the area you are working in by reading the MSDS.
5. Lockout/Tagout Procedure:
 - a. Lockout/tagout energy sources before beginning work.
 - b. Make sure all valves associated with the work are locked out and tagged out on each side of the penetration.
 - c. Make sure the lines are depressurized.
6. Overhead work:
 - a. Use appropriate personal protective equipment; i.e., safety harness, lifeline, etc.
 - b. Select appropriate tie-off points; i.e., structurally adequate, not a pipe or conduit, etc.
 - c. Spotter assigned and in position.
 - d. Pipe rack access; i.e., check design capacity, protective decking or scaffolding in place, exposed valves or electrical switches identified and protected.
7. Safety equipment:
 - a. Shepherd's hook.
 - b. ARC flash protection.
 - c. Fire extinguisher.
 - d. Other:
8. Accidents:
 - a. Should accidents occur, do not shut off, and do not attempt to correct the situation, unless you are absolutely positive that your action will correct the problem and not adversely affect other people or equipment.
9. Review start-up documents:
 - a. In the event the system is shutdown, the Control Center should have a working knowledge of the start-up procedures in order to deal effectively with unforeseen events.
10. Evacuation procedures:
 - a. Do not obstruct evacuation routes.
 - b. Take time to survey the area for evacuation routes.
11. Contractor and subcontractors and their representatives must comply with all City of Daytona Beach safety policies and relevant OSHA requirements.

Method of Procedure (MOP) Log
Sample

MOP Number	Task Title	Date Requested	Date Approved	Date Work Planned	Work Completed (yes/no)
001					
002					
003					

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01292

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for preparation, format, and submittal of Schedule of Values.
- B. Related section:
 - 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 01324B - Progress Schedules and Reports.
 - b. Section 16050 - Common Work Results for Electrical.

1.02 PREPARATION

- A. Prepare Schedule of Values identifying costs of Major Items of Work and other costs shown in sample included at end of this Section.
- B. Divide the work into following major items of work:
 - 1. Mobilization.
 - 2. Demobilization.
 - 3. As-Built Site Survey.
 - 4. Sludge Dewatering Facility Improvements.
 - 5. Electrical and Instrumentation Controls.
 - 6. Demolition items.
- C. Assign prices to Major Items of Work which aggregate the Contract Price. Base prices on costs associated with scheduled activities based on the Project Schedule for each Major Item of Work.

1.03 SUBMITTALS

- A. Submit preliminary schedule of values.
- B. Submit corrected schedule of values within 10 days upon receipt of reviewed Schedule of Values, but no later than 10 days prior to anticipated submittal of first Application for Payment.
- C. Upon request, support prices with data which will substantiate their correctness.

- D. If activities are added or removed from the Progress Schedule revise the Schedule of Values and resubmit.

1.04 SAMPLE SCHEDULE OF VALUES

- A. Following is an acceptable form for Schedule of Values:

SUGGESTED SCHEDULE OF VALUES		
NO.	DESCRIPTION OF ITEM	COST
1.	Mobilization.	
2	Demolition Items <ul style="list-style-type: none"> Existing Belt Filter Presses (BFPs) including four (4) hydraulic pump units, four (4) control panels, and one (1) alarm panel. Existing cake conveyor system including five (5) screw conveyors and three (3) control panels. MCC-3 BFP containment area including BFP supports, and curb walls. BFP room mezzanine stairs. BFP room doors and frames. All first and second floor odor control piping within the dewatering building only. Second floor BFP area drain piping suspended beneath the first floor ceiling. Portions of plant service water and BFP sludge feed piping as indicated on the drawings. 	
3.	Dewatering facility piping including all below grade year and above grade piping, valves, appurtenances	
4.	Electrical major items of work. <ul style="list-style-type: none"> MCC-3 BFP and Conveyor control panels. Conduit & Wire 	
5.	Major Equipment (Supply, Installation, Start-up and Testing) <ul style="list-style-type: none"> 3-belt BFPs Washwater pumps Cake Conveyor System Polymer blending units 	
6.	Structuruals <ul style="list-style-type: none"> BFP containment area support columns BFP containment area 	

SUGGESTED SCHEDULE OF VALUES		
	<ul style="list-style-type: none"> • Second floor mezzanine stairs. • Door and frames. 	
8.	Instrumentation and Control major items of work. <ul style="list-style-type: none"> • Programming BFP and Conveyor control logic into existing PLC PCP2 • Programming & Testing and integration with Plant SCADA • Field Instruments (supplied by Contractor) 	
9.	Start-up, testing and Training	
10.	Demobilization	
11.	Miscellaneous work items and other prices not included in previous items and necessary to complete the Work.	
	TOTAL LUMP SUM BID	

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01294

APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Procedures for preparation and submittal of Applications for Payment.

1.02 FORMAT

- A. Develop satisfactory spreadsheet-type form generated by downloading cost data from the Schedule of Values.
- B. Fill in information required on form.
- C. When Change Orders are executed, add Change Orders at end of listing of scheduled activities:
 - 1. Identify change order by number and description.
 - 2. Provide cost of change order in appropriate column.
- D. After completing, submit Application for Payment.
- E. Owner will review application for accuracy.
- F. Execute application with signature of responsible officer of Contractor firm.

1.03 SUBSTANTIATING DATA

- A. Provide Substantiating Data with cover letter identifying:
 - 1. Project.
 - 2. Application number and date.
 - 3. Detailed list of enclosures.
 - 4. For stored products with item number and identification on application, description of specific material, and proof of insurance coverage for offsite stored products.
 - 5. Submit "certified" payroll.

1.04 SUBMITTALS

- A. Submit 5 copies of Application for Payment and Substantiating Data with cover letter.

1.05 PAYMENT REQUESTS

- A. Prepare progress payment requests on a monthly basis. Base requests on the breakdowns of costs for each scheduled activity and the percentage of completion for each activity. The City will provide summary cover sheet for pay requests.

- B. Indicate total dollar amount of work planned for every month of the project. Equate sum of monthly amounts to Lump Sum Contract Price.
- C. Generate Progress Payment request forms by downloading cost data from the schedule information to a spreadsheet type format. Identify each activity on the Progress Schedule that has a cost associated with it, the cost for each activity, the estimated percent complete for each activity, and the value of work completed for both the payment period and job to date.
- D. Prepare summary of cost information for each Major Item of Work listed in the Schedule of Values. Identify the value of work completed for both the payment period and job to date.
- E. Submit progress payment requests at progress meetings.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01312

PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Requirements for conducting conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest, and includes the following:
 - 1. Qualifications of Meeting Participants.
 - 2. Preconstruction Conference.
 - 3. Progress Meetings.
 - 4. Pre-Installation Meetings.
- 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 16050 - Basic Electrical Materials and Methods.
 - b. Section 17000 - Instrumentation and Controls.

1.02 QUALIFICATIONS OF MEETING PARTICIPANTS

- A. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of entity each represents.

1.03 PRECONSTRUCTION CONFERENCE

- A. Upon issuance of Notice to Proceed, or earlier when mutually agreeable, Engineer on behalf of Owner, will arrange preconstruction conference in convenient place for most persons invited, in accordance with the General Conditions.
- B. Attending Preconstruction Conference: Contractor's Project Manager, Quality/Safety Manager, Superintendent, Owner's representative (Plant Superintendent), Engineer's Representative, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda.
- C. Engineer's Representative will preside at conference.

- D. Purpose of conference: To establish working understanding between parties and to discuss Construction Schedule, shop drawing and other submittals, cost breakdown of major lump sum items, processing of submittals and applications for payment, and other subjects pertinent to execution of the Work.
- E. Engineer will prepare and distribute agenda in advance on the meeting.
- F. Engineer's representative and Contractor will record minutes of meeting and distribute copies of minutes within 7 days of meeting to participants and interested parties.

1.04 PROGRESS MEETINGS

The Contractor will be responsible for the following:

- A. Conduct progress meetings at least once a month in Contractor's field office, Owner's office, or other mutually agreed upon place.
- B. Distribute to each anticipated participant written notice and agenda of each meeting at least 4 days before meeting.
- C. Require attendance of Contractor's representatives, Engineer's representative, and subcontractors who are or are proximate to be actively involved in the Work, or who are necessary to agenda.
- D. Invite Owner's representative (Plant Superintendent), utility companies when the Work affects their interests, and others necessary to agenda.
- E. Complete and bring Application for Payment and Progress Schedule to progress meeting.
- F. Prepare and distribute agenda.
- G. Preside at meetings.
- H. Purpose of progress meetings: To expedite work of subcontractors or other organizations that are not meeting scheduled progress, resolve conflicts, and coordinate and expedite execution of the Work.
- I. Review progress of the Work, Progress Schedule, narrative report, Application for Payment, record documents, and additional items of current interest that are pertinent to execution of the Work.
- J. Verify:
 - 1. Actual start and finish dates of completed activities since last progress meeting.
 - 2. Durations and progress of activities not completed.
 - 3. Reason, time, and cost data for Change Order Work that will be incorporated into Progress Schedule and application for payment.
 - 4. Percentage completion of items on Application for Payment.
 - 5. Reasons for required revisions to Progress Schedule and their effect on Contract Time and Contract Price.

- K. Discuss potential problems which may impede scheduled progress and corrective measures.
- L. Both Contractor and Engineer's representative will record minutes of meeting and distribute copies of minutes within 7 days of meeting to participants and interested parties.

1.05 PRE-INSTALLATION MEETINGS

The Contractor will be responsible for the following:

- A. General: Meet with manufacturers and installers of major units of construction which require coordination between subcontractors.
- B. Distribute to each anticipated participant written notice and agenda of each meeting at least 4 days before meeting.
- C. Schedule meeting at least 7 days in advance of installation.
- D. Conduct meetings in Contractor's field office or other mutually agreed upon place.
- E. Require attendance of Contractor representatives, Engineer's representatives, appropriate manufacturers and installers of major units of constructions, and affected subcontractors.
- F. Invite Owner's representative (Plant Superintendent).
- G. Preside at meetings.
- H. Record minutes of meeting and distribute copies of minutes within 3 days of meeting to participants and interested parties.

1.06 SCHEDULE UPDATE MEETINGS

- A. Contractor will schedule meetings throughout progress of the Work at maximum monthly intervals.
- B. Contractor will make arrangements for meetings; will prepare agenda with copies for participants, and preside at meetings.
- C. Attendance required: Owner, Engineer's representative, Contractor's Project Manager, General Superintendent, project scheduler, major subcontractors, and suppliers as appropriate to agenda topics for each meetings.
- D. Agenda:
 - 1. Review Monthly Schedule, (Actual Progress and Variance).
 - a. "Activities Started/Completed" this period.
 - b. "Activities Started/Completed" "Variance" Baseline vs. current.
 - c. "Added/Deleted Activities".
 - d. "Revised Activity Descriptions".
 - e. Any significant Proposed Logic Changes.
 - 2. Review milestone "Substantial Completion" Schedule.
 - a. "Critical" Activities - "Critical Area, Float and Vital Statistics".

3. Review "Cumulative and Monthly Costs" graph.
 4. Review "Budgeted Cost" indicating the Current Project Budgeted Cost.
- E. Both Contractor and Engineer's representative will record changes for update and distribute electronic copies within 7 calendar days after meeting to participants and interested parties.

1.07 QUALITY CONTROL MEETINGS

- A. Contractor will schedule and administer meetings throughout progress of the Work at maximum weekly intervals.
- B. Contractor will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.
- C. Attendance Required: Contractor's Project Manager and staff, Contractor's Quality Control Manager and staff, and Engineer's Representative.
- D. Agenda:
1. Review minutes of previous meetings.
 2. Review of Work progress and schedule.
 3. Review of out-of-compliance inspection or test results.
 4. Field observations, problems, and decisions.
 5. Review of offsite fabrication and delivery schedules.
 6. Planned progress during succeeding work period.
 7. Coordination of required inspections and tests.
 8. Review 6-week schedule report with upcoming inspections and special tests.
 9. Maintenance of quality and work standards.
 10. Other business relating to Work.
- E. Both Contractor and Engineer's representative will record minutes and distribute electronic copies within 5 calendar days after meeting to participants, and those affected by decisions made.

1.08 PRESHTUTDOWN MEETINGS

- A. Contractor will follow Owner's standard Construction Method of Procedure (MOP). See Appendix A of Section 01140 for MOP format.
- B. All short-term and longer-term shutdowns and other tie-ins that require an Owner approved MOP also require a pre-shutdown meeting at Project site prior to commencing shutdown for tie-in or modification of specific plant systems.
- C. Require attendance of parties directly affecting, or affected by shutdown, including Engineer's representative, specific work crews, Owner's representative (Plant Superintendent).
- D. Contractor will notify Owner's representative (Plant Superintendent) and Engineer's representative 7 calendar days in advance of meeting date.

- E. Contractor will prepare agenda and preside at meeting:
 - 1. Review accepted MOP including conditions of shutdown, preparation, and installation procedures.
 - 2. Review timelines and sequences.
 - 3. Review responsibilities.
 - 4. Review dry run plan and schedule, as necessary.
 - 5. Review coordination with related work.
- F. Both Contractor and Engineer's representative will record minutes and distribute copies within 5 calendar days after meeting and prior to scheduled shutdown to participants, with copies to Engineer, Owner, and those affected by decisions made.

1.09 PRE-PROCESS START-UP MEETINGS

- A. All processes and equipment that requires testing and process start-up also requires a pre-startup meeting at Project site before commencing process start-up of specific plant systems.
- B. Require attendance of parties directly affecting, or affected by process start-up and testing, including Engineer's representative, specific work crews, Owner's representative (Plant Superintendent).
- C. Contractor will notify Owner's representative (Plant Superintendent) and Engineer's representative 7 calendar days in advance of meeting date.
- D. Contractor will prepare agenda and preside at meeting:
 - 1. Review accepted MOP including conditions of process start-up and testing, preparation, and installation procedures.
 - 2. Review timelines and sequences.
 - 3. Review responsibilities.
 - 4. Review dry run plan and schedule, as necessary.
 - 5. Review coordination with related work.
- E. Both Contractor and Engineer's representative will record minutes and distribute electronic copies within 5 calendar days after meeting and prior to scheduled process start-up to participants, with copies to Engineer, Owner, and those affected by decisions made.
- F. Contractor will follow Owner's standard Construction Method of Procedure (MOP). See Appendix A of Section 01140 for MOP format.

1.10 ELECTRICAL AND INSTRUMENTATION COORDINATION MEETINGS

- A. Contractor shall be responsible for conducting the following:
 - 1. Electrical Meetings:
 - a. Pre-submittal review meeting as specified in Section 16050.
 - b. Electrical System Study Meetings as specified in Division 16.
 - c. Other meetings as required and as otherwise specified.
 - 2. Instrumentation and Control Meetings:
 - a. Pre-Submittal Conference as specified in Section 17000.
 - b. System Configuration Meetings as specified in Section 17000.

- c. Graphics Meetings as specified in Division 17.
- d. Report Meetings as specified in Division 17.
- e. Other meetings as required and as otherwise specified.

1.11 CLOSE-OUT MEETING

- A. Contractor will schedule close-out meeting.
- B. Contractor will make arrangements for meeting, prepare agenda with copies for participants, and preside at meeting.
- C. Attendance required: Owner, Engineer's representative, Contractor's Project Manager, Superintendent.
- D. Agenda:
 - 1. Review punchlist completion.
 - 2. Transfer of record documents.
 - 3. Finalize payment.
- E. Engineer's representative will record minutes and within 5 calendar days after meeting distribute copies to participants.

1.12 POST CONSTRUCTION MEETING

- A. Meet with and inspect the Work 11 months after date of Substantial Completion with Owner and Engineer's representative.
- B. Owner will arrange meeting at least 7 days before meeting.
- C. Meet in Owner's office or other mutually agreed upon place.
- D. Inspect the Work and draft list of items to be completed or corrected.
- E. Review service and maintenance contracts, and take appropriate corrective action when necessary.
- F. Complete or correct defective work and extend correction period accordingly.
- G. Require attendance of Contractor's Project Manager, or Superintendent, appropriate manufacturers and installers of major units of constructions, and affected subcontractors.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01324B

PROGRESS SCHEDULES AND REPORTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Preparation, submittal, and maintenance of computerized progress schedule and reports, contract time adjustments, and payment requests, including the following:
 - 1. Preliminary Schedule.
 - 2. Baseline Schedule.
 - 3. Monthly Schedule Updates.
 - 4. Weekly Summary Schedule.
 - 5. Submittal Schedule.
 - 6. Manpower Schedule.
 - 7. Equipment Schedule.
 - 8. Commissioning and Process Start-up Schedule.
 - 9. As-built Schedule.
- 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. General Conditions.
 - b. Section 01292 - Schedule of Values.
 - c. Section 01294 - Applications for Payment.
 - d. Section 01756 - Testing, Training and Facility Start-up.

1.02 SCHEDULER

- A. Contractor shall designate, in writing and within 5 calendar days after Notice-to-Proceed, person responsible for preparation, maintenance, updating, and revision of all schedules.
- B. Qualifications of scheduler:
 - 1. Authority to act on behalf of Contractor.
 - 2. 5 years verifiable experience in preparation of complex construction schedules for projects of similar value, size, and complexity.
 - 3. Knowledge of critical path method (CPM) scheduling utilizing latest version of Primavera P6 Professional.

- C. Owner in consultation with Engineer's representative reserves the right to disapprove scheduler when submitted by Contractor if not qualified. Owner reserves the right to remove scheduler from the project if found to be incompetent.

1.03 SCHEDULING FORMAT AND SOFTWARE

- A. Schedule format: Utilize CPM format.
- B. Prepare computerized schedule utilizing Primavera P6 Professional, most current version.
 - 1. Provide 1 licensed copy of the scheduling software to the Engineer's representative, registered in the Engineer's name, for the duration of the project.
 - 2. The provided copy of the software shall be a standalone version for installation on a standalone computer.

1.04 PRECONSTRUCTION SCHEDULING MEETING

- A. Contractor will conduct Preconstruction Scheduling Meeting with Contractor's Project Manager, General Superintendent, and scheduler within 7 calendar days after Notice-to-Proceed. This meeting is separate from the Preconstruction Conference Meeting and is intended to cover schedule issues exclusively.
- B. At the meeting, review scheduling requirements. These include schedule preparation, reporting requirements, updates, revisions, and schedule delay analysis. Present schedule methodology, planned sequence of operations, and proposed activity coding structure.
- C. Coding structure:
 - 1. Submit proposed coding structure, identifying the code fields and the associated code values it intends to use in the project schedule.
 - 2. A minimum, include code fields for Project Segment or Phase, Area of Work, Type of Work.
 - 3. Submittal/Procurement/Construction and Responsibility/Subcontractor. Refer to network details and graphical output for listing of activity categories to be included in the schedule.
- D. Naming convention: Name schedule files with the year, month and day of the data date, revision identifier, and a description of the schedule.
 - 1. Example 1: 2014_07_30 rev 1 draft baseline schedule.xer.
 - 2. Example 2: 2014_09_30 rev 2 sep final update.xer.
- E. Filing: Post submitted files to EADOC document control system.

1.05 SCHEDULE PREPARATION

- A. Preparation and submittal of Progress Schedule represents Contractor's intention to execute the Work within specified time and constraints. Failure to conform to requirement may result in termination for cause as specified in Document 00700, under Suspension of Work and Termination.
- B. Contractor's price covers all costs associated with the execution of the Work in accordance with the Progress Schedule.

- C. During preparation of the preliminary Progress Schedule, Engineer's representative will facilitate Contractor's efforts by being available to answer questions regarding sequencing issues, scheduling constraints, interface points, and dependency relationships.
- D. Prepare schedule utilizing Precedence Diagramming Method (PDM).
- E. Prepare schedule utilizing activity durations in terms of working days. Do not exceed 15 working day duration on activities except concrete curing, submittal review, and equipment fabrication and deliveries. Where duration of continuous work exceeds 15 working days, subdivide activities by location, stationing, or other sub-element of the Work. Coordinate holidays to be observed with the Owner's representative (Plant Superintendent), and incorporate them into the schedule as non-working days.
- F. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified times and at price specified in Agreement. Contract requirements are not waived by failure of Contractor to include required schedule constraints, sequences, or milestones in schedule. Contract requirements are not waived by Owner's acceptance of the schedule. In event of conflict between accepted schedule and Contract requirements, terms of Contract govern at all times, unless requirements are waived in writing by the Owner.
- G. Reference schedule to working days with beginning of Contract Time as Day "1."
- H. Contract float is for the mutual benefit of both Owner and Contractor. Changes to the project that can be accomplished within this available period of float may be made by Owner without extending the Contract time, by utilizing float. Time extensions will not be granted nor delay damages owed until Work extends beyond currently accepted Contract completion date. Likewise, Contractor may utilize float to offset delays other than delays caused by Owner. Mutual use of float can continue until all available float shown by schedule has been utilized by either Owner or Contractor, or both. At that time, extensions of the Contract time will be granted by Owner for valid Owner-caused or third party-caused delays which affect the planned completion date and which have been properly documented and demonstrated by Contractor.
- I. Schedule logic: Assembled to show order in which Contractor proposes to carry out Work, indicate restrictions of access, availability of Work areas, and availability and use of manpower, materials, and equipment. Form basis for assembly of schedule logic on the following criteria:
 - 1. Which activities must be completed before subsequent activities can be started?
 - 2. Which activities can be performed concurrently?
 - 3. Which activities must be started immediately following completed activities?
 - 4. What major facility, equipment or manpower restrictions are required for sequencing these activities?
- J. Non-sequestering of float: Pursuant to float sharing requirements of Contract, schedule submittals can be rejected for, use of float suppression techniques such as preferential sequencing or logic, special lead or lag logic restraints, extended activity durations or imposed dates.

- K. Interim milestone dates, operational constraints: In event there are interim milestone dates and/or operational constraints set forth in Contract, show them on schedule. Do not use Zero Total Float constraint or Mandatory Finish Date on such Contract requirements.
- L. Schedule windows for Owner furnished, Contractor-installed equipment or materials: Immediately after Notice-to-Proceed, obtain from Engineer's representative anticipated delivery dates of Owner furnished equipment or materials. Show these dates in the schedule in same manner indicated by Engineer.
- M. Cost loading: All schedules:
 - 1. Only on-site construction activities.
 - 2. The sum total of all cost loaded activities equal the current value of the Contract, including change orders, at all times.
 - 3. Owner acceptance of the Baseline Schedule creates the Schedule of Values required as specified in Section 01292.
 - 4. Provide updated Schedule of Values as the monthly Payment Application as specified in Section 01292.
 - 5. Payments will not be made until updated Schedule of Values is accepted.

1.06 NETWORK DETAILS AND GRAPHICAL OUTPUT

- A. Produce a clear, legible, and accurate calendar based, time scaled, graphical network diagram. Group activities related to the same physical areas of the Work. Produce the network diagram based upon the early start of all activities.
- B. Include for each activity, the description, activity number, estimated duration in working days, total float, and all activity relationship lines.
- C. Illustrate order and interdependence of activities and sequence in which Work is planned to be accomplished. Incorporate the basic concept of the precedence diagram network method to show how the start of one activity is dependent upon the start or completion of preceding activities and its completion restricts the start of following activities.
- D. Indicate the critical path for the project.
- E. Delineate the specified contract duration and identify the planned completion of the Work as a milestone. Show the time period between the planned and Contract completion dates, if any, as an activity identified as project float unless a Change Order is issued to officially change the Contract completion date.
- F. Identify system shutdown dates, system tie-in dates, specified interim completion or milestone dates and contract completion date as milestones.
- G. Include, in addition to construction activities:
 - 1. Submission dates and review periods for major equipment submittals, shoring submittals, and indicator pile program:
 - a. Shoring reviews: Allow 4-week review period for each shoring submittal.
 - b. Pile indicator program: Allow 3-week review period for analysis of program.
 - 2. Any activity by the Owner or the Engineer that may affect progress or required completion dates.

3. Equipment and long-lead material deliveries over 8 weeks.
 4. Approvals required by regulatory agencies or other third parties.
- H. Produce network diagram on 22-inch by 34-inch sheets with grid coordinate system on the border of all sheets utilizing alpha and numeric designations.
- I. Identify the execution of the following:
1. Mobilization.
 2. All required submittals and submittal review times showing 30 calendar day duration for such activities and equal amount of time for re-submittal reviews.
 3. Equipment and materials procurement/fabrication/delivery.
 4. Excavation.
 5. Shoring design and submission of detailed shoring submittals. Identify submission as a milestone.
 6. Shoring review, shoring materials procurement, shoring installation, and shoring removal.
 7. Backfill and compaction.
 8. Dewatering.
 9. Grading, subbase, base, paving, and curb and gutters.
 10. Concrete, including installation of forms and reinforcement, placement of concrete, curing, stripping, finishing, and patching.
 11. Tests for leakage of concrete structures intended to hold water.
 12. Metal fastenings, framing, structures, and fabrications.
 13. Doors and windows, including hardware and glazing.
 14. Finishes including coating and painting, flooring, ceiling, and wall covering.
 15. Process equipment, including identification of ordering lead-time, factory testing, and installation.
 16. Pumps and drives, including identification of ordering lead time, factory testing, and installation.
 17. Other mechanical equipment including fans and heating, ventilating, and air conditioning equipment.
 18. Trenching, pipe laying, and trench backfill and compaction.
 19. Piping, fittings, and appurtenances, including identification of ordering and fabrication lead time, layout, installation and testing.
 20. Valves, gates, and operators, including identification of order lead-time, installation, and testing.
 21. Plumbing specialties.
 22. Electric transmission, service, and distribution equipment, including identification of ordering lead-time, and factory testing.
 23. Other electrical work including lighting, heating and cooling, and special systems, including identification of ordering lead-time.
 24. Instrumentation and controls, including identification of ordering lead-time.
 25. Preliminary testing of equipment, instrumentation, and controls.
 26. Commissioning Phase:
 - a. Source Testing.
 - b. Owner Training.
 - c. Installation Testing.
 - d. Functional Testing.
 - e. Clean Water Facility Testing.

27. Process Start-up Phase:
 - a. Process Start-up.
 - b. Process Operational Period.
 - c. Instrumentation and Controls Performance Testing.
28. Substantial completion.
29. Punch list work.
30. Demobilization.

1.07 SUBMITTAL OF PROGRESS SCHEDULES

- A. Submit preliminary and baseline schedule.
- B. Submit, on a monthly basis, updated schedules as specified.
- C. Submit final schedule update as specified.
- D. Submit revised schedules and time impact analyses as specified.
- E. Submit schedules in the media and number of copies as follows:
 1. Three sets of the CPM network and/or bar chart (as specified by the Owner and Engineer's representatives) on D-size sheets. Color-coding to be specified by the Owner.
 2. Three sets of Tabular reports listing all activities sorted numerically identifying duration, early start, late start, early finish, late finish, total float, and all predecessor/successor information.
 3. Two sets of CPM Schedule data electronic files stored on CD/DVD or Owner provided flash drive.

1.08 PRELIMINARY SCHEDULE

- A. Submit Preliminary Schedule as defined in the General Conditions and/or Contractor Contract as applicable. Include a detailed plan of operations for first 90 calendar days of Work after receipt of Notice to Proceed.
- B. Meet with Engineer's representative within 7 calendar days after receipt of Preliminary Schedule to review and make necessary adjustments. Submit revised preliminary schedule within 5 calendar days after meeting.
- C. Submit schedule of costs for all activities on revised Preliminary Schedule.
- D. Schedule of costs:
 1. Schedule of Values required under Section 01292 for first 90 calendar days of Work.
 2. Submittal and acceptance of Preliminary Schedule is condition precedent to making of progress payments under Section 01294 and payments for mobilization costs otherwise provided for in the Contract.
 3. No pay item Work shall commence until Preliminary Schedule and schedule of costs have been accepted by Owner (Owner and Engineer's representatives).
- E. Incorporated unchanged, the accepted Preliminary Schedule as first 90 calendar days of activity in Contractor's Baseline Schedule.

- F. Updated monthly during first 90 calendar days after Notice to Proceed. Updated Preliminary Schedule shall be submitted with the payment application required under Section 01294.

1.09 BASELINE SCHEDULE

- A. No more than 45 calendar days after Notice to Proceed, submit the Baseline Schedule for all Work of the project. Show sequence and interdependence of all activities required for complete performance of all Work, beginning with date of Notice to Proceed and concluding with date of final completion of Contract.
- B. Acceptance of the Baseline Schedule by the Owner and Engineer's representatives is a condition precedent to making payments as specified in Section 01294 after the first 90 calendar days after Notice to Proceed.

1.10 WEATHER DAYS ALLOWANCE

- A. See General Conditions for Weather Days and Delays.

1.11 REVIEW AND ACCEPTANCE OF SCHEDULES

- A. See General Conditions.
- B. Engineer's representative will review Baseline Schedule, Schedule Updates, Schedule Revisions, and Time Impact Analyses to ascertain compliance with specified project constraints, compliance with milestone dates, reasonableness of durations and sequence, accurate inter-relationships and completeness.
- C. Engineer and Owner's representatives will issue written comments following completion of review of Baseline Schedule within 21 calendar days after receipt.
- D. Written comments on review of Schedule Updates and Schedule Revisions and Time Impact Analyses will be returned to Contractor within 14 calendar days after receipt by Engineer's representative.
- E. Revise and resubmit schedule in accordance with Engineer's comments within 7 calendar days after receipt of such comments, or request joint meeting to resolve objections.
- F. If Engineer requests a meeting the Contractor and all major subcontractors must participate in the meeting with Engineer.
 - 1. Revise and resubmit schedule within 7 calendar days after meeting.
- G. When schedule reflects Owner, Engineer and Contractor's agreement of project approach and sequence, schedule will be accepted by Owner. Use accepted schedule for planning, organizing, and directing the work and for reporting progress.

1.12 SCHEDULE UPDATES

- A. Any update:
 - 1. Prepare update using most recent accepted version of schedule including:
 - a. Actual start dates of activities that have been started.
 - b. Actual finish dates of activities that have been completed.

- c. Percentage of completion of activities that have been started but not finished.
 - d. Actual dates on which milestones were achieved.
 - e. Update activities by inputting percent complete figures with actual dates.
 - f. Use retained logic in preparing Schedule Updates.
 - g. When necessary, input remaining durations for activities whose finish dates cannot be calculated accurately with a percent complete figure only.
 - h. Revisions to the schedule may be included that have been previously approved as specified in this Section under Revisions to Schedule.
- B. Monthly updates:
- 1. Submit written narrative report in conjunction with each Schedule Update including descriptions of the following:
 - a. Activities added to or deleted from the schedule are to adhere to cost and other resource loading requirements.
 - 1) Identify added activities in manner distinctly different from original activity designations.
 - b. Changes in sequence or estimated duration of activities.
 - c. Current or anticipated problems and delays affecting progress, impact of these problems and delays and measures taken to mitigate impact.
 - d. Assumptions made and activities affected by incorporating change order work into the schedule.
 - 2. Submit updated schedule and materials specified under Submittal of Progress Schedules, 5 calendar days before the monthly schedule update meeting.
 - 3. Since Monthly Schedule Update is submitted with the application for progress payment as required by Section 01294, submittal and acceptance of the monthly Schedule Update is a condition precedent to the making of any progress payments.
- C. Weekly progress meeting:
- 1. Update the schedule prior to weekly progress meeting.
 - a. Identify overall progress of each Major Item of Work in the Summary Schedule.
 - b. If there are significant changes to the schedule, submit a written report at the weekly progress meeting.
 - 2. Should monthly Schedule Update show project completion earlier than current Contract completion date, show early completion time as schedule activity, identified as "Project Float."
 - 3. Should monthly Schedule Update show project completion later than current Contract completion date, prepare and submit a Schedule Revision in accordance with the Revisions to Schedule.

1.13 REVISIONS TO SCHEDULE

- A. Submit Revised Schedule within 5 calendar days:
- 1. When delay in completion of any activity or group of activities indicates an overrun of the Contract time or milestone dates by 20 working days or 5 percent of the remaining duration, whichever is less.
 - 2. When delays in submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of activities.
 - 3. When the schedule does not represent the actual progress of activities.

4. When any change to the sequence of activities, the completion date for major portions of the work, or when changes occur which affect the critical path.
 5. When Contract modification necessitates schedule revision, submit schedule analysis of change order work with cost proposal.
- B. Create a separate submittal for Schedule Revisions.
1. Comply with schedule updates as specified in this Section.
 2. Do not submit with Schedule Updates.
- C. Schedule Revisions will not be reflected in the schedule until after the revision is accepted by the Owner.
1. This includes Schedule Revisions submitted for the purpose of mitigating a Contractor-caused project delay (Recovery Schedule).

1.14 PAYMENT REQUESTS AND CASH FLOW

- A. As described in the General Conditions and/or Contractor Contract as applicable.

1.15 WEEKLY SCHEDULE

- A. Submit to Engineer's representative, at every weekly progress meeting, a 6-Week Schedule showing the activities completed during the previous week and the Contractor's schedule of activities for following 5 weeks.
- B. Use the logic and conform to the status of the current progress schedule when producing a Weekly Schedule in CPM schedule or a bar chart format. In the event that the Weekly Schedule no longer conforms to the current schedule, Contractor may be required to revise the schedule as specified in this Section.
- C. The activity designations used in the Weekly Schedule must consistent with those used in the Baseline Schedule and the monthly Schedule Updates.
- D. Contractor and Engineer must agree on the format of the Weekly Schedule.

1.16 SCHEDULE OF VALUES

- A. Requirements for Schedule of Values are specified in Section 01292.
- B. Submit, in conjunction with the Progress Schedule, a Schedule of Values identifying costs of all on-site construction activities as generated by the cost loaded schedule. Equate the aggregate of these costs to the Lump Sum Contract Price.

1.17 ADJUSTMENT OF CONTRACT TIMES

- A. Contract Time will be adjusted only for causes specified in Contract Documents.
1. Non-excusable delay: Non-excusable delays include actions or inactions of the Contractor, or events for which the Contractor has assumed contractual responsibility (including actions or inactions of subcontractors, suppliers, or material manufacturers at any tier) that would independently delay the completion of the Work beyond the current Contract completion date). No time extensions will be granted for non-excusable delays.

2. Excusable delay: Events which are unforeseeable, outside the control of, and without the fault or negligence of either the Owner or the Contractor (or any party for whom either is responsible), which would independently delay the completion of the Work beyond the current Contract completion date. The Contractor is entitled to a time extension only. No other damages will be approved.
 3. Compensable delay: Actions or inactions of the Owner, or events for which the Owner has assumed contractual responsibility, which would independently delay the completion of the Work beyond the current Contract completion date. The Contractor is entitled to a time extension and delay damages.
 4. Concurrent delay: Concurrent delay is any combination of the above 3 types of delay occurring on the same calendar date.
 - a. Exception to concurrent delay: Cases where the combination consists of 2 or more instances of the same type of delay occurring on the same calendar date. When one cause of delay is Owner-caused or caused by an event which is beyond the control and without the fault or negligence of either the Owner or the Contractor and the other Contractor-caused, the Contractor is entitled only to a time extension and no delay damages.
- B. If the Contractor believes that the Owner has impacted its work, such that the project completion date will be delayed, the Contractor must submit proof demonstrating the delay to the critical path. This proof, in the form of a Time Impact Analysis, may entitle the Contractor to an adjustment of contract time.
- C. The Time Impact Analysis:
1. Use the accepted schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other Owner-caused delay). Represent the delay event in the schedule by:
 - a. Inserting new activities associated with the delay event into the schedule,
 - b. Revising activity logic, or
 - c. Revising activity durations.
 2. If the project schedule's critical path and completion date are impacted as a result of adding this delay event to the schedule, a time extension equal to the magnitude of the impact may be warranted.
 3. The Time Impact Analysis submittal must include the following information:
 - a. A fragment of the portion of the schedule affected by the delay event.
 - b. A narrative explanation of the delay issue and how it impacted the schedule.
 - c. A CD containing the schedule file used to perform the Time Impact Analysis.
- D. When a delay to the project as a whole can be avoided by revising preferential sequencing or logic, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.
- E. Indicate clearly that the Contractor has used, in full, all project float available for the work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date. Utilize the latest version of the Schedule Update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the contract time.

- F. Adjustment of the Contract Times will be granted only when the Contract Float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the contract completion date. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.
- G. Actual delays in activities which do not affect the critical path work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the contract time.
- H. If completion of the project occurs within the specified contract time, the Contractor is not entitled to job-site or home office overhead beyond the Contractor's originally planned occupancy of the site.
- I. Notify Engineer of a request for contract time adjustment. Submit request as specified in General Conditions. In cases where the Contractor does not submit a request for contract time adjustment for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.
- J. The Engineer will, within 30 calendar days after receipt of a contract time adjustment, request any supporting evidence, review the facts and advise the Contractor in writing.
 - 1. Include the new Progress Schedule data, if accepted by the Owner, in the next monthly Schedule Update.

1.18 SUMMARY SCHEDULE

- A. Provide Summary Schedule, which consolidates groups of activities associated with Major Items of Work shown on Baseline Schedule. Summary Schedule is intended to give an overall indication of the project schedule without a large amount of detail.
- B. Submit updated Summary Schedule at weekly progress meetings and after each Schedule Update or Schedule Revision.

1.19 SUBMITTAL SCHEDULE

- A. Submittal Schedule shall include submittals required in the Contract Documents but not limited to Commissioning and Process Start-up Plans, Training Plans, test procedures, operation and maintenance manuals, shop drawings, samples, record documents, and specifically required certificates, warranties, and service agreements.
- B. Preliminary Submittal Schedule:
 - 1. Due date: After Preliminary Schedule has been submitted and accepted by Owner (Plant Superintendent).
 - 2. Format:
 - a. Include submittals anticipated in the first 90 calendar days after Notice-to-Proceed using early start dates.
 - b. Indicate week and month anticipated for each submittal.

- c. Indicate "Priority" submittals where review time can impact Contractor's schedule.
 - 1) "Priority" indication will not alter review times specified in Section 01330.
 - 2) Engineer will endeavor to provide early review of "Priority" submittals where possible.
 - 3. Submittal of Preliminary Submittal Schedule shall be a condition precedent to Owner making progress payments during the first 90 calendar days after Notice to Proceed.
- C. Final Submittal Schedule:
 - 1. Due date: After Baseline Schedule has been submitted and accepted by Owner (Plant Superintendent).
 - 2. Format:
 - a. Include submittals using early start dates.
 - b. Include all submittals, including those required in the preliminary schedule of shop drawings and sample submittals.
 - c. Indicate week and month anticipated for each submittal.
 - d. Indicate "Priority" submittals where review time can impact Contractor's schedule.
 - 1) "Priority" indication will not alter review times specified in Section 01330.
 - 2) Engineer will endeavor to provide early review of "Priority" submittals where possible.
 - 3. Submittal of Final Submittal Schedule shall be a condition precedent to Owner making progress payments after the first 90 calendar days after Notice to Proceed.
- D. Provide updated Submittal Schedule with updated schedules if schedule revisions change listing and timing of submittals.

1.20 MANPOWER SCHEDULES

- A. Due date: After Baseline Schedule has been submitted and accepted by Owner.
- B. Format:
 - 1. Schedule histogram depicting total craft manpower and craft manpower for Contractor's own labor forces and those of each subcontractor.
 - 2. Submit electronically on a computer disk and City provided flash drive in Excel format, with 1 paper copy.
- C. Progress payments after the first 90 calendar days after Notice to Proceed will not be made until manpower schedule is provided.

1.21 EQUIPMENT SCHEDULE

- A. Due date: After Baseline Schedule has been submitted and accepted by Owner. (Plant Superintendent)

- B. Format:
 - 1. Tabular report listing each major piece of construction equipment to be used in performing the Work.
 - 2. Include major equipment for Contractor and each subcontractor.
 - 3. Submit electronically on a computer disk in Excel format with 1 paper copy.
- C. Progress payments after the first 90 calendar days after Notice to Proceed will not be made until equipment schedule is provided.

1.22 COMMISSIONING AND PROCESS START-UP SCHEDULE SUBMITTAL

- A. Proposed Commissioning and Process Start-up Schedule:
 - 1. Due date: As specified in Section 01756.
 - 2. Schedule requirements: As specified in Section 01756.
 - 3. Engineer response due within 20 calendar days of receipt.
 - 4. Contractor responsible for updating schedule and resubmitting within 10 calendar days of receipt of Engineer and Owner comments.
- B. The Commissioning and Process Start-up Schedule may not be combined with the Detailed Schedule until Engineer acceptance of the Proposed Commissioning and Process Start-up Schedule.
- C. Commissioning and Process Start-up Schedule monthly update requirements:
 - 1. Highlight percentages of completion, actual start and finish dates, and remaining durations, as applicable.
 - 2. Include activities not previously included in the previously accepted detail work plan Commissioning and Process Start-up Schedule.
 - 3. Change Order required for any change to contractual dates.
 - 4. Reviews of these submittals by Engineer will not be construed to constitute acceptance within the time frames, durations, or sequence of work for each added activity.

1.23 FINAL SCHEDULE SUBMITTAL

- A. The final Schedule Update becomes the As-Built Schedule.
 - 1. The As-Built Schedule reflects the exact manner in which the project was constructed by reflecting actual start and completion dates for all activities accomplished on the project.
 - 2. Contractor's Project Manager and scheduler sign and certify the As-Built Schedule as being an accurate record of the way the project was actually constructed.
- B. Retainage will not be released until final Schedule Update is provided.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01329

SAFETY PLAN

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Development and maintenance of a Construction Safety Plan.

1.02 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. 70E - Standard for Electrical Safety in the Workplace.
- B. Occupational Safety and Health Standards (OSHA).

1.03 CONSTRUCTION SAFETY PLAN (BY CONTRACTOR)

- A. Submit a Safety Plan as required by the General Conditions and/or Contractor Contract and/or as directed by the Owner.
- B. Detail the Methods and Procedures to comply with NFPA 70E, Federal, and Local Health and Safety Laws, Rules and Requirements for the duration of the Contract Times. Methods and procedures must also comply with the Owner's Safety Plan. Include the following:
 - 1. Identification of the Certified or Licensed Safety Consultant who will prepare, initiate, maintain, and supervise safety programs, and procedures.
 - 2. Procedures for providing workers with an awareness of safety and health hazards expected to be encountered in the course of construction.
 - 3. Safety equipment appropriate to the safety and health hazards expected to be encountered during construction. Include warning devices, barricades, safety equipment in public right-of-way and protected areas, safety equipment used in multi-level structures, personal protective equipment (PPE) as required by NFPA 70E.
 - 4. Methods for minimizing employees' exposure to safety and health hazards expected during construction.
 - 5. Procedures for reporting safety or health hazards.
 - 6. Procedures to follow to correct a recognized safety and health hazard.
 - 7. Procedures for investigation of accidents, injuries, illnesses, and unusual events that have occurred at the construction site.
 - 8. Periodic and scheduled inspections of general work areas and specific workstations.
 - 9. Training for employees and workers at the jobsite.
 - 10. Methods of communication of safe working conditions, work practices and required personal protection equipment.
 - 11. Provision of a site specific emergency action and evaluation plan.
 - 12. Verify safety plan includes reference to and compliance with latest Owner safety policies.

- C. Assume sole responsibility for every aspect of Health and Safety on the jobsite, including the health and safety of subcontractors, suppliers, and other persons on the jobsite:
 - 1. Forward available information and reports to the Safety Consultant who shall make the necessary recommendations concerning worker health and safety at the jobsite.
 - 2. Employ additional health and safety measures specified by the Safety Consultant, as necessary, for workers in accordance with OSHA guidelines.
- D. Transmit to Owner and Engineer copies of reports and other documents related to accidents or injuries encountered during construction.

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.
 - 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 01292 - Schedule of Values.
 - b. Section 01294 - Applications for Payment.
 - c. Section 01330 - Submittal Procedures.
 - d. Section 01324B - Progress Schedules and Reports.
 - e. Section 01770 - Closeout Procedures.
 - f. Section 03200 - Concrete Reinforcing.

1.02 DEFINITIONS

- A. Certificates: Describe certificates that document affirmations by the Contractor or other entity that the work is in accordance with the Contract Documents.
- B. Extra stock materials: Describe extra stock materials to be provided for the Owner's use in facility operation and maintenance.
- C. Maintenance material submittals: Use this article to categorize maintenance materials submittals requiring no A/E action other than confirmation of receipt under an explanatory heading.
- D. 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.
- E. Product data: Product data usually consists of manufacturers' printed data sheets or catalog pages illustrating the products to be incorporated into the project.
- F. 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.

- G. 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.
- H. 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.
- I. Submittals: Submittals are samples, product data, shop drawings, and others that demonstrate how Contractor intends to conform with the Contract Documents.
- J. 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 or reasonably required for construction, operation, and maintenance of the Work.
- 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. In order to expedite construction, the Contractor 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.

- H. Hardcopy submittals:
 - 1. If submittal is more than 200 pages provide hardcopy.
 - 2. Must be clear and legible, and of sufficient size for presentation of information.
 - a. Minimum page size will be 8 1/2 inches by 11 inches.
 - b. Maximum page size will be 11 inches by 17 inches.
- I. Submittals in electronic media format:
 - 1. General: Provide all information In PC compatible format using Windows Operating System as used by the Engineer and Owner.
 - 2. Text: Provide text documents and manufacturer's literature using current version of Adobe Acrobat (i.e. PDF extension) as utilized by the Owner and Engineer.
 - 3. Graphics: Provide all graphic submittals (drawings, diagrams) utilizing current version of Adobe Acrobat (i.e. PDF extension) as utilized by the Engineer and Owner.
- J. Approved Material List:
 - 1. General: Provide the Approved Material List that documents all products that have been determined to be without exceptions through the submittal process. Maintain and update the list throughout the construction period. Provide Owner and Engineer with current copy of list. Provide the list electronically in EXCEL file.
 - 2. Content: Provide Approved Material List in log form with columns titled, "Spec. Section", "Paragraph", "Submittal No.", "Acceptance Date", "Product Description", and "Manufacturer Name". Include only products submitted and found to be without exceptions, that is, the review response indicating "Reviewed-No Corrections Noted", "Submittal Not Reviewed, Filed for Record", or "Submittal Not Reviewed".

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. Contractor: 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. Contractor: 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. Contractor: stamp, sign and date submittals indicating review and approval:
 - 1. Signature indicates Contractor has satisfied submittal review responsibilities and constitutes Contractor's written approval of submittal.
 - 2. Submittals without Contractor's signature will be returned to the Contractor un-reviewed. Subsequent submittal of this information will be counted as the first resubmittal.
- C. 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 Contractor from Contractor's responsibility for performance of requirements of Contract Documents. Neither shall Engineer's review release Contractor from fulfilling purpose of installation nor from Contractor'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 Contractor.
 - 2) Contractor'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 Contractor.
 - 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 14 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) Contractor 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) Contractor 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 Contractor with one of the following dispositions.
 - a. Approved:
 - 1) No Exceptions:
 - a) There are no notations or comments on the submittal and the Contractor may release the equipment for production.
 - 2) Make Corrections Noted - See Comments:
 - a) The Contractor 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 Contractor 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) Contractor may not proceed with the work described in the submittal.
 - b) Contractor 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) Contractor 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.
- D. Contractor: 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) Contractor shall be allowed no extensions of any kind to any part of their contract due to the rejection of non-compliant submittals.
 - 5) Submittal review comments not addressed by the Contractor in re-submittals shall continue to apply whether restated or not in subsequent reviews until adequately addressed by the Contractor 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. Contractor shall provide re-submittal within 15 days.
 - b. When a re-submittal cannot be returned within the specified period, Contractor 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 Contractor.
 - b. Reimbursement to Owner will be made by deducting such costs from Contractor's subsequent progress payments.

1.08 SUBMITTALS

- A. Shop Drawings:
 - 1. Contractor 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.
- B. Product Information:
 - 1. Product Data:
 - a. Details:
 - 1) Supplier name and address.
 - 2) Subcontractor 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.
- C. 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.
- D. Qualifications Statements:
 - 1. Details:
 - a. Defined in technical sections.
 - b. Licensing documentation.
 - c. Certification documentation.
 - d. Education documentation.
- E. 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.
- F. Project management submittals:
 - 1. Applications for payment:
 - a. Details:
 - 1) As specified in Section 01294.
 - 2. Schedules:
 - a. Details:
 - 1) Progress schedules: As specified in Section 01324B.
 - 2) Schedule of values: As specified in Section 01292.
 - 3) Schedule of submittals: As specified in Section 01324B.
 - 3. Progress reports and quantity charts:
 - a. Details: As specified in Section 01324B.

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

CONTRACTOR SUBMITTAL TRANSMITTAL FORM



CONTRACTOR SUBMITTAL

TRANSMITTAL

Owner: City of Daytona Beach

Submittal Number:

Contractor:

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):

General Contractor'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: _____

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01400

TEMPORARY FACILITIES

PART 1 GENERAL

1.01 DESCRIPTION

- A. Section includes: Contractor's responsibilities for temporary facilities and utilities that the Contractor may require during construction.

1.02 SCOPE OF WORK

- A. Provide temporary facilities required which may include, but are not necessarily limited to, the following:
 - 1. Storage sheds.
 - 2. Temporary lighting and electrical service.
 - 3. Temporary fire protection.
 - 4. Temporary office trailer, including temporary utilities.
- B. Site Offices - Site offices for City will not be required for this project. Contractor shall provide adequately sized mobile trailer(s) with furnished offices to be used for the duration of the Contract for its own personnel and its subcontractors on the job site at locations approved by the City. Such offices shall be maintained in a clean, orderly condition. An authorized representative shall be present at all times while Work is in progress.
- C. The Contractor shall provide the following temporary utilities for the office trailers:
 - 1. Potable water.
 - 2. Sanitary sewer.
 - 3. Electrical.
 - 4. Telephone.
 - 5. Internet.
- D. The Contractor shall be responsible for costs of installing the utilities from the points of connection, maintenance, and removal of all materials for all temporary utilities. The Contractor shall also be responsible for installation, maintenance and removal of the electrical power, telephone, internet, lighting, potable water, and sanitary sewer utilities. Additionally, the Contractor shall be responsible for maintenance and removal of parking areas around the Contractor's office trailers. This shall include policing the area of litter and debris, and weed control.
- E. Temporary Water:
 - 1. Furnish and install temporary water service for use throughout construction period or until required.
 - 2. Provide separate supply of potable water. If supplied from City source, the system shall be protected by approved backflow devices.
 - 3. Maintain strict supervision of use of temporary services.
 - 4. Cost of installation and Operation - Pay costs for temporary water supply used by all trades, including costs of installation, maintenance, and removal of pipe and equipment.

F. Temporary Electrical and Lighting:

1. Furnish, install, and maintain adequate temporary lighting and electric power service for construction needs throughout the construction period. All temporary electrical facilities shall meet the requirements of all pertinent building codes. The work may include the following:
 - a. Power centers for miscellaneous tools and equipment used in construction work.
 - 1) Provide step-down transformer(s) for converting the power supply to 120-volt power.
 - 2) Provide circuit breaker protection for each outlet.
 - 3) Provide equipment grounding continuity for entire system.
 - 4) Users shall provide grounded, UL approved extension cords from power center to point of operation.
 - 5) Comply with N.E.C. regarding ground fault protection.
 - b. Power for testing and checking equipment and systems.
 - c. Power for welding units and for other equipment having special power requirements.
 - d. Emergency power for those situations involving work on existing facilities where loss of construction power would be detrimental to the facility.
2. Pay costs of, installation, maintenance, and removal of temporary electrical services used.
3. Maintain strict supervision of use of temporary services.
4. If required, provide a minimum 120-volt, single phase, 60 hertz electric power service to the site.

G. Temporary Sanitary Facilities:

1. Furnish, install, and maintain temporary sanitary facilities for use throughout construction period.
 - a. Enclosed toilet facilities for construction personnel. Separate facilities will be provided for men and women.
 - b. Potable water for construction personnel:
 - 1) Portable containers to dispense drinking water.
2. Minimum number of fixtures.
3. Maintain strict supervision of use of facilities.
4. Pay for costs of installation and operation including service charges for use of portable units, costs of water or ice, costs for temporary sanitary facilities.
5. Obtain acceptance of City's Representative for all locations.
6. Enclosure for toilet facilities shall be weatherproof, sight proof, sturdy, temporary enclosures.

H. Contractor Employee Parking:

1. Contractor employee parking shall be allowed in only those areas approved by the City's Representative. The Contractor is to submit a plan of intended parking areas for approval 30 days prior to mobilizing on site. The plan shall include the proposed design and construction of the parking areas if required.
2. The Contractor is to maintain strict supervision of use of the parking areas. The Contractor is to maintain, service and clean the areas acceptable to the City.

- I. Project Signs:
 - 1. Furnish and install project signs directing deliveries and others from the front gate to the project site. Signs shall be placed as directed by the City and shall be maintained and remain in good condition for the life of the construction period.
- J. Contractor and Subcontractors will not store any equipment, incidentals etc. from other job site(s) or project(s) not related to this project on-site at any time.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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) 2014.
 - 2. Electrical code:
 - a. National Electrical Code: NEC 2011.
 - 3. Energy Conservation:
 - a. Florida Energy Conservation Code - 2014
 - 4. Fire prevention code:
 - a. Florida Fire Prevention Code - 2014.
 - 5. Fuel gas code:
 - a. Florida Building Code: Fuel Gas - 2014.
 - 6. Mechanical code:
 - a. Florida Building Code: Mechanical - 2014.
 - 7. Plumbing code:
 - a. Florida Building Code: Plumbing Draft - 2014.
 - 8. Test protocols:
 - a. Florida Building Code: Test Protocols for High-Velocity Hurricane Zones - 2014.
- B. Local regulatory requirements.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01420

TESTING AND TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. City will employ and pay for services of an independent testing laboratory to perform all inspection and testing as required by the Contract Documents. This may include, but is not limited to testing of soil, concrete, asphalt, or structural connections and other such tests which the Owner and Engineer deems necessary.

1.02 IMPLEMENTATION

- A. City Hired Laboratory Responsibilities
 - 1. Meet "Recommended Requirements for Independent Laboratory Qualifications" latest edition, published by American Council of Independent Laboratories and be authorized/certified to perform work in the state of Florida.
 - 2. Cooperate with Owner, Engineer, and Contractor, provide qualified personnel promptly on notice.
 - 3. Perform specified inspections, sampling, cylinder breaks and testing of materials and methods of construction:
 - a. Comply with specific standards, ASTM, and other recognized authorities.
 - b. Ascertain compliance with requirements of Contract Documents.
 - 4. Promptly notify the Engineer and Contractor of irregularities or deficiencies of work which are observed during performance of services.
 - 5. Promptly submit five copies of reports of inspections and tests to Owner and Engineer, including:
 - a. Date Issued.
 - b. Project title and Engineer's Job Number.
 - c. Testing laboratory name and address.
 - d. Name and signature of the inspector.
 - e. Date of inspection or sampling.
 - f. Record of temperature and weather.
 - g. Date of test.
 - h. Identification of product.
 - i. Location in project.
 - j. Type of inspection or test.
 - k. Observations regarding compliance with Contract Documents.
 - 6. Perform additional services as required by the Contractor and/or Owner.
 - 7. Laboratory will not be authorized to:
 - a. Release, revoke, alter, or enlarge on requirements of Contract Documents.
 - b. Approve or accept any portion of work.
 - c. Perform any duties of the Contractor.
- B. Contractor's Responsibilities:
 - 1. City will hire an independent testing laboratory and pay for all the on-site testing of soil, asphalt, concrete and any other material processes or activities deemed necessary, or as required, by the Contract Documents.

2. Cooperate with laboratory personnel, provide access to work, and to Subcontractor's, and Suppliers operations.
3. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.
4. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other materials mixes which require control by the testing laboratory.
5. Materials and equipment used in the performance of work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. Standard specifications for quality and workmanship are indicated in the Contract Documents. Engineer may require Contractor to provide statements or certificates from the manufacturers or fabricators the materials and equipment provided by them are manufactured or fabricated in full compliance with the approved specifications for quality and workmanship. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor, and no charge to the Owner shall be allowed on account of such testing and certification.
6. Furnish incidental labor and facilities:
 - a. To provide access to work to be tested.
 - b. To obtain and handle samples at the project site or at the source of the product to be tested.
 - c. To facilitate inspections and tests.
 - d. For storage and curing of test samples.
7. Notify laboratory, Owner and Engineer sufficiently in advance of the operations to allow for laboratory assignment of personnel and scheduling of tests.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01460

CONTRACTOR QUALITY CONTROL PLAN

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Contractor Quality Control Plan.

1.02 SUBMITTALS

- A. Qualifications of the Contractor's Quality Control (CQC) Plan Manager must include all qualifying registrations and show that the candidate has had experience (minimum 10 years) on projects of similar type and size.
- B. Contractor's Daily Quality Control Report: Submit to Engineer within 1 day of completion of each inspection.
- C. Daily Inspection Report: Submit to Engineer at the end of each working day or no later than prior to the beginning of the next working day.

1.03 CONTRACTOR'S INSPECTION OF THE WORK

- A. Work performed by Contractor shall be inspected by the Contractor's CQC Plan Manager. Non-conforming Work and any safety hazards in the Work area shall be noted and promptly corrected.
- B. No materials or equipment shall be used in Work without inspection and acceptance by Contractor's CQC Plan Manager.

1.04 QUALIFICATIONS

- A. Contractor's CQC Plan Manager: Demonstrate having performed similar CQC functions on similar type projects. Submit records of personnel experience, training, and qualifications.

1.05 COVERING WORK

- A. Whenever Contractor intends to backfill, bury, cast in concrete, or otherwise cover any Work, notify Engineer not less than 24 hours in advance to request inspection before beginning any such Work of covering. Failure of Contractor to notify Engineer in accordance with this requirement shall be resolved according to the General Conditions.

1.06 REJECTED WORK

- A. Failure to promptly remove and replace rejected Work will be considered a breach of this Contract, and Owner may proceed under provisions of the General Conditions.

1.07 CONTRACTOR'S QUALITY CONTROL PROGRAM

- A. General: Establish and execute a Quality Control (CQC) Plan for Work. The plan shall establish adequate measures for verification and conformance to defined requirements by Contractor personnel and lower-tier Subcontractors (including Fabricators, Suppliers, and Subcontractors). This program shall be described in a Plan responsive to this Section.
- B. CQC personnel:
 - 1. Contractor's CQC Plan Manager shall report to a Senior Project Manager of the Contractor and shall have no supervisory or managerial responsibility over the workforce.
 - 2. The Contractor CQC Plan Manager shall be on-site as often as necessary, but not less than the daily working hours specified in the Contract Documents to remedy and demonstrate that Work is being performed properly and to make multiple observations of Work in progress.
 - 3. The Contractor is to furnish personnel with assigned CQC functions reporting to the CQC Manager. Persons performing CQC functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions.
- C. CQC Plan:
 - 1. Contractor's CQC Plan shall include a statement by the Project Manager designating the CQC Plan Manager and specifying the authority delegated to the CQC Plan Manager to direct cessation or removal and replacement of defective Work.
 - 2. Describe the CQC program and include procedures, work instructions, and records. Describe methods relating to areas that require special testing and procedures as required by the specifications.
 - 3. Include specific instructions defining procedures for observing Work in process and comparing this Work with the Contract requirements (organized by specifications section).
 - 4. Describe procedures to ensure that equipment or materials that have been accepted at the Site are properly stored, identified, installed, and tested.
 - 5. Include procedures to verify that procured products and services conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to lower-tier Suppliers and/or Subcontractors.
 - 6. Startup and testing quality control: Include procedures to verify that the startup and testing requirements of the Contract Documents are integrated into the Contractor's CQC Plan and conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to the Contractor and the lower-tier Suppliers and/or Subcontractors.
 - 7. Include instructions for recording inspections and requirements for demonstrating through the Daily Inspection Reports that Work inspected was in compliance or a deficiency was noted and action to be taken.
 - 8. Procedures to preclude the covering of deficient or rejected Work.
 - 9. Procedures for halting or rejecting Work.
 - 10. Procedures for resolution of differences between the CQC Plan Manager and the production personnel.
 - 11. Identify contractual hold/inspection points as well as any Contractor-imposed hold/inspection points.

- D. Daily Inspection Report: Include, at a minimum:
1. Inspection of specific work.
 2. Quality characteristics in compliance.
 3. Quality characteristics not in compliance.
 4. Corrective/remedial actions taken.
 5. Statement of certification.
 6. CQC Manager's signature.
 7. Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents.
- E. Deficient and Non-conforming Work and Corrective Action: Include procedures for handling deficiencies and non-conforming Work. Deficiencies and non-conforming Work are defined as documentation, drawings, material, equipment, or Work not conforming to the indicated requirements or procedures. The procedure shall prevent non-conformances by identification, documentation, evaluation, separation, disposition, and corrective action to prevent reoccurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documents and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:
1. Personnel responsible for identifying deficient and non-complying items within Work.
 2. How and by whom deficient and non-compliant items are documented "in the field."
 3. The personnel and process utilized for logging deficient and non-compliant Work at the end of each day onto a deficiency log.
 4. Tracking processes and tracking documentation for deficient and non-conforming Work.
 5. Personnel responsible for achieving resolution of outstanding deficiencies.
 6. Include detailed procedures for the performance and control of special process (e.g., welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).
- F. Audits: The CQC program shall provide for regularly scheduled documented audits to verify that CQC procedures are being fully implemented by Contractor and its Subcontractors. Audit records shall be made available to Engineer upon request.
- G. Documented control/quality records:
1. Establish methods for control of Contract Documents that describe how Drawings and Specifications are received and distributed to assure the correct issue of the document being used. Describe how record document/drawing data are documented and furnished to Engineer.
 2. Maintain evidence of activities affecting quality. Including operating logs, records of inspection, audit reports, personnel qualification, and certification records, procedures, and document review records.
 3. Maintain quality records in a manner that provides for timely retrieval and traceability. Protect quality records from deterioration, damage, and destruction.
 4. Develop a list of specific records as required by the Contract Documents that will be furnished to Engineer at the completion of activities.

- H. Acceptance of CQC Plan: Engineer's acceptance of the CQC Plan shall not relieve Contractor from any of its obligations for performance of Work. Contractor's CQC staffing is subject to Engineer's review and continued acceptance. Owner, at its sole option, and without cause, may direct Contractor to remove and replace the CQC Plan Manager.
1. Acceptance of the CQC Plan by the Engineer is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction.
 2. After acceptance of the CQC Plan, notify the Engineer in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01568

TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall prepare an appropriate Stormwater Pollution Prevention Plan (SWPPP) for this project. Coordinate with Owner to develop the SWPPP based on existing SWPPP prepared by the Owner for the treatment plant. Contractor shall provide, maintain, and remove temporary erosion and sedimentation controls according to the Stormwater Pollution Prevention Plan (SWPPP) as required by the Florida Department of Environmental Protection (FDEP). All projects that will disturb one (1) acre of land or more shall submit the notice set forth in the FDEP Form 62-621.300(4)(b) to FDEP to obtain the acknowledgement letter with the FDEP identification number of the Project prior to commencement of any construction activity. The Contractor is responsible for keeping the FDEP permit acknowledgement letter and the SWPPP at the project site at all times for projects over one (1) acre. The total disturbance for this project is estimated to be less than one (1) acres and will not require a notice to the FDEP.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 IMPLEMENTATION

- A. The Contractor shall implement temporary controls to prevent soil erosion from the Project site caused by stormwater runoff, soil tracking by equipment, and/or wind. Temporary controls shall be implemented as shown on the drawings. Best Management Practices (BMPs) included in the SWPPP such as installation of silt fence, measures at construction entrances and exits that prevent soil tracking, dust control, and stabilizing of stockpiles shall be installed and maintained by the Contractor. The Contractor shall be responsible for implementing any additional BMPs that are necessary to comply with Federal, State and Local laws and regulations at no additional cost to the City. The Contractor shall notify the Engineer of any required changes and modify the SWPPP accordingly subject to the City approval.
- B. Sedimentation control shall be implemented according to the SWPPP and must prevent turbid stormwater runoff greater than 29 nephelometric turbidity units (NTU) turbidity from leaving the Project site. BMPs shall be installed and maintained by the Contractor according to the SWPPP. No bay haies shall be used. Dewatering must be done by installing well point systems or any other City approved method that will only discharge clear water with a turbidity level in compliance with allowable standards.

3.02 COMPLETION

- A. The Contractor shall clean debris and soil from all new and existing stormwater pipes and structures within the Project area/site (as applicable) after the construction is completed. The Contractor shall clean debris and soil from all existing storm pipes and structures outside the Project site if these materials originated from the Project site. The Contractor shall remove any soil deposits at outfalls from pipes in lakes or ponds that were caused by the construction. The Contractor shall remove all erosion control equipment after the Project site is stabilized and storm system is cleaned. The foregoing items must be completed for the Work to be determined to have reached Final Completion.

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Product requirements; product selection; product options and substitutions; quality assurance; delivery, handling, and storage; and manufacturer's instructions.
- B. Related section:
 - 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 01756 - Testing, Training and Facility Start-up.
 - b. Section 01782 - Operation and Maintenance Data.
 - c. Section 09960 - High-Performance Coatings.

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 Contractor in such circumstances shall offer product from the named supplier only. Where one or more suppliers are named, 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 3 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.
6. 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. 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.
- 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. Transport products by methods that avoid product damage. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.
- D. Provide equipment and personnel to handle products by methods to prevent soiling or damage.
- E. Upon delivery, 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. 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 Contractor shall furnish a copy of the manufacturer's instructions for storage to the 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. Store products with seals and legible labels intact.
- H. Store moisture sensitive products in weathertight enclosures.
- I. Maintain products within temperature and humidity ranges required or recommended by manufacturer.

- J. Maintain storage areas at ambient temperatures recommended by manufacturer.
- K. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Repaint damaged painted surfaces. 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. 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

- 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. 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 CONTRACTOR, SUBCONTRACTORS, AND ALL REPRESENTATIVES TO THE WESTSIDE REGIONAL WATER RECLAMATION FACILITY

- A. Plant Superintendent should receive a list of all personnel to be admitted to the Facility.
- B. Plant Superintendent will get this list to the guard.
- C. Guard is on duty Monday through Friday from 0630 to 1630 hours.
- D. If under special circumstances the Contractor and/or their subcontractors need access to the Facility that access must be granted by the Superintendent.
- E. 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.
- B. Attachment No. 2 - Sample Substitution Request Form.

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

Attachment No. 2

Sample Substitution Request Form

Project: _____	Substitution Request Number: _____
_____	From: _____
To: _____	Date: _____
_____	Engineer Project Number: _____
Re: _____	Contract For: _____

Specification Title: _____	Description: _____
Section: _____ Page: _____	Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

☐ Point-by-point comparative data attached - REQUIRED BY ENGINEER

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Savings to Owner for accepting substitution: _____ (\$ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
 - Same warranty will be furnished for proposed substitution as for specified product.
 - Same maintenance service and source of replacement parts, as applicable, is available.
 - Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
 - Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
 - Proposed substitution does not affect dimensions and functional clearances.
 - Payment will be made for changes to building design, including Engineer design, detailing, and construction costs caused by the substitution.
 - Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.
-

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: _____

ENGINEER'S REVIEW AND ACTION

- ☐ Substitution accepted - Make submittals in accordance with Specification Section 01330.
- ☐ Substitution accepted as noted - Make submittals in accordance with Specification Section 01330
- ☐ Substitution rejected - Use specified materials.
- ☐ Substitution Request received too late - Use specified materials.

Signed by:

Date:

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ Engineer ☐ _____

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

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01710

PROJECT HOUSEKEEPING/CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Maintain construction cleanliness during progress of Work and perform final cleaning at completion of the Work, and as required by conditions of the Contract. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.
- B. Materials
 - 1. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
 - 2. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
 - 3. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 DURING CONSTRUCTION

- A. Execute daily cleaning to keep the Work, the site, access ways, access roads, free from accumulation of waste materials, rubbish, and windblown debris, resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris and rubbish containers must be emptied daily or as frequently as necessary to contain disposals.
- C. Remove waste materials, debris, and rubbish from the site periodically and dispose of at legal disposal areas away from the site.
- D. Schedule operations so that dust and other contaminants resulting from cleaning process shall not fall on wet or newly created surfaces.
- E. Under no circumstances will the Contractor and subcontractors bury any waste, debris and other unsuitable material on-site or as part of site work such as pipe trench fill back etc.

3.02 FINAL CLEANING

- A. Employ skilled workmen for final cleaning.
- B. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces.
- C. Prior to final inspection, or City occupancy, Contractor shall conduct an inspection of all work areas, to verify that the entire Work is clean.

END OF SECTION

SECTION 01720

AS-BUILTS/RECORD DOCUMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section sets forth the requirements for preparing as-built/record drawings and documents for verification of construction and archiving for future use. Contractor shall secure the services of a Florida licensed surveyor to collect data and prepare as-built/record drawings.

1.02 REFERENCE

- A. The preparation work shall be in accordance with this Section and supplementary details in the City of Daytona Beach Utilities Department (Owner) Standard Details, latest edition.

1.03 AS-BUILT/RECORD DRAWINGS

- A. As-built/record drawings are required for all public facilities constructed. Prior to construction completion these as-built/record requirements will be reviewed to be certain the Contractor's surveyor has a clear understanding of what is required for completion of this work.
- B. In order to ensure that the Owner's project records are maintained to the highest standards and the information can easily be added to the Owner's electronic records the following information is required on all as-built/record drawings:
 - 1. Pavement and curb widths shall be verified and dimensioned for each street at each block (for subdivisions) and as appropriate to confirm paving limits (on site plans).
 - 2. All radii at intersections shall be verified and dimensioned. This information is to be clearly indicated on the as-built/record drawings.
 - 3. Roadway elevations shall be recorded at all grade changes, 100 foot intervals along roadway, and other intervals as needed along all streets. Street centerline and curb invert elevations shall be recorded as noted.
 - 4. The as-built centerline profile of all streets shall also be shown on the plan and profile so it may be compared to the design profile grade lines. In the event that the as-built centerline longitudinal grade does not meet the Owner's minimum standards, additional longitudinal grades of the adjacent curbing and similar roadway cross-section surveys to verify the correct cross slope, shall be required to verify that the system will function as originally designed.
 - 5. Storm drainage structures shall be located and/or dimensioned from centerlines or lot lines as appropriate. Each structure shall be located by sub-meter GPS with latitude, longitude and elevation data.
 - 6. Storm drainage pipe invert and inlet elevations shall be recorded and clearly denoted as as-built information. Design elevations shall be crossed out and as-built information written next to it.

7. Storm drainage pipe material, length, and size shall be measured and/or verified. This information is to be clearly indicated as being as-built information.
8. All applicable topographic information pertinent to the on-site drainage system, such as ditches, swales, lakes, canals, etc. that are deemed necessary by the Owner to verify the functional performance of the storm water system, shall be noted. Normally, recording elevations every 100 feet at the top of bank and toe of slope will be required. Measurements shall be taken and recorded in order to accurately tie down these features to the roadway centerlines and to plat lines. Whenever possible, contour lines shall be utilized to graphically describe these topographic features.
9. Retention areas shall have their top of bank and bottom elevations recorded. Actual measurements shall be taken and dimensions recorded of the size of all retention areas. Measurements shall be done from top of bank with side slopes indicated. Separate calculations shall be submitted to indicate required and provided retention volumes.
10. Actual materials used and elevations and dimensions of overflow weir structures and skimmers shall be noted on the as-built.
11. Storm drainage swale centerlines shall be located and elevations of flow line and top of bank shall be recorded every 100 feet. Side slopes shall also be indicated.
12. Sanitary sewer manholes shall be verified and dimensioned from street centerlines or lot lines as appropriate. All rim and invert elevations shall be verified and recorded. This information shall be clearly indicated as being as-built information. Design Elevations shall be crossed out and as-built information written next to it.
13. For subdivisions, proposed design finish floor elevations shall appear on all subdivision lots on the appropriate plan and profile sheet as well as on the master drainage plan.
14. Sanitary Sewer line lengths, sizes, material, slope, etc., shall be verified and recorded, this information is to be clearly indicated as being as-built information.
15. Sewer Laterals shall be verified and recorded at their clean out locations, stationing and offset distances shall be measured from downstream manholes towards upstream manholes. Invert information at cleanout shall be provided, and be located by sub-meter GPS with latitude, longitude and elevation data
16. Lift stations and force mains shall be verified and dimensioned from street centerlines or lot lines as appropriate. Force main depth and location including valves will be provided and tied to permanent above grade features. Dimensional and elevation information indicated on the approved plan shall be verified and recorded. This information shall be clearly indicated as being as-built information. Buried potable water lines and electrical service lines shall be clearly dimensioned, located, and labeled. Each lift station shall be located by sub-meter GPS with latitude, longitude, and elevation data provided.
17. Curb cuts or metal tabs, used to mark sewer laterals, water services and water valves, shall be verified for presence and accuracy of location.
18. Potable and reclaimed water main lines shall be dimensioned off the baseline construction. Water main line material size, length and depth placed shall be noted. Locations of valves shall also be tied to baseline construction. This information shall be clearly indicated as being as-built information.

19. Potable and reclaimed water valves, tees, bends, all services, and fire hydrants shall be located by tying them to baseline construction (Sta. & Offset). Similarly, force main valves, tees, and bends shall be located in the same manner. Stationing and offset distances shall be measured from downstream manholes to upstream manholes. All valves and hydrants shall be located by sub-meter GPS with latitude, longitude, and elevation data provided.
20. For perpendicular crossings of storm water, sanitary sewer, potable water, or reclaimed water, the as-built plans shall clearly indicate which utilities are located over or under other utilities, as necessary.
21. Any special features such as, concrete flumes, lake banks, walls, fencing, etc. which are a part of the approved construction drawings should also be located and dimensioned.
22. If an approved subdivision plat or site plan shows a conservation easement, the project surveyor should provide the exact location of the specimen tree(s) from the right-of-way or property lines and proposed easement boundaries on the as-built drawing. The as-built location of these trees will help verify the sufficiency of the conservation easement prior to plat recording or certificate of occupancy.
23. When storm water, potable water, reclaimed water, or sanitary sewer improvements are located within an easement, the as-built drawing will accurately depict the location of the easement itself as well as the exact location of the improvements within the easement. This is required in order to verify that the improvements have been properly located and to ensure that future subsurface excavation to perform remedial repair can be accomplished without disturbance beyond the easement.
24. As-built drawings are to be prepared by a Florida licensed surveyor and shall include a signed certification statement by the Florida licensed engineer of record. A Mylar set of as-built record drawings shall be provided with a digital copy in a compatible AutoCAD format.
25. Elevations shall be referenced to NGVD 1988 Data. As-built survey information shall be referenced to at least two Florida State Plane east coordinates NAD 83.
26. Benchmark Datum utilizes monumentation from the North American Vertical Datum (NAVD) of 1929 with elevations adjusted to NGVD 1988 data. Any NAVD 1929 monument with the limits of construction is to be protected.

1.04 SUBMITTALS

- A. The CONTRACTOR shall require the Surveyor and Mapper to locate all improvements for the Project As-Built Survey using State Plane Coordinates and the vertical datum referenced on the Drawings. The CONTRACTOR shall obtain an electronic copy of the Drawings from the CITY for use as a base for the As-Built Survey. The As-Built Survey shall clearly show the designed and constructed locations and elevations information for ease of comparison. This shall be accomplished by adding the As-Built information on a separate CAD level or layer, while keeping all the design call-outs and construct requirements visible. The As-Built information shall be labeled as such and be shown with a bolder text weight in order to be easily identifiable. The As-Built Survey shall include all storm and sanitary sewers and structures, clean-outs, potable and reclaimed water mains, meters, valves, force mains, gas mains, irrigation lines (2-inch and larger), process piping, electric and communication duct banks, traffic and pedestrian signals, pull

boxes, cabinets, transformers, structures, drainage conveyance systems, retention ponds, fences, pavement, curbs, sidewalks, driveways, relocated utilities, appurtenances and buildings. All planned improvements referenced by station and offset on the Plans, shall also be referenced on the As-Built Survey in the same manner. All constructed improvements that have location and/or elevation information called-out on the Plans, shall have the same information identified on the As-Built Survey. If a structure information table was provided on the Plans, then the As-Built information shall be shown in the table. Design call-outs shall have a thin strike line through the design call-out and all As-Built information must be labeled (or abbreviated "AB") and be shown in a bolder text that is completely legible. Pavement and drainage flowline elevation shots shall be taken at minimum 25' intervals and grade breaks. As-Built Survey shots shall be taken at the same locations as shown on the Plans for ease of comparison. Any variations from required material sizes or types shall also be noted.

- B. The CONTRACTOR shall submit a copy of the current monthly updated As-Built Survey ("Progressive As-Built Survey") signed and sealed on each page and also submit identically matching electronic files in PDF format and the same CAD file format as the original design. The Progressive As-Built Survey shall be submitted to the City and Engineer with each Application for Payment and indicate the horizontal and vertical locations of all constructed improvements to date with sufficient information and notes to easily determine if the improvements were constructed in conformance with the Contract Documents. The Progressive As-Built Survey submittals shall include a cover sheet and include the surveyor's statement regarding the constructed improvements being within the specified tolerances or if not indicating the variances, as described above in paragraph II.B.3. The CONTRACTOR's submission of a Progressive As-Built Survey or Final As-Built Survey, as applicable, acceptable to the City, with its Application for Payment, is a condition precedent to the ENGINEER's payment recommendation to the City. If no construction has been performed during the period, the Contractor shall provide documentation of such in accordance with the requirements of the Engineer.
- C. The Contractor shall submit a minimum of three (3) signed and sealed sets of the final As-Built Survey incorporating all Work performed under the Contract Documents ("Final As-Built Survey") with the Application for Final Payment, as well as identically matching electronic files in PDF format, Mylar, and the same CAD file format as the original design (AutoCAD). See 3.01 D below for more details on final submittal. Electronic file submittals that have more than one file or a file for each plan sheet shall have an index and/or a logical filename containing a description of the file's contents. The final conformed Drawings shall be used as the basis for the As-Built Survey. The sets shall be in design plan format containing a complete set of all of the original plan sheets. The Surveyor and Mapper shall only sign and seal those sheets containing As-Built Survey information. Failure to provide accurate survey information in the proper format requested may result in the CITY determining the As-Built Survey is incomplete. In general as-built survey/drawings should be as follows:
 - 1. As-built drawings/surveys should be "Progressive as-built" submitted monthly with the pay applications. Contractor shall allow sufficient time to coordinate and approval of the City and Engineer of Record on the format and content of the "Progressive as-built" drawings before submitting them as part of the pay applications.

2. As-built drawings/surveys should show all constructed components and note deviations made from the design (as shown on conformed drawings). Such deviations shall be noted with a reference to the RFIs or field change directive or any other reason resulting in the change. This reference should be identified in the title block under the revisions block. A unique identifier number shall be put on the drawing with the description of the reference in the title block.
 3. As-builts shall show all electrical duct banks (including the size, top elevation and grade elevation along the duct bank every 10-ft interval). All changes in direction and elevation of the duct bank shall be specifically called out and shown on the as-builts.
 4. As-builts shall show all piping and fittings (including size, top elevation and grade elevation along the pipe every 10-ft interval). All changes in direction and elevation of the pipe shall be specifically called out and shown on the as-builts.
 5. As-builts shall show all piping, fittings, valves, pipe supports, electrical conduits or duct banks, and all equipment as installed both inside existing and new structures and outside in the field (above and below grade).
- D. At Final Completion of the Project, the Contractor shall submit field mark-up drawings showing all other constructed improvements not included in the As-Built Survey as required above. This includes improvements such as, but not limited to, irrigation lines smaller than 2-inch, sprinkler heads, miscellaneous wiring, site furnishings and traffic control loops, and only applies to variations from what is shown on the Drawings. These mark-up drawings shall be compiled on a clean set of the original Drawings.
- E. If unidentified utilities (not shown on the Drawings) are encountered during the installation of the Work, their horizontal and vertical location shall be included in the As-Built Survey. Provide the name and type of utility, the size and material type of pipe, conduit or structure and if known, the status (active or inactive) of the utility.
- F. The Contractor shall submit documentation to verify the accuracy of field surveying work at the request of the Engineer or City.
- G. Contractor shall submit Record Drawings on CD and Mylar. When the As-Builts are delivered for clearance of water lines (two paper copies), they will be scheduled for chlorination. Owner will not release the drinking water bacteriological laboratory report to Volusia County Health Department until the As-built information meets Owner requirements. Contractor will have 60 days from the time that the bacteriological samples are collected to submit the as-built Mylar and CD to City. Send the two paper copies for approval before making the Mylar. If Contractor goes past the 60 days re-chlorination will be required and pay for the bacteriological laboratory report will be required. Below are minimum detail samples of how the As-Built drawing information will need to be presented

- H. These are examples of how to display and label valves, fittings, and pipes on the plans. Include a location arrow going to the identified object:

Valve Example:

20" GATE VALVE
STA. 22+33 (LT.55.0')
LAT. = 29°12'53.009"N
LONG. = 81°04'03.355"W
N = 1,774,373.4058
E = 634,602.7566
TOP ELEV. = 27.50
FINISH GROUND ELEV. = 30.50

Pipe Example:

20" DIP WATER MAIN
STA. 22+00 (RT.55.0')
LAT. = 29°12'50.009"N
LONG. = 81°04'26.355"W
N = 1,774,373.4058
E = 634,602.7566
TOP OF PIPE ELEV. = 27.50
FINISH GROUND ELEV. = 30.50

(All Bench Marks used must be shown on the plans)

Bench Mark Example:

BM#13
STA. 20+33 (LT. 85.5')
3/4" Iron Rod with Plastic Cap...
N = 1,774,373.4058
E = 634,602.7566
LAT. = 29°04'53.355" W
LONG. = 81°04'53.355" W
ELEV. = 32.55

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 GENERAL

- A. All drawings shall be prepared to True State Plane Coordinates. Contractor shall provide all materials, equipment, labor needed to prepare and submit accurate As-Built/Record Drawings.
- B. It is acceptable to the City if the surveyor utilizes an after the fact approach to collecting and verifying the location and depth by vertical PVC pipes placed by the Contractor as markers for this purpose. The surveyor shall verify to the accuracy defined in Florida Statutes the As-Built conditions and certify the Record Drawings.

- C. City shall not be considered the best source of information for valve locations that may have been lost during final grading, the surveyor or Contractor shall excavate and properly mark all valve boxes and each valve shall have a tag or color coded to define water, sewer or reuse water valves. The use of temporary PVC pipe markers color coded is acceptable so long as cross references are provided on the Record Drawings to prevent the tops from a water valve being placed on a sewer valve.
- D. The Contractor shall provide the utilities department engineering division the final as-built/record drawings on cd and mylar. The as-built record drawings shall be prepared using autocad format 2010 or later. In model space the drawing shall be in fl83-ef state plane coordinates and shall be able to be inserted into the owner's overall gis system. The record drawings shall also be printed on mylar signed and sealed as allowed by state of florida regulations. A disclaimer may be noted in a transmittal letter plus the surveyor may add a special notice on each sheet regarding the location of the true original record drawings or place limits on responsibility should sometime in the future someone need to modify the mylars.
- E. Identify the source markers for the survey used for Record Drawings.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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, 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 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 15050 - Common Work Results for Mechanical Equipment.

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: filter effluent piping 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: filter level transmitter or water 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. Contractor with input from relevant equipment manufacturer(s) 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.
- 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. Test equipment for proper performance at point of manufacture or assembly when specified.
- 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 Contractor under direction / supervision of Manufacturer's Representative/Technician.
- B. Mechanical systems: As specified in the individual equipment Sections and Sections 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. Perform checkout and performance testing as specified in the individual equipment Sections (Performed by Contractor under direction / supervision of 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 facility. Demonstrate satisfactory operation of equipment and systems in actual operation. (Performed by Contractor under direction / supervision of Manufacturer's Representative / Technician).
- B. Conduct operational test for continuous 7-day period.
- C. Owner will provide operations personnel, power, fuel, and other consumables for duration of test.

- D. Immediately correct defects in material, workmanship, or equipment that became evident during operational test.
- E. 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, 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. 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 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 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. Provide operations and maintenance training for items of mechanical, electrical, and instrumentation equipment. Utilize manufacturer's representatives to conduct training sessions.
- B. 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.
- C. 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.
- D. Satisfactorily complete functional testing before beginning operator training.
- E. 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.
- F. 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.
- G. Training sessions: Provide training sessions for equipment as specified in the individual equipment Sections.
- H. The Contractor shall videotape all training sessions and provide a copy for the Owner.
- I. The 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.

- J. The 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. 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. 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
	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 submitted to us by the Contractor.
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 Contractor, 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 Contractor for insertion in each of the Equipment Brochures.

MANUFACTURER'S CHECK CERTIFICATION SIGNATURE PAGE

	MANUFACTURER	CONTRACTOR	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
	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 Contractor:

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 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 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)

SECTION 01770

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Contract closeout requirements including:
 - 1. Final cleaning.
 - 2. Waste disposal.
 - 3. Touch-up and repair.
 - 4. Disinfection of systems.
 - 5. Preparation and submittal of closeout documents.
 - 6. 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.
 - 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 01324B - Progress Schedules and Reports.

1.02 REFERENCES

- A. American Water Works Association (AWWA).

1.03 FINAL CLEANING

- A. Perform final cleaning prior to inspections for Substantial Completion and Final Acceptance.
- B. Employ skilled workers who are experienced in cleaning operations.
- C. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned. Do not use City's cleaning supplies. Remove used cleaning chemicals and supplies at the end of the project.
- D. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.
- E. Clean roofs, gutters, downspouts, and drainage systems.
- F. Broom clean exterior paved surfaces and rake clean other surfaces of site work.
- G. Remove dust, cobwebs, and traces of insects and dirt.

- H. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.
- I. Remove non-permanent protection and labels.
- J. Polish waxed woodwork and finish hardware.
- K. Wash tile.
- L. Wax and buff hard floors, as applicable.
- M. Wash and polish glass, inside and outside.
- N. Wash and shine mirrors.
- O. Polish glossy surfaces to clear shine.
- P. Vacuum carpeted and soft surfaces.
- Q. Clean permanent filters and replace disposable filters when heating, ventilation, and air conditioning units were operated during construction.
- R. Clean ducts, blowers, and coils when units were operated without filters during construction.
- S. Clean light fixtures and replace burned-out or dim lamps.

1.04 WASTE DISPOSAL

- A. Arrange for and dispose of surplus materials, waste products, and debris off-site:
 - 1. Prior to making disposal on private property, obtain written permission from City of such property.
- B. Do not fill ditches, washes, or drainage ways which may create drainage problems.
- C. Do not create unsightly or unsanitary nuisances during disposal operations.
- D. Maintain disposal site in safe condition and good appearance.
- E. Complete leveling and cleanup prior to final acceptance of the Work.

1.05 TOUCH-UP AND REPAIR

- A. 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.

1.06 CLOSEOUT DOCUMENTS

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

1.07 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.

1.08 PROJECT RECORD DOCUMENTS

- A. Maintain at Project site, available to City and Engineer, 1 copy of the Contract Documents, shop drawings, and other submittals in good order:
1. Mark and record field changes and detailed information contained in submittals and change orders.
 2. Record actual depths, horizontal and vertical location of underground pipes, duct banks, and other buried utilities. Reference dimensions to permanent surface features.
 3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes.
 4. Identify location of spare conduits including beginning, ending, and routing through pull boxes and manholes. Record spare conductors, including number and size, within spare conduits and filled conduits.
 5. Provide schedules, lists, layout drawings, and wiring diagrams.
 6. Make annotations with erasable colored pencil conforming to the following color code:

Additions:	Red
Deletions:	Green
Comments	Blue
Dimensions:	Graphite

- B. Maintain documents separate from those used for construction:
 - 1. Label documents "RECORD DOCUMENTS."
- C. Keep documents current:
 - 1. Record required information at the time the material and equipment is installed and before permanently concealing.
- D. Deliver record documents with transmittal letter containing date, Project title, Contractor's name, and address, list of documents, and signature of Contractor.
- E. Record documents will be reviewed by City monthly to determine the percent complete for the monthly pay application.
- F. During progress meetings, record documents will be reviewed to ascertain that changes have been recorded.
- G. Final Schedule Submittal as specified in Section 01324B.

1.09 WARRANTIES AND BONDS

- A. Provide executed Warranty or Guaranty Form if required by Contract Documents. See General Conditions.
- B. Provide specified additional warranties, guarantees, and bonds from manufacturers and suppliers.

1.10 CERTIFICATE OF FINAL COMPLETION

- A. When 7-day operational test has been successfully completed, City will certify that new facilities are operationally complete. City 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 Contractor.
- C. When all items have been completed or corrected, 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, City will either prepare a written acceptance of the entire work or advise Contractor of work not complete. If necessary, inspection procedures will be repeated.

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.
 - 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.

1.02 SUBMITTALS

- A. 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 FlashDrives.
- C. Final Operation and Maintenance Manuals:
 - 1. Make additions and revisions in accordance with City'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 City Training.
 - 3. Quantity:
 - a. Hard copy: 2 sets.
 - b. Electronic: 2 FlashDrives.
- D. Make manuals available at project site for use by construction personnel and City 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 Contractor, equipment supplier and Plant Superintendent to prepare customized Operations and Maintenance Manuals for the various portions of the work. Contractor 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, City'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 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.
16. Completed Asset form.
 - a. Contractor shall complete and submit to the City of Daytona Beach project representative the below New Asset Form on a "CD" in Microsoft® Excel format for all equipment and products furnished and installed under this Contract. A complete New Asset Form shall also be included in the Operating and Maintenance Manuals for each equipment and product submitted for the project.

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. City'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 _____

**WESTSIDE REGIONAL WATER RECLAMATION FACILITY BIOSOLIDS DEWATERING IMPROVEMENTS PROJECT
NEW ASSET FORM**

Location	Classification (type of asset)	Name (be descriptive)	Tag Number	Model	Serial Number	Vendor	Manufacturer	Warranty end date	Purchase Date	Purchase Cost	Installed Date

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02050

SOILS AND AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Aggregate base course.
 - 2. Class 2 permeable.
 - 3. Drain rock.
 - 4. Gravel.
 - 5. Lightweight material.
 - 6. Native material.
 - 7. Sand.
 - 8. Select material.
 - 9. Stabilization material.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C 117 - Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing.
 - 2. C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 3. C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 4. C 535 - Standard Test Method for Resistance to Degradation of Larger-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 5. D 422 - Standard Test Method for Particle-Size Analysis of Soils.
 - 6. D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - 7. D 2844 - Standard Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils.
 - 8. D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - 9. D 4829 - Standard Test Method for Expansion Index of Soils.
 - 10. D 5821 - Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.

1.03 SUBMITTALS

- A. Product data:
 - 1. Material source.
 - 2. Gradation.
 - 3. Testing data.

- B. Quality control for aggregate base course:
 - 1. Test reports: Reports for tests required by Sections of State of Florida Department of Transportation Standard Specifications for Road And Bridge Construction, Latest Edition.
 - 2. Certificates of Compliance: Certificates as required by Sections of State of Florida Department of Transportation Standard Specifications for Road And Bridge Construction, Latest Edition.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Storage and protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General:
 - 1. Provide material having maximum particle size not exceeding 4 inches and that is free of trash, lumber, debris, leaves, grass, roots, stumps, and other organic matter.
 - 2. Materials derived from processing demolished or removed asphalt concrete are not acceptable.
 - 3. See Sections of State of Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Latest Edition.
- B. Aggregate base course:
 - 1. Provide Aggregate Base as specified in Section 204 of the State of Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Latest Edition.
- C. Class 2 permeable:
 - 1. Consists of hard, durable particles of stone or gravel; screened or crushed to the specified size and gradation; and free from organic matter, lumps or balls of clay, and other deleterious matter.
 - 2. Sand equivalent: Not less than 75 when tested in accordance with ASTM D 2419.
 - 3. Conforms to size and grade within the following limits when tested in accordance with ASTM C 117 and C 136:

Sieve Size (Square Openings)	Percent by Weight Passing Sieve
1 inch	100
3/4 inch	90 - 100
3/8 inch	40 - 100
Number 4	25 - 40
Number 8	18 - 33
Number 30	5 - 15
Number 50	0 - 7
Number 200	0 - 3

D. Drain rock:

1. Consists of hard, durable particles of stone or gravel; screened or crushed to specified size and gradation; and free from organic matter, lumps or balls of clay, or other deleterious matter.
2. Crush or waste coarse material and waste fine material as required to meet gradation requirements.
3. Conforms to size and grade within the following limits when tested in accordance with ASTM C 117 and C 136:

Sieve Size (Square Openings)	Percent By Weight Passing Sieve
2 inch	100
1-1/2 inch	95 - 100
3/4 inch	50 - 100
3/8 inch	15 - 55
Number 200	0 - 2

E. Native material:

1. Sound, earthen material passing 1-inch sieve.
2. Percent of material by weight passing Number 200 sieve shall not exceed 30 when tested in accordance with ASTM D 422.
3. Expansion index less than 35 when tested in accordance with ASTM D 4829.

F. Sand:

1. Clean, coarse, natural sand.
2. Non-plastic when tested in accordance with ASTM D 4318.
3. 100 percent shall pass a 1/2-inch screen.
4. No more than 20 percent shall pass a Number 200 sieve.

G. Select material:

1. Sound earthen material for which the sum of plasticity index when tested in accordance with ASTM D 4318 and the percent of material by weight passing a Number 200 sieve shall not exceed 23 when tested in accordance with ASTM D 422.
2. Organic content shall not be greater than 3 percent by volume.

H. Stabilization material:

1. Consists of clean, hard, durable particles of crushed rock or gravel; screened or crushed to the specified sizes and gradations; and free of any detrimental quantity of soft, friable, thin, elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.
2. Shall be free of slaking or decomposition under the action of alternate wetting and drying.
3. The portion of material retained on the 3/8-inch sieve shall contain at least 50 percent of particles having 3 or more fractured faces. Not over 5 percent shall be pieces that show no such faces resulting from crushing. Of that portion which passes the 3/8-inch sieve but is retained on the Number 4 sieve, not more than 10 percent shall be pieces that show no faces resulting from crushing.
4. Conforms to size and grade when tested in accordance with ASTM C 117 and ASTM C 136.

Sieve Size (Square Openings)	Percent by Weight Passing Sieve
1 inch	100
3/4 inch	90 - 100
Number 4	0 - 10
Number 200	0 - 2

PART 3 EXECUTION

3.01 See applicable sections of Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition.

END OF SECTION

SECTION 02200

SITE CLEARING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Clearing, grubbing and stripping project site.
- 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 DEFINITIONS

- A. Clearing: Consists of removal of natural obstructions and existing foundations, buildings, fences, lumber, walls, stumps, brush, weeds, rubbish, trees, boulders, utility lines, and any other items which interfere with construction operations or are designated for removal. CONTRACTOR to verify if such existing foundations, utilities or other obstructable material is present in the designated construction area of the proposed deep-bed sand filter and associated influent pump station.
- B. Grubbing: Consists of the removal and disposal of wood or root matter below the ground surface remaining after clearing and includes stumps, trunks, roots, or root systems greater than 1 inch in diameter or thickness to a depth of 6 inches below the ground surface.
- C. Stripping: Includes the removal and disposal of all organic sod, topsoil, grass and grass roots, and other objectionable material remaining after clearing and grubbing from the areas designated to be stripped. The depth of stripping is estimated to be 6 inches, but the required depth of stripping will be determined by the Engineer.

1.03 QUALITY ASSURANCE

- A. Regulatory requirements: Verify and comply with applicable regulations regarding those governing noise, dust, nuisance, drainage and runoff, fire protection, and disposal.
- B. Pre-construction conference: Meet with Engineer to discuss order and method of work.

1.04 SEQUENCING AND SCHEDULING

- A. Clearing and grubbing: Perform clearing and grubbing in advance of grading operations.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Examine site and verify existing conditions for beginning work.

3.02 PREPARATION

- A. Protect existing improvements from damage by site preparation work.

3.03 INSTALLATION

- A. Clearing:
 - 1. Clear areas where construction is to be performed and other areas as indicated on the Drawings, or specified in this Section, of stumps, brush, roots, weeds, trees, shrubs, rubbish, and other objectionable material of any kind which, if left in place, would interfere with proper performance or completion of the work, would impair its subsequent use, or form obstructions.
 - 2. Do not incorporate organic material from clearing and grubbing operations in fills and backfills.
- B. Grubbing:
 - 1. From excavated areas: Grub stumps, roots, and other obstructions 3 inches or over in diameter to depth of not less than 18 inches below finish grade.
 - 2. Backfill and compact cavities left below subgrade elevation by removal of stumps or roots to density of adjacent undisturbed soil.
- C. Stripping:
 - 1. Remove soil material containing sod, grass, or other vegetation to depth of 6 inches from areas to receive fill or pavement and from area within 5 feet outside foundation walls.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Loosening, excavating, filling, grading, borrow, hauling, preparing subgrade, compacting in final location, wetting and drying, and operations pertaining to site grading for buildings, basins, reservoirs, boxes, roads, and other facilities.
 - 2. Backfilling and compacting under and around structures.
- 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 Procedure.
 - b. Section 02742 - Asphaltic Concrete Paving.
 - c. Section 03300 - Cast-in-Place Concrete.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
 - 2. D 1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m^{3 - 3. D 6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).}

1.03 DEFINITIONS

- A. Backfill adjacent to structure: Backfill within volume bounded by the exterior surfaces of structure, the surface of undisturbed soil in the excavation around structure, and finish grade around structure.
- B. Embankments: Dikes, levees, berms, and similar facilities.
- C. Excavation: Consists of loosening, removing, loading, transporting, depositing, and compacting in final location, wet and dry materials, necessary to be removed for purposes of construction of structures, ditches, grading, roads, and such other purposes as are indicated on the Drawings.

1.04 SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. Where mud or other soft or unstable material is encountered, remove such material and refill space with stabilization material. Wrap stabilization material with stabilization fabric.
 - 2. Obtain acceptable import material from other sources if surplus or borrow materials obtained within Project site do not conform to specified requirements or are not sufficient in quantity.
 - 3. No extra compensation will be made for hauling of fill materials nor for water required for compaction.
 - 4. The City will pay for any testing services necessary (unless there is a failure and retest is required).

1.05 SUBMITTALS

- A. Copy of Property Owner's Agreement allowing placement of surplus soil material on their property.
- B. Excavation plan.
- C. Test reports:
 - 1. Submit certified test reports of all tests specified to be performed by the Contractor.
 - 2. Sign and seal test reports by a registered Geotechnical Engineer registered in State of Florida.

1.06 QUALITY ASSURANCE

- A. Initial compaction demonstration:
 - 1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
 - a. 50 cubic yards of backfill adjacent to structures.
 - b. 200 Linear feet of trench backfill.
 - c. 100 cubic yards of fill.
 - d. 50 cubic yards of roadway base material.
 - e. 100 cubic yards of road fill.
 - 2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
 - 3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

1.07 SEQUENCING AND SCHEDULING

- A. Schedule earthwork operations to meet requirements specified in this Section for excavation and uses of excavated material.
- B. If necessary, stockpile excavated material in order to use it at specified locations.

- C. Excavation, backfilling, and filling: Perform excavation, backfilling, and filling during construction in manner and sequence that provides drainage at all times.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Water for compacting: Use water from source acceptable to Engineer.
- B. Fill Materials:
1. General:
 - a. Provide sand, aggregate base course, drain rock, select material, and native material, where required for fill and backfill.
 - b. Obtain material for fills from cut sections or from borrow source.
 - c. Prove material having maximum particle size not exceeding 3 inches and that is free from trash, lumber, debris, leaves, grass, roots, stumps, and other vegetable matter.
 - d. Materials derived from processing demolished or removed asphalt concrete are not acceptable.
 2. Aggregate Base Course: As specified in Section 02722.
 3. Drain Rock:
 - a. Consist of hard durable particles of stone or gravel, screened or crushed to specified size and gradation.
 - b. Free from vegetable matter, lumps, or balls of clay, or other deleterious matter.
 - c. Crushed or waste coarse material and waste fine material as required to meeting gradation requirements.
 - d. Durability Index: Not greater than 40 percent when tested in accordance with ASTM C 131.
 - e. Conform to size and grade within limits as follows when tested in accordance with AASHTO T-27 or ASTM C 136:

Sieve Size (Square Openings)	Percent by Weight Passing Sieve
2 inch	100
1 - 1/2 inch	95 - 100
3/4 inch	50 - 100
3/8 inch	15 - 55
 4. Native Material:
 - a. Sound, earthen material passing 1 inch sieve.
 - b. Percent of material by weight passing Number 200 sieve shall not exceed 30 when tested in accordance with ASTM C 136.
 - c. Expansion index less than 35.
 5. Sand:
 - a. Clear, coarse, natural sand.
 - b. Non-plastic when tested in accordance with ASTM D 4318.
 - c. No more than 12 percent shall pass a Number 200 screen.
 6. Select Material: Sound earthen material for which sum of plasticity index when tested in accordance with ASTM D 4318 and the percent of material by weight passing number 200 sieve shall not exceed 23 when tested in accordance with ASTM C 136. Organic content shall not be greater than 3 percent by volume.

- C. Geotextile:
 - 1. Geo-textile shall have the minimum value when tested in accordance with the ASTM method listed below.
 - 2. Geotextile shall be Mirafi 500X or equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions:
 - 1. Character and quantity of material:
 - a. Verify character and quantity of rock, gravel, sand, silt, water, and other inorganic or organic materials to be encountered in work to be performed.
 - b. Determine gradation and shrinkage, and swelling of soil, and suitability of material for use intended in work to be performed.
 - c. Determine quantity of material, and cost thereof, required for construction of backfills, cuts, embankments, excavations, fills, and roadway fills, whether from onsite excavations, or borrow areas or imported materials. Include in cost of work to be performed.
 - d. Include wasting of excess material, if required, in cost of work to be performed.

3.02 PREPARATION

- A. Backfills:
 - 1. After clearing and excavation are completed, scarify entire areas which underlie backfills or structures to a depth of 6 inches and until surface is free of ruts, hummocks, and other features which would prevent uniform compaction by equipment to be used.
 - 2. Recompact scarified areas to density specified before placing backfill material or concrete.
 - 3. If foundation areas have soft soils, do not scarify the top 6 inches prior to compaction. Remove all loose material using hand equipment or with a flat edged backhoe bucket. Do not remold and weaken the remaining soil by operating heavy equipment on final bottom elevation of excavation.
 - 4. Do not place backfill against walls until:
 - a. Walls have been cast full height of structure and concrete has reached the specified strength.
 - Connecting slabs and beams have been cast and concrete has reached the specified strength.
 - 5. Prior to backfilling:
 - a. Remove all forms.
 - b. Clean all trash and debris from the excavation site.
 - 6. After inspection of foundation, walls, and pipes, place backfill symmetrically around structures to prevent eccentric loading of structures.
- B. Fills:
 - 1. After clearing is completed, scarify entire areas which underlie fill sections or structures to a depth of 6 inches and until surface is free of ruts, hummocks, and other features which would prevent uniform compaction by equipment to be used.

2. Recompact scarified areas to density specified for compacted fills before placing of fill material or concrete.
- C. Roadway fills:
1. After clearing is completed, scarify entire areas which underlie roadway fills to a depth of 6 inches and until surface is free of ruts, hummocks, and other features which would prevent uniform compaction by equipment to be used.
 2. Recompact scarified areas to density specified for roadway fills before placing of roadway fill material.

3.03 INSTALLATION

- A. General:
1. Dispose of excavated materials which are not required or are unsuitable for fill and backfill in lawful manner at no additional cost to the Owner. Unsuitable materials shall be hauled off-site.
 2. Rocks, broken concrete, or other solid materials larger than 4 inches in greatest dimension: Remove from project site at no additional cost to the Owner.
 3. Stabilization of subgrade: Provide materials used, or perform work required, to stabilize subgrade so it can withstand loads that may be placed upon it by Contractor's equipment.
- B. Compaction:
1. Provide specified compaction for backfills, cuts, embankments, fills, roadway fills, and other earthwork.
 2. Perform confirmation tests to verify and confirm that work has complied, and is complying at all times, with compaction requirements specified in this Section for initial compaction demonstration and field quality control testing.
 3. In-place density of compacted backfills, cuts, embankments, fills, and roadway fills determined in accordance with ASTM D 1556, or with ASTM D 6938.
 4. Maximum density obtained in laboratory when tested in accordance with ASTM D 1557.
 5. To prevent damage to structures due to backfilling operations, place backfill with equipment that does not exceed H-20 loading, within a distance from the face of the structure of not less than 1/2 the depth of backfill. The depth of backfill is the distance between the level being compacted and the bottom of the excavation. Outside this distance, heavier compaction equipment may be used.
 6. Compact to percentage of maximum density as follows:
 - a. Backfill adjacent to structures: 95 percent.
 - b. Backfilling voids: 95 percent.
 - c. Bottom of sludge beds: 90 percent.
 - d. Embankments: 95 percent.
 - e. Demolition areas: As indicated on the Drawings.
 - f. Intermediate dikes: 90 percent.
 - g. Loose fill:
 - 1) No compaction other than by hauling vehicles will be required.
 - 2) Uniformly distribute travel of vehicles over fill area as required to provide uniformly compacted surface.
 - h. Other areas: 85 percent.
 - i. Spoil areas indicated on the Drawings: No minimum required.

- j. Under present and future structures: 95 percent.
 - k. Under roadways, parking and storage areas, curbs, and sidewalks: 95 percent.
 - l. Upper 6 inches of cuts: 95 percent.
 - m. Fills: 95 percent.
- C. Materials for backfills, embankments, fills, and roadway fills:
- 1. General:
 - a. Obtain import material from other sources if surplus materials from cuts and excavations obtained from within Project site do not conform to specified requirements or are not sufficient in quantity for construction of Project.
 - 2. Backfills:
 - a. Backfill adjacent to structures, slabs, or walls: Native material or imported material meeting the requirements of native material, unless otherwise specified or indicated on the Drawings.
 - b. Backfill material under concrete structures: Aggregate base course material, except in areas where controlled low-strength material or concrete encasement are indicated on the Drawings.
 - c. Extend backfill in any area under concrete structures from undisturbed soil or rock to the bottom aggregate base course material layer.
 - 3. Embankments:
 - a. Native material or imported material meeting the requirements of native material, unless otherwise specified or indicated on the Drawings.
 - 4. Fills:
 - a. Native material or imported material meeting the requirements of native material, unless otherwise specified or indicated on the Drawings.
 - b. Extend fill in any area under concrete structures from undisturbed soil or rock to the bottom aggregate base course material layer.
 - 5. Roadway fills: One of the following, unless otherwise specified or indicated on the Drawings:
 - a. Aggregate base course material.
 - b. Native material or imported material meeting the requirements of native material.
- D. Placement:
- 1. General:
 - a. Lines and grades:
 - 1) Construct backfills, embankments, fills, and road fills, at locations and to lines and grades indicated on the Drawings.
 - 2) Overbuild all permanent fill slopes by at least 1 foot and then cut to final grade to provide adequate compaction of the remaining fill.
 - 2. Backfills:
 - a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
 - b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
 - c. Defective compacted backfills: Remove and recompact.

3. Fills:
 - a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
 - b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
 - c. Defective compacted fills: Remove and recompact.
4. Lightweight materials:
 - a. When excavations extend into soft soils, backfill consists of lightweight material from base of excavation to the top of the soft soil. Above soft soil, native material may be used.
 - b. Where lightweight material is used for backfill: Separated from adjacent soils by the use of filter fabric.
5. Embankments:
 - a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
 - b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
 - c. Defective compacted embankments: Remove and recompact.
6. Roadway fills:
 - a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
 - b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
 - c. Defective compacted roadway fills: Remove and recompact.
7. Loose fill:
 - a. In disposal areas: In disposal areas as indicated on the Drawings, bring fill up in an essentially level layer over entire spoil area indicated:
 - 1) Continue filling spoil area until disposal of surplus excavated material is completed.
 - 2) Slope edges of fill area at between 1 and 2 horizontal to 1 vertical to the intersection with existing grade.
 - 3) Provide slopes that are smooth and uniform.
 - 4) Level finished surface of disposal area to within 4 inches of elevation indicated on the Drawings.

3.04 FIELD QUALITY CONTROL

- A. Tests:
 1. Confirmation tests:
 - a. Contractor's responsibilities:
 - 1) Accomplish specified compaction for backfills, fills, and other earthwork.
 - 2) Control operations by confirmation tests to verify that compaction work complies, and is complying at all times, with requirements specified in this Section concerning compaction, control, and testing.
 - 3) Cost of confirmation tests: Paid for by the Contractor.
 - 4) Qualifications of Contractor's testing laboratory: Perform confirmation testing by soils testing laboratory acceptable to the Engineer.
 - 5) Copies of confirmation test reports: Submit promptly to the Engineer.

2. Compliance tests:
 - a. Periodic compliance tests will be made by the Engineer to verify that compaction is meeting requirements previously specified.
 - b. Remove overburden above level at which the Engineer wishes to test. Backfill and recompact excavation after testing is completed.
 - c. If compaction fails to meet specified requirements, perform remedial work by one of the following methods:
 - 1) Remove and replace materials at proper density.
 - 2) Bring density up to specified level by other means acceptable to the Engineer.
 - d. Retesting:
 - 1) Contractor bears the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
 - 2) Contractor's confirmation tests during performance of remedial work: Double the normal rate specified.

B. Tolerances:

1. Finish grading of backfills, cuts, embankments, fills, and roadway fills:
 - a. Perform fine grading under concrete structures such that finish surfaces are never above the grade or cross section indicated on the Drawings and are never more than 0.10 feet below.
 - b. Provide finish surface for areas outside of structures that are within 0.10 feet of grade or cross section indicated on the Drawings.
2. Unlined channels and basins:
 - a. In both cut and fill, and levee and access road side slopes in cut: Vertical tolerance of none above and 3 inches below grade indicated on the Drawings on bottom and side slopes.
 - b. On top surface of levee and access road in both cut and fill, and levee and access road side slopes in fill: Vertical tolerance of none below and 3 inches above grade indicated on the Drawings.
3. Areas which are not under structures, concrete, asphalt, roads, pavements, sidewalks, dikes, and similar facilities:
 - a. Provide finish graded surfaces of either undisturbed soil, or cohesive material not less than 6 inches deep.
 - b. Intent of proceeding is to avoid sandy or gravelly areas.
4. Finish grading of surfaces:
 - a. Reasonably smooth, compacted, and free from irregular surface changes.
 - b. Provide degree of finish that is ordinarily obtainable from blade grader operations, except as otherwise specified.
 - c. Uniformly grade areas that are not under concrete.
 - d. Finish ditches and gutters so that they drain readily.

3.05 ADJUSTING

- A. Finish grades of excavations, backfills, and fills:
1. Repair and reestablish grades to required elevations and slopes due to any settlement or erosion that may occur from action of the elements or any other cause prior to final acceptance.

3.06 PROTECTION

- A. Finish grades of backfills, cuts, excavations, and fills:
 - 1. Protect newly graded areas from erosion and deterioration by action of the elements.
- B. Ditches and gutters:
 - 1. Maintain ditches and gutters free from detrimental quantities of debris that might inhibit drainage until final acceptance.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02318

TRENCHING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Trench excavation, fine grading, pipe bedding, backfilling, and compaction for the following, including requirements for ditch crossings:
 - 1. Pipes.
 - 2. Direct buried electrical and control conduits.
 - 3. Electrical and control duct banks.
 - 4. Manholes, valves, or other accessories.
 - 5. Potable water pipe appurtenances.
- 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 02050 - Soils and Aggregates for Earthwork.
 - b. Section 02300 - Earthwork.
 - c. Section 15956 - Piping Systems Testing.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
 - 2. D 1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. D 6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 SUBMITTALS

- A. Lab certification.
- B. Confirmation test reports.

1.04 QUALITY ASSURANCE

- A. Initial compaction demonstration:
 - 1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
 - a. 200 linear feet of trench backfill.
 - 2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
 - 3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

PART 2 PRODUCTS

2.01 MATERIALS

- A. Soil and rock materials:
 - 1. Aggregate base course material: As specified in Section 02050.
 - 2. Gravel: As specified in Section 02050.
 - 3. Native material: As specified in Section 02050.
 - 4. Sand: As specified in Section 02050.
 - 5. Select material: As specified in Section 02050.

PART 3 EXECUTION

3.01 PREPARATION

- A. General:
 - 1. Embankment condition:
 - a. Exists where width of trench exceeds limits specified in this Section.
 - b. Before laying pipes in fill, place fill and compact it to not less than 2 feet above top of pipe.
 - c. After placing and compacting fill, excavate pipe trench through fill.
- B. Protection: Stabilize trench excavations.

3.02 INSTALLATION

- A. Trench excavation:
 - 1. General requirements:
 - a. If, because of soil conditions, safety requirements, or other reasons, trench width at top of pipe is increased beyond width specified in this Section, upgrade laying conditions or install stronger pipe designed in conformance with Specifications for increased trench width, without additional cost to Owner.
 - b. Excavate bottom of trench to depth indicated on the Drawings. The bottom of the trench excavation shall be firm and dry.

2. The trench may be excavated by machinery to the grade indicated on the Drawings provided that the soil material remaining in the bottom of the trench is no more than slightly disturbed.
3. Rock:
 - a. Pipe: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of fine grading material. Backfill overcut with aggregate base course material compacted to 95 percent of maximum density up to bottom of fine grading material.
 - b. Direct buried electrical and control conduits: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of conduit bedding material. Backfill overcut with aggregate base course material up to bottom of conduit bedding material.
 - c. Electrical and control ductbanks: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of concrete ductbank. Backfill overcut with aggregate base course material up to bottom of concrete ductbank.
4. Overcut of trench bottom: Where the bottom of the trench is excavated below the depth indicated on the Drawings, restore trench bottom to proper grade by back filling with aggregate base course material compacted to 95 percent of maximum density, at no additional cost to Owner.
5. Soft or unstable material:
 - a. If bottom of excavation is found to consist of soft or unstable material which is incapable of providing proper support, remove such material to a depth and for the length required, as determined by the Engineer. Backfill trench to bottom of fine grading material with aggregate base course material compacted to 95 percent of maximum density.
6. Concrete cradle: Where indicated on the Drawings, cradle pipe in concrete.
7. Trench widths:
 - a. Minimum clear width of trench for pipe (measured at top of pipe):
 - 1) For pipe sizes 4 inches to and including 24 inches: Not less than outside diameter of pipe plus 18 inches.
 - 2) For pipe sizes larger than 24 inches: Not less than outside diameter of pipe plus 24 inches.
 - b. Maximum clear width of trench for pipe (measured at top of pipe):
 - 1) For pipe sizes 4 inches to and including 24 inches: Not to exceed outside diameter of pipe plus 24 inches.
 - 2) For pipe sizes larger than 24 inches: Not to exceed outside diameter of pipe plus 36 inches.
8. For manholes, valves, or other accessories:
 - a. Provide excavations sufficient to leave at least 12 inches clear between their outer surfaces and sides of trench or shoring.
 - b. Backfilling of manhole excavation: Conform to backfilling requirements as specified for trenches in this Section.
 - c. Backfill under manholes, vaults, tanks, or valves with aggregate base course material. Do not backfill with soil.

- d. Fill any unauthorized excess excavation below elevation indicated on the Drawings for foundation of any structure with aggregate base course material at no additional cost to Owner.
- 9. Potable water pipe appurtenances:
 - a. Lay in trenches separate from those used for sewers.
 - b. Unless otherwise specified or indicated on the Drawings, lay in trenches having cover of not less than 3 feet below surface of ground and located at distance of not less than 10 feet from any parallel sewer trench.
- 10. At road crossings or existing driveways:
 - a. Make provision for trench crossings at these points, either by means of backfills, tunnels, or temporary bridges.
- B. Pipe fine grading:
 - 1. Schedule fine grading material as specified in this Section.
 - 2. For pipes 16 inches in nominal diameter and under.
 - a. Place 4 inches of fine grading material below bottom of pipe.
 - b. Place fine grading material at uniform density, with minimum possible compaction.
 - 3. For pipe over 16 inches in diameter.
 - a. Place 4 inches, or 1/12 the outside diameter of pipe, whichever is greater, of fine grading material below bottom of pipe.
 - b. Place fine grading material at uniform density, with minimum possible compaction.
 - 4. Bell or coupling holes:
 - a. Dig holes after trench bottom has been graded.
 - b. Provide holes of sufficient width to provide ample room for grouting, banding, or welding.
 - c. Excavate holes only as necessary for making joints and to ensure that pipe rests upon prepared trench bottom and not supported by any portion of the joint.
 - 5. Depressions for joints, other than bell-and-spigot:
 - a. Make in accordance with recommendations of joint manufacturer for particular joint used.
- C. Pipe bedding:
 - 1. Schedule bedding material as specified in this Section.
 - 2. After pipe laid:
 - a. Place bedding material under and around pipe in 6 inch maximum lifts of bedding material, to level 12 inches above top of pipe. Compact to 95 percent of maximum density.
 - 3. Pipe displacement:
 - a. Take necessary precautions in placement and compaction of bedding material to prevent displacement of piping.
 - b. In event there is movement or floating of the piping, re-excavate, re-lay, and backfill the pipe.
- D. Trench backfill above pipe bedding, electrical and control conduit bedding, and electrical and control ductbanks:
 - 1. Under structures:
 - a. Backfill trench up to underside of structure with aggregate base course material as specified in Section 02050 compacted to 95 percent of maximum density.

2. Cuts across roadways and paved streets:
 - a. Backfill trench to underside of pavement with aggregate base course material as specified in Section 02050 compacted to 95 percent of maximum density.
 3. Under and parallel to roadways, paved areas, or storage areas:
 - a. Backfill trench up to within 2 feet of finish grade with native material compacted to 95 percent of maximum density.
 - b. Then backfill from 2 feet below finish grade to finish grade, or underside of aggregate base course or pavement as indicated on the Drawings with aggregate base course material as specified in Section 02050, compacted to 95 percent of maximum density.
 4. In areas outside the improved section of roadways or in open country:
 - a. Backfill to finish grade with native material as specified in Section 02050 compacted to 95 percent of maximum density.
 5. Through earth slopes adjacent to, or supporting structures:
 - a. Backfill to finish grade with aggregate base course material or select material compacted to 95 percent of maximum density.
- E. Under existing intersecting pipes or conduits larger than 3 inches in diameter:
1. Backfill from bottom of new pipe trench to spring line of intersecting pipe or conduit with aggregate base course material, as specified in Section 02050, compacted to 95 percent of maximum density.
 2. Extend aggregate base course material as specified in Section 02050 two feet on either side of intersecting pipe or conduit to ensure that material remains in place while other backfill is being placed.
 3. Backfill remainder of trench as specified in "Trench backfill above pipe bedding and for conduits and duck banks" above.
- F. Compaction:
1. In-place density of compacted trench backfill, and bedding determined in accordance with ASTM D 1556, or with ASTM D 6938.
 2. Maximum density obtained in laboratory when tested in accordance with ASTM D 1557.
 3. Consolidation:
 - a. Do not use water settling methods such as flooding, poling, or jetting.
 4. Consolidation:
 - a. When acceptable to the Engineer, perform consolidation by flooding and poling, or jetting so as to obtain compaction of backfill material at least equal to that specified.
 - b. Do not use water settling methods when backfill material is not sufficiently granular in nature to be self-draining during and after consolidation and when foundation materials may be softened or otherwise damaged by water.
 - c. When flooding, poling, or jetting methods are used, place and consolidate material used as backfill in layers not exceeding 4 feet in thickness.
 - d. Supplement flooding, poling, or jetting methods by use of vibratory or other compaction equipment when necessary to obtain required compaction.
- G. Excess material:
1. Remove excess excavated material from the Project site as specified in Section 02300 and dispose of legally off site.

3.03 FIELD QUALITY CONTROL

A. Tests:

1. Confirmation tests:
 - a. CONTRACTOR's responsibilities:
 - 1) Accomplish specified compaction of trench backfill.
 - 2) Control operations by confirmation tests to verify and confirm that compaction work complies, and is complying at all times, with requirements specified in this Section concerning compaction, control, and testing.
 - 3) Cost of confirmation tests: Paid for by the CONTRACTOR.
 - 4) Qualifications of CONTRACTOR's testing laboratory: Acceptable to Engineer. Provide lab certification.
 - 5) Copies of confirmation test reports: Submit promptly to the Engineer.
 - b. Frequency of confirmation testing:
 - 1) Perform testing not less than as follows:
 - a) For trenches: At each test location include tests for each type or class of backfill from bedding to finish grade.
 - b) In open fields: 2 every 1,000 linear feet.
 - c) Along dirt or gravel road or off traveled right-of-way: 2 every 500 linear feet.
 - d) Crossing paved roads: 2 locations along each crossing.
 - e) Under pavement cuts or within 2 feet of pavement edges: 1 location every 400 linear feet.
2. Compliance tests:
 - a. Frequency of testing: Periodic compliance tests will be made by the Engineer to verify that compaction is meeting requirements previously specified.
 - b. If compaction fails to meet specified requirements: Perform remedial work by one of the following methods:
 - 1) Remove and replace backfill at proper density.
 - 2) Bring density up to specified level by other means acceptable to the Engineer.
3. Retesting:
 - a. Costs of retesting: CONTRACTOR is responsible for the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
 - b. CONTRACTOR's confirmation tests during performance of remedial work:
 - 1) Performance: Perform tests in manner acceptable to the Engineer.
 - 2) Frequency: Double amount specified for initial confirmation tests.

B. Piping system testing:

1. As specified in Section 15956.

3.04 SCHEDULES

A. Pipe fine grading materials:

1. Fine grading material shall be the same as bedding material.

B. Bedding materials:

1. Pipes:

- a. For pipe less than 16-inch nominal size: Except as otherwise specified, use sand or aggregate base course material.
- b. For pipe from 16- inch to 48-inch nominal size: Except as otherwise specified, use sand or aggregate base course material.
- c. For pipe over 48 inches: Aggregate base course material.
- d. For polyvinyl chloride or other plastic pipe less than 2 inches in diameter: Sand.

2. Direct buried electrical and control conduits: Sand or Flowable Fill.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02722

AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Aggregate base course.
- 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 CMAR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CMAR'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 CMAR to see that the completed Work complies accurately with the Contract Documents.

1.02 REFERENCES

- A. Florida Department of Transportation:
 - 1. Standard Specifications for Road and Bridge Construction
- B. ASTM International (ASTM):
 - 1. C 117 - Standard Test Method for Materials Finer than 75 μ M (No. 200) Sieve in Mineral Aggregate by Washing.
 - 2. C 131 - Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 3. C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 4. D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- C. City of Daytona Beach Standard Specification and Details:
<http://www.codb.us/DocumentCenter/Home/View/900>.

1.03 SUBMITTALS

- A. Product data:
 - 1. Source.
 - 2. Gradation.
 - 3. Testing data.
- B. Quality control:
 - 1. Test reports: As required by Sections of Division 2.
 - 2. Certificates of Compliance: As required by Sections of Division 2.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Storage and protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregate base course:
 - 1. Consist of hard, durable particles or fragments of stone or gravel, screened or crushed to required size and grading and free from vegetable matter, lumps, or balls of clay, alkali, adobe, or other deleterious matter.
 - 2. Materials derived from processing demolished or removed asphalt concrete are not acceptable.
 - 3. Materials derived from processing demolished or removed asphalt concrete can be blended with approved base course material and used only as base course under asphaltic concrete paving. It cannot be used as structural backfill under or around any buried facilities.
 - 4. When sampled and tested in accordance with specified test methods, material shall comply with following requirements:
 - a. Durability: Percentage of wear not greater than 40 percent when tested in accordance with ASTM C 131.
 - b. Plasticity index: Not be more than 5 when tested in accordance with ASTM D 4318.
 - c. Liquid limit: Not be more than 25 percent when tested in accordance with ASTM D 4318.
 - 5. Aggregate base course for structures:
 - a. Consist of crushed or fragmented particles.
 - 6. Conform to size and grade within limits as follows when tested in accordance with ASTM C 117 and ASTM C 136:

Sieve Sizes (Square Openings)	Percent by Weight Passing Sieve
1-1/2 inch	95 - 100
3/4 inch	65 - 90
Number 4	35 - 60
Number 10	25 - 45
Number 50	5 - 25
Number 200	0 - 10

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine conditions upon which the work specified in this Section depends for defects that may influence installation and performance.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Subgrade preparation: Prepare as specified in Section 02300.

3.03 INSTALLATION

- A. Furnish, spread, and compact material to the lines, grades, and dimensions indicated on the Drawings:
 - 1. Spread in accordance with sections of Division 2.
 - 2. Compact in accordance with sections of Division 2.

3.04 FIELD QUALITY CONTROL

- A. Tests: Perform field tests as required by sections of Division 2.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02742

ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Asphalt concrete pavement on prepared subgrade or aggregate base course, and on existing pavement, to lines, grades, compacted thicknesses, and cross sections indicated on the Drawings.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. Standard Specifications for Transportation Materials and Methods of Sampling and Testing:
 - a. MP1: Specification for Performance Graded Asphalt Binder.
- B. ASTM International (ASTM):
 - 1. C 117 - Standard Test Method for Material Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing.
 - 2. C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 3. C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 4. D 977 - Standard Specification for Emulsified Asphalt.
 - 5. D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures using Marshall Apparatus.
 - 6. D 3381 - Specification for Viscosity-Graded Asphalt Cement for use in Pavement Construction.
 - 7. D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- C. City of Daytona Beach Standard Specification and Details:
<http://www.codb.us/DocumentCenter/Home/View/900>.

1.03 DEFINITIONS

- A. Bituminous prime coat: Consist of application of hot bituminous material on previously prepared base course.

1.04 SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. Compact the asphalt concrete to at least 95 percent of the density of the laboratory specimen of the same mixture subjected to 75 blows of a standard Marshall hammer test in accordance with ASTM D1559.

1.05 SUBMITTALS

- A. Proposed mix design and gradation of materials.
- B. Quality control submittals:
 - 1. Certificate of Compliance.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Asphalt concrete delivery:
 - 1. Transport the mixture from the mixing plant to the point of use in vehicles having tight bodies previously cleaned of all foreign materials.
 - 2. Treat bodies as necessary to prevent material from sticking to the bodies.
 - 3. Cover each load with canvas or other suitable material of sufficient size and thickness to protect the asphalt mixture from the weather.

1.07 PROJECT CONDITIONS

- A. Environmental requirements:
 - 1. Asphalt concrete:
 - a. Place asphalt concrete only when surface is dry, when atmospheric temperature in the shade is 40 degrees Fahrenheit and rising, or above 50 degrees Fahrenheit if falling.
 - b. Do not place asphalt concrete when weather is foggy or rainy nor when base on which material is to be placed is in wet or frozen condition.
 - 2. Prime coat:
 - a. Do not apply prime coat when atmospheric temperature is below 60 degrees Fahrenheit.
 - b. Apply prime coat only when base course is dry or contains moisture not in excess of that which will permit uniform distribution and desired penetration.

1.08 SEQUENCING AND SCHEDULING

- A. Prime coat:
 - 1. Prior to requesting Engineer's acceptance for application, inspect area to be coated to determine its fitness to receive bituminous priming material.
 - 2. Do not begin application before area to be coated has been accepted for application by the Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Prime coat: Asphalt prime coat shall be asphalt emulsion Type RS-2, CRS-2 or liquid asphalt RC-70 or RC-250 conforming to Section 916 of the FDOT Standard Specifications.
- B. Sand: Acceptable to the Engineer.
- C. Tack coat: Asphalt emulsion shall be RS-2, SS-1, or SS - 1H conforming to Section 916 of the FDOT Standard Specification.

D. Asphalt concrete materials:

1. Asphalt cement: Conform to requirements for asphalt cement, AR-4000, ASTM D 3381.
2. Mineral aggregate:
 - a. Consist of coarse aggregate of crushed stone or gravel composed of hard, durable particles, sand, and filler as follows:
 - 1) Coarse aggregate: Portion of material retained on Number 8 sieve.
 - 2) Fine aggregate: That portion passing Number 8 sieve.
 - b. Provide composite material that is uniformly graded from coarse to fine and that complies with requirements of one of following gradings when tested in accordance with ASTM C 136.
 - c. Asphalt concrete: 2 course plant mix for asphalt concrete having an overall thickness of 2 1/2 inches or more if not indicated. If less than 2-1/2 inches asphalt concrete, use single course plant mix.

Plant Mix, Two Course				Plant Mix, Single Course	
Seal, 3/4 inch Thick Minimum		Base, 1-3/4 inch Thick Minimum		1-1/2 inch Thick Minimum	
Sieve Size	Percent Passing	Sieve Size	Percent Passing	Sieve Size	Percent Passing
1/2"	100	1-1/4"	100	3/4"	100
3/8"	95 - 100	1"	87 - 100	1/2"	75 - 95
No. 4	50 - 70	3/4"	75 - 90	3/8"	65 - 85
No. 8	35 - 55	3/8"	55 - 72	No. 4	50 - 65
No. 30	15 - 30	No. 4	40 - 60	No. 8	35 - 50
No. 100	5 - 15	No. 8	30 - 50	No. 30	15 - 30
No. 200	3 - 8	No. 30	15 - 30	No. 100	5 - 15
		No. 100	5 - 15	No. 200	3 - 8
		No. 200	3 - 8		

3. Coarse aggregate:
 - a. Consist of at least 70 percent by weight of each size aggregate and consist of particles, which have at least 1 rough, angular surface produced by crushing:
 - 1) Have percentage of wear of not more than 50 at 500 revolutions, in accordance with ASTM C 131.
 - b. Aggregate plasticity index: Not more than 2 in accordance with ASTM D 4318.
 - c. Sand may be added to crusher or pit run product to supply any deficiency in 8-mesh size, and filler may be added to supply any deficiency in 200-mesh material. If aggregate contains an excess of sand, wasting will be required.
 - d. Filler:
 - 1) Use finely powdered limestones, portland cement, or other artificially or naturally powdered mineral dust, acceptable to the Engineer.
 - 2) Weigh filler and add separately to each batch at time of proportioning.
 - 3) Use filler that is free from deleterious matter of any kind.
 - 4) Fineness that meet the following requirements:
 - a) Passing 50 mesh sieve: 100 percent.
 - b) Passing 200 mesh sieve: At least 75 percent.

- 5) Determine amount of material passing the Number 200 sieve in accordance with ASTM C 117.
- e. Provide composite aggregate that is free from vegetable matter, lumps or balls of clay, adherent films of clay, or other matter which would prevent thorough coating of asphalt cement.
- f. Materials derived from processing demolished, or removed asphalt concrete, are not acceptable.

E. Fog sealing: Asphalt emulsion, Grade SS-1h.

2.02 EQUIPMENT

- A. Bituminous distributor: Designed and equipped so as to distribute bituminous material uniformly at even heat on variable widths of surface at readily determined and controlled rate with pressure range of 25 to 75 pounds per square inch.
- B. Liquid asphalt distributor:
 1. Designed and operated to distribute asphaltic material in uniform spray without atomization.
 2. Equipped with bitumeter having dial registering feet of travel per minute.
 - a. Locate dial so that it is visible to truck driver so that he can maintain constant speed required for application at specified rate.
 3. Equip pump with tachometer having dial registering gallons per minute passing through nozzles.
 - a. Locate dial so that it is readily visible to operator.
 4. Provide means for accurately indicating temperature of asphaltic material in distributor at all times.
 - a. Locate thermometer well so that it is not in contact with, or close to, heating tube.
 5. Have spray bar having normal width of application of not less than 12 feet and capable of providing for application of lesser width when necessary.
 6. Provided with hose and spray nozzle attachment for applying asphaltic material to patches and areas inaccessible to spray bar.
 7. Equipped with heating attachments and capable of circulating asphaltic material through spray bar during entire heating process.
- C. Asphalt concrete mixing plants:
 1. Equipment:
 - a. Use screen and storage bins at plant of sufficient capacity to furnish the necessary amount of all aggregates, when operating at the maximum capacity of the plant, with no periods of undue waiting for material.
 - 1) Use bins consisting of at least 2 compartments, so proportioned as to insure adequate storage of appropriate fractions of the aggregate.
 - 2) Provide each compartment with an overflow pipe of such size and at such location as to prevent any backing up of material into other compartments.
 - b. Dryer:
 - 1) Designed to heat and dry the aggregate to Specification requirements and to agitate it continuously during the heating.
 - 2) Capable of preparing aggregates at a rate equal to the full-rated capacity of the plant.

- c. Dust collector:
 - 1) So constructed as to waste or return uniformly to the hot elevator all or any part of the material collected.
- d. Mixer:
 - 1) Adequate capacity, with twin shafts.
- e. Thermometers:
 - 1) Furnished for determining the temperature of the mix.
- f. Weighting and measuring equipment:
 - 1) Weighing or volumetric measuring equipment of sufficient capacity.
 - 2) Devices to permit easy readjustment of any working part needing readjustment, so that the equipment will function properly and accurately.
 - 3) Attach scales for weighing to the bucket.
 - 4) Test and seal all weighing equipment by a representative of the Inspector of Weights and Measures having jurisdiction, as often as the Engineer may deem necessary to insure accuracy.
- g. Tanks for storage of bituminous material:
 - 1) Capable of heating the material under effective and positive control at all times to temperatures within the range stipulated.
- 2. Asphalt concrete plant operation:
 - a. Mineral aggregate:
 - 1) Dry and heat mineral and then screen into at least 2 fractions and conveyed into separate compartments ready for proportioning and mixing.
 - 2) When combined with asphalt cement.
 - b. Aggregate:
 - 1) Contain not more than 2 percent moisture by weight.
 - 2) Be at a temperature within the range of that specified for the asphalt cement but not more than 25 degrees Fahrenheit above the temperature of the asphalt cement.
 - c. Combine dry aggregate in the plant in the proportionate amounts of each fraction of aggregate required to meet the specified grading.
 - 1) Introduce the asphalt cement into the mixer in the amount and at the temperature for the particular material being used.
 - 2) Continue mixing for at least 30 seconds, and for such longer period as may be necessary to coat all the particles.
 - d. When a continuous mixer is used, determine the mixing time by weight method using the following formula:
 - 1) $\text{Mixing time in seconds} = \frac{\text{Pugmill dead capacity in pounds}}{\text{Pugmill output in pounds per second}}$
 - 2) Pugmill output in pounds per second.
- D. Asphalt concrete placing equipment:
 - 1. Use equipment for placing, spreading, shaping, and finishing asphalt concrete consisting of a self-contained power machine operating in such manner that no supplemental spreading, shaping, or finishing is required to provide surface which complies with requirements for smoothness contained in this Section.
 - a. In areas inaccessible to the machine, hand spreading may be permitted.
 - 2. Furnish 1 self-propelled, pneumatic-tired roller, and one 8 ton (minimum), smooth-wheel tandem roller.
 - a. When spreading is in excess of 100 tons per hour, furnish 1 additional roller of either type for each additional 100 tons, or fraction thereof, spread per hour.

2.03 MIXES

- A. Asphalt cement:
 - 1. Do not mix at temperatures lower than 275 degrees Fahrenheit nor higher than 325 degrees Fahrenheit.
 - 2. Usual amount of asphalt cement, by weight, to be added to aggregate be 5.4 percent to 5.8 percent of weight of mixture.
- B. Asphalt concrete:
 - 1. Before being delivered to the site, mix aggregate with asphalt cement at central mixing plant.
 - 2. Use mixing plants that are in good working order with no excessively worn parts and so equipped that:
 - a. Temperatures of aggregates leaving dryer, of asphalt cement entering mixer, and of mix leaving mixer can be readily determined and positively controlled within Specification limits at all times.
 - b. Weights of different sizes of aggregates and of asphalt cement as set by the Engineer can be consistently introduced into mixer.
 - c. Asphalt cement can be uniformly distributed throughout mixture with aggregate completely coated.
 - d. Mixing time can be positively controlled to minimum specified.
 - e. Bin samples of aggregate can be readily obtained.
 - f. Provide means of calibrating weighing devices.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protection
 - 1. Prime coated surfaces:
 - a. Maintain surfaces until succeeding layer of pavement has been placed.
 - b. During this interval, protect primed surfaces against damage and repair any broken spots.
- B. Surface preparation:
 - 1. Prime coat:
 - a. Where portions of base course prepared for immediate treatment are excessively dry, sprinkle such portions lightly with water immediately in advance of prime coat application.
 - b. Immediately following preparation of base course, apply bituminous material by means of bituminous distributor at the temperature previously specified.
 - c. Apply priming material in manner that results in uniform distribution being obtained at all points of surface to be primed.
 - d. Following the application of prime material, allow the surface to dry for a period of not less than 48 hours without being disturbed, or for such additional period of time as may be necessary to obtain penetration into the base course and drying out or evaporation of the volatiles from prime material.
 - e. Spread sufficient sand on areas which show an excess of bituminous material to effectively blot up and cure the excess.

2. Base courses:
 - a. Thoroughly clean base and apply prime coat before placing asphalt concrete.
 - b. Thoroughly clean any existing base, surfacing, or pavement prior to placing plant-mixed surfacing.
 - c. Where existing pavement is being widened or extended cut to straight vertical face and treat with asphalt paint binder prior to paving operations.
 - d. When asphalt concrete is to be applied over existing pavement and local irregularities in existing surface would result in course of more than specified thickness, bring surface of existing pavement to uniform contour by patching with asphalt concrete thoroughly tamped or rolled until it conforms with surrounding surface, and then apply tack coat.

3.02 APPLICATION

- A. At existing asphalt to be paved over: Apply tack coat at minimum rate of 0.10 gallons per square yard.
- B. Placing and compacting asphalt concrete:
 1. Placing and compacting asphalt mixture: Progress in sections generally not more than 750 linear feet in length.
 2. Spreading of mixture:
 - a. Spread, shape, and finish by specified equipment.
 - b. Spread each successive strip adjacent to previously spread strip.
 - c. Do not compact minimum 6-inch width of each strip adjacent to new strip until after new strip has been placed.
 - d. Spread as nearly continuous as possible.
 - e. Laying against vertical surfaces such as gutters: Roughen and clean face of vertical surfaces as required for proper bonding and then paint with light coating of asphalt cement or emulsified asphalt.
 - f. At terminations of new surface courses: Feather asphalt mixture into existing surface over such distance as may be required to produce smooth riding transition.
 - g. Base course and single course construction: Joined by vertical butt joints, finished and rolled to smooth surface.
 - h. Rolling:
 - 1) Perform initial or "breakdown" rolling with tandem power roller and follow spreading operation when mixture has reached temperature where it does not "pick up" on rolls.
 - 2) Keep rolls properly moistened but do not use surplus of water.
 - 3) Follow initial rolling with pneumatic roller when mixture is in proper condition and when rolling does not cause undue displacement, cracking, or shoving.
 - 4) Begin rolling at sides and progress gradually to center, lapping each preceding track until entire surface has been rolled.
 - 5) Terminate alternate trips of roller in stops at least three feet distant from any preceding stop.
 - 6) At any place not accessible to roller, thoroughly compact mixture with tampers and finish, if necessary, with hot iron to provide uniform layer over entire width being paved.
 3. Provide finish surface having uniform texture.

- C. Fog sealing:
 - 1. Fog seal asphalt pavement after compaction with fog sealing material applied at rate of 0.05 gallons per square yard at following locations:
 - a. At locations indicated on the Drawings.
- D. Full-depth asphalt pavement:
 - 1. CMAR's option:
 - a. Install either full-depth asphalt pavement or asphalt over 6 inch aggregate base course where reservoir bottoms are indicated on the Drawings.
 - b. Install either asphalt and aggregate base material or full-depth asphalt pavement in areas where paving is indicated on the Drawings or specified to be 2 inches of asphalt concrete over aggregate base course.
 - c. If option is selected to install full-depth asphalt pavement, prepare subgrade as previously specified in this Section.
 - d. Substitute asphalt concrete for aggregate base at ratio of 1 inch of asphalt concrete to 2-1/2 inches of aggregate base material. Use full-depth asphalt pavement not less than 4 inches in thickness after compaction.
 - e. Place asphalt concrete in courses of not more than 4 inches.
 - f. Use compaction equipment in accordance with following course thicknesses:
 - 1) 1 to 2 inch thickness: Minimum 8 ton roller.
 - 2) 2 to 3 inch thickness: Minimum 10 ton roller.
 - 3) 3 to 4 inch thickness: Minimum 12 ton roller.
 - 2. Pneumatic rollers used for initial or secondary rolling: Use 12 to 15 tons with tires capable of 90 pounds per square inch inflation pressure.
 - 3. Asphalt concrete for full-depth asphalt pavement:
 - a. Asphalt concrete as previously specified in this Section.
 - b. Apply bituminous prime coats where full-depth asphalt pavement is installed.
 - c. CMAR's option: If CMAR elects to use full-depth asphalt pavement, at road shoulders reduce aggregate base course to minimum aggregate thickness of 4 inches.
 - 4. Except for asphalt thickness, aggregate base course thickness and prime coating, full-depth asphalt pavement comply with requirements of this Section.

3.03 FIELD QUALITY CONTROL

- A. Placement:
 - 1. Place the mixture on the roads, pavements, or walks at a temperature not less than 225 degrees Fahrenheit.
- B. Tests:
 - 1. Provide sampling and control testing for the asphalt concrete.
 - a. The type and size of the samples: Suitable to determine conformance with stability, density, thickness, compaction, and other specified requirements.
 - b. Use an approved power saw or core drill for cutting samples.
 - c. Furnish all tools, labor, and materials for cutting samples, testing, and replacing the pavement where samples were removed.
 - d. Take a minimum 1 sample per 200 tons of asphalt concrete placed.

C. Inspection:

1. Asphalt concrete:

- a. Test with a 10-foot straightedge laid on the surface parallel with the centerline of the road: Variation of the surface from the testing edge of the straightedge not to exceed 1/4 inch.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02952

PAVEMENT RESTORATION AND REHABILITATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Resurfacing roads and paved surfaces in which surface is removed or damaged by installation of new work.
- 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. City of Daytona Beach Standard Specification and Details
<http://www.codb.us/DocumentCenter/Home/View/900>.
 - 3. 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.
 - 4. 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 02722 - Aggregate Base Courses.
 - b. Section 02742 - Asphaltic Concrete Paving.
 - c. Section 03300 - Cast-in-Place Concrete.

1.02 SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. Limiting dimensions:
 - a. Determine the exact lengths and dimensions of such roads, pavements, parking areas, and walks that will require removal and replacement for new work.
 - b. Join existing surfaces to terminals of new surfacing in smooth juncture.

1.03 SUBMITTALS

- A. Mix designs:
 - 1. Prior to placement of asphalt concrete, submit full details, including design and calculations for the asphalt concrete mix proposed.
 - 2. Submit gradation of aggregate base.
 - 3. Submit proposed mix design of portland cement concrete.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregate base course: As specified in Section 02722.

- B. Asphalt pavement: As specified in Section 02742.
- C. Portland cement concrete replacement material: Class A concrete as specified in Section 03300.

2.02 EQUIPMENT

- A. Roads, pavements, parking areas, and walks:
 - 1. Equipment requirements: Good condition, capable of performing work intended in satisfactory manner.

2.03 ACCESSORIES

- A. Material for painting asphalt concrete pavement: Tack coat as specified in Section 02742.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Aggregate surface removal replacement:
 - 1. When trench cut is in aggregate surfaced areas, replace aggregate base course material with material matching existing material compacted to 95 percent of its maximum density.
- B. Pavement removal and temporary asphalt replacement:
 - 1. Install temporary asphalt pavement or first course of permanent pavement replacement immediately following backfilling and compaction of trenches that have been cut through existing pavement.
 - 2. Except as otherwise provided, maintain this temporary pavement in safe and reasonably smooth condition until required permanent pavement is installed.
 - 3. Remove and dispose of temporary paving from project site.
 - 4. Where longitudinal trench is partly in pavement, replace pavement to original pavement edge, on a straight line, parallel to centerline of roadway.
 - 5. Where no part of longitudinal trench is in pavement, surfacing replacement shall only be required where existing surfacing materials have been removed.
- C. Asphalt pavement replacement:
 - 1. Replace asphalt pavement to same thickness as adjacent pavement and match as nearly as possible adjacent pavement in texture, unless otherwise indicated on the Drawings.
 - 2. Cut existing asphalt pavements to be removed for trenches or other underground construction by wheel cutter, clay spade, or other device capable of making neat, reasonably straight, and smooth cut without damaging adjacent pavement. Cutting device operation shall be subject to acceptance of Engineer.

3. Cut and trim existing pavement after placement of required aggregate base course and just prior to placement of asphalt concrete for pavement replacement, and paint trimmed edges with material for painting asphalt concrete pavement immediately prior to constructing new abutting asphalt pavements. No extra payment will be made for these items, and all costs incurred in performing this work shall be incidental to pipe laying or pavement replacement.
 4. Conform replacement of asphalt pavement to contour of original pavement.
- D. Curb, gutter, and sidewalk replacement:
1. Where any concrete curb, gutter, or sidewalk has been removed or displaced, replace to nearest construction joints with new Class A curb, gutter, or sidewalk to same dimensions and finish as original construction that was removed:
 - a. Provide expansion joints of same spacing and thickness as original construction.
- E. Asphalt pavements:
1. Trim existing asphalt pavements which are to be matched by pavement widening or pavement extension to neat true line with straight vertical edges free from irregularities with saw specifically designed for this purpose. Minimum allowable depth of cut shall be 1-1/2 inches.
 2. Cut and trim existing pavement after placement of required aggregate base course and just prior to placement of asphalt concrete for pavement widening or extension, and paint trimmed edges with material for painting asphalt concrete pavement immediately prior to constructing new abutting asphalt concrete pavements.
 3. No extra payment will be made for these items and all costs incurred in performing this work shall be incidental to widening or pavement extension.

3.02 FIELD QUALITY CONTROL

- A. Tests:
1. Asphalt concrete as specified in Section 02742.
 2. Concrete as specified in Section 03300.
- B. Inspection:
1. Asphalt concrete:
 - a. Lay 10-foot straightedge parallel to centerline of trench when the trenches run parallel to street, and across pavement replacement when trench crosses street at angle.
 - b. Remove and correct any deviation in cut pavement replacement greater than 1/4 inch in 10 feet.
 2. Portland cement concrete replacement pavement:
 - a. Lay 10-foot straightedge either across pavement replacement or longitudinal with centerline of gutter or ditch.
 - b. Remove and correct any deviation in cut pavement replacement greater than 1/4 inch in 10 feet.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03055

ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Bonding reinforcing bars and all thread rods in concrete using adhesives as specified.
- 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 03200 - Concrete Reinforcing.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.
- B. ASTM international (ASTM):
 - 1. C 881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- C. ICC Evaluation Service, Inc. (ICC-ES):
 - 1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
- D. Society for Protective Coatings (SSPC):
 - 1. Surface Preparation Standards (SP)
 - a. SP-1 - Solvent Cleaning.

1.03 SUBMITTALS

- A. Product Data: Furnish technical data for adhesives, including:
 - 1. Manufacturer's printed installation instructions (MPII).
 - 2. Independent laboratory test results.
 - 3. Handling and storage instructions.
- B. Quality control submittals:
 - 1. Adhesive manufacturer's past project experience data on at least 3 similar projects supplied with proposed products within the last 3 years.

2. ICC Evaluation Service, Inc., Evaluation Services Report in compliance with the AC308-Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
3. Installer qualifications: Submit evidence of successful completion of certification program for each installer of work described in this Section.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 1. Installer qualifications:
 - a. All individuals performing the work described in this Section shall be certified by a qualified organization to install adhesive anchors by following the MPII. Those organizations deemed to be qualified are:
 - 1) ACI-CRSI Adhesive Anchor Installer Certification Program.
 - 2) An adhesive anchor manufacturer's certification program, subject to acceptance by the Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Storage and protection:
 1. Store adhesives and adhesive components on pallets or shelving in a covered-storage area.
 2. Control temperature above 60 degrees Fahrenheit and dispose of product if shelf life has expired.
 3. If stored at temperatures below 60 degrees Fahrenheit, test components prior to use to determine if they still meet specified requirements.

PART 2 PRODUCTS

2.01 GENERAL

- A. Like items of materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

2.02 ADHESIVE FOR SELF-CONTAINED CARTRIDGE SYSTEM

- A. Adhesive shall have a current ICC Evaluation Service report documenting acceptance under AC308 for use with cracked concrete and for the seismic design categories specified.
- B. Materials:
 1. In accordance with ASTM C 881, Type IV, Grade 3, Class B or C depending on site conditions.
 2. 2-component, 100 percent solids, insensitive to moisture.
 3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.
- C. Packaging:
 1. Furnished in side-by-side cartridges with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle. Nozzle designed to thoroughly blend the components for injection from the nozzle directly into prepared hole.

2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
- D. Manufacturers: One of the following or equal:
1. Hilti, Inc., Tulsa, OK: RE 500-SD.
 2. Simpson Strong-Tie Company, Inc., Pleasanton, CA: SET-XP.

2.03 REINFORCING BARS

- A. As specified in Section 03200.

PART 3 EXECUTION

3.01 GENERAL

- A. Execution of this work is restricted to those installers certified through a qualified certification program described under Quality Assurance and accepted by the Engineer.
- B. The work shall be performed in strict accordance with the accepted MPII and the following instructions. Where the accepted MPII and the following instructions conflict, the MPII shall prevail.
- C. Provide adhesive packaged as follows:
1. Disposable, self-contained cartridge system capable of dispensing multiple adhesive components in the proper mixing ratio, and fit into a manually or pneumatically operated caulking gun.
 2. Dispense components through a mixing nozzle that thoroughly mixes components.

3.02 HOLE SIZING AND INSTALLATION

- A. Drilling holes:
1. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device, and mark locations with construction crayon on the surface of the concrete.
 2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by Engineer.
- B. Hole drilling equipment:
1. Electric or pneumatic rotary impact type with medium or light impact.
 2. Drill bits: Carbide-tipped in accordance with ANSI B212-15
 3. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.
 4. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.
- C. Hole diameter: Reinforcing bar diameter or all thread rod diameter plus 1/8 inch.

- D. Obstructions in drill path:
1. If an existing reinforcing bar or other obstruction is hit while drilling hole, stop drilling hole and fill the hole with drypack mortar. Relocate the hole to miss the obstruction and drill another hole. Repeat the above until the hole has been drilled to the required depth.
 2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the structural member and endanger the stability of the structure. Drypack holes which hit obstructions and allow drypack to reach strength equal to the existing concrete before drilling adjacent holes. Epoxy grout may be substituted for drypack when acceptable to Engineer.
 3. When existing reinforcing steel is encountered during drilling and when acceptable to Engineer, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter.
 4. Bent bar reinforcing bars: Where edge distances are critical, and striking reinforcing steel is likely, and if acceptable to Engineer, drill hole at 10 degree angle or less from axis of reinforcing bar or all thread rod being installed.
- E. Install reinforcing bars and all thread rods to depth, spacings, and locations as indicated on the Drawings.
1. Do not install adhesive-bonded all-thread rods or reinforcing bars in overhead applications.
- F. Cleaning holes:
1. Insert long air nozzle into hole and blow out loose dust. Use compressed air that is free of oil, water, or other contaminants that will reduce bond.
 2. Use a stiff bristle brush to vigorously brush hole to dislodge compacted drilling dust.
 3. Repeat step 1.
 4. Repeat above steps as required to remove drilling dust or other material that will reduce bond. The hole shall be clean and dry.
- G. Cleaning reinforcing bars and all thread rods:
1. Solvent clean reinforcing bar and all thread rods over the embedment length in accordance with SSPC SP-1 Solvent Cleaning. Provide an oil and grease free surface to promote bonding of adhesive to steel.
 2. Clean reinforcing bars and all thread rods over embedment length to bare metal. The reinforcing bars and all thread rods shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
- H. Filling hole with adhesive:
1. Fill hole with adhesive before inserting the reinforcing bar or all thread rod. Fill hole with adhesive starting from bottom of hole. Fill hole without creating air voids.
 2. Fill hole with sufficient adhesive so that excess adhesive is extruded out of the hole when the reinforcing bar or all thread rod is inserted into the hole.
 3. Do not install adhesive prior to receiving adhesive manufacturer's onsite training.

3.03 MANUFACTURERS' SERVICES

- A. Furnish manufacturer's representative to conduct jobsite training for proper installation, handling, and storage of adhesive, for personnel who will perform actual installation. Engineer may attend training sessions.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03071

EPOXIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Epoxy.
 - 2. Epoxy gel.
 - 3. Epoxy bonding agent.
- 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. ASTM International (ASTM):
 - 1. C 881 – Standard Specification for Epoxy-Resin-Base Systems for Concrete.
 - 2. C 882 – Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - 3. D 638 - Standard Test Method for Tensile Properties of Plastics.
 - 4. D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.

1.03 SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. Provide epoxy materials that are new.
 - 2. Store and use products within shelf life limitations set forth by manufacturer.
 - 3. Perform and conduct work of this Section in neat orderly manner.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's data completely describing epoxy materials.
 - 1. Submit evidence of conformance to ASTM C 881. Include manufacturer's designations of Type Grade, Class, and Color.
 - 2. Submit evidence that materials meet or exceed the specified physical characteristics.
- B. Quality control submittals:
 - 1. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General: Moisture tolerant, water-insensitive, two-component epoxy resin adhesive material containing 100 percent solids, and meeting or exceeding the performance properties specified when tested in accordance with the standards specified.
- B. Epoxy: Low viscosity product in accordance with ASTM C 881; Types I, II and V; Grade 1; Class C.
1. Manufacturers: One of the following or equal:
 - a. BASF, Concrese Standard LVI.
 - b. Sika Corporation, Sikadur 35 Hi-Mod LV.

2. Required properties:

Table 1: Material Properties – Epoxy.		
Property	Test Method	Required Results (“neat”)
Tensile Strength (7-day)	ASTM D 638	7,500 pounds per square inch, minimum.
Compressive Strength, (7-day)	ASTM D 695	11,000 pounds per square inch, minimum.
Bond Strength (2-day)	ASTM C 882	Concrete shall fail before failure of epoxy.
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

- C. Epoxy gel: Non-sagging product in accordance with ASTM C 881, Types I and IV, Grade 3, Class C.
1. Manufacturers: One of the following or equal:
 - a. BASF, Concrese Paste LPL.
 - b. Sika Corporation, Sikadur 31, Hi-Mod Gel.
 2. Required properties:

Table 2 – Material Properties – Epoxy Gel.		
Property	Test Method	Required Results (“neat”)
Tensile Strength (7-day)	ASTM D 638	2,000 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D 695	8,000 pounds per square inch, minimum.
Bond Strength (14-day)	ASTM C 882	1,500 pounds per square inch, minimum..
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

- D. Epoxy bonding agent: Non-sagging product in accordance with ASTM C 881, Type II, Grade 1, Class C.
1. Manufacturers: One of the following or equal:
 - a. BASF, Concrese Liquid LPL.
 - b. Sika Chemical Corp., Sikadur 32 Hi-Mod LPL.
 2. Required properties.

Table 3 – Material Properties – Epoxy Bonding Agent		
Property	Test Method	Required Results
Tensile Strength (7-day)	ASTM D 638	4,400 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D 695	8,300 pounds per square inch, minimum.
Bond Strength (14-days)	ASTM C 882	1,800 pounds per square inch, minimum. Concrete shall fail before failure of epoxy bonding agent.
Pot Life	-	Minimum 70 minutes at 77 degrees Fahrenheit or Minimum 90 minutes at 73 degrees Fahrenheit
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

3. If increased contact time is required for concrete placement, epoxy resin/ portland cement bonding agent may be used instead of epoxy bonding agent.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.
- B. Epoxy:
 1. Apply in accordance with manufacturer's installation instructions.
- C. Epoxy gel:
 1. Apply in accordance with manufacturer's installation instructions.
 2. Use for vertical or overhead work, or where high viscosity epoxy is required.
 3. Epoxy gel used for vertical or overhead work may be used for horizontal work.
- D. Epoxy bonding agent:
 1. Apply in accordance with manufacturer's installation instructions.
 2. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03102
CONCRETE FORMWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Concrete formwork.
- 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 03300 - Cast-in-Place Concrete.
 - b. Section 03600 - Grouting.
 - c. Section 07900 - Joint Sealants.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary.
- B. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.
- C. Underwriters Laboratories (UL).

1.03 DEFINITIONS

- A. Green concrete: Concrete with less than 100 percent of the minimum specified compressive strength (f'_c).

1.04 SYSTEM DESCRIPTION

- A. Design requirements:
 - 1. Design of concrete forms, falsework, and shoring in accordance with local, state, and federal regulations.
 - 2. Design forms and ties to withstand concrete pressures without bulging, spreading, or lifting of forms.

- B. Performance requirements:
 - 1. Construct forms so that finished concrete conforms to shapes, lines, grades, and dimensions indicated on the Drawings.
 - 2. It is intended that surface of concrete after stripping presents smooth, hard, and dense finish that requires minimum amount of finishing.
 - 3. Provide sufficient number of forms so that the work may be performed rapidly and present uniform appearance in form patterns and finish.
 - 4. Use forms that are clean and free from dirt, concrete, and other debris.
 - a. Coat with form release agent if required, prior to use or reuse.

1.05 SUBMITTALS

- A. Information on proposed forming system:
 - 1. Submit in such detail as the Engineer may require to assure himself that intent of the Specifications can be complied with by use of proposed system.
 - 2. Alternate combinations of plywood thickness and stud spacing may be submitted.
- B. Form release agent. NSF 61 certification prepared by NSF, Underwriters Laboratories (UL) or other, similar, nationally recognized testing laboratory acceptable to the Engineer.

1.06 QUALITY ASSURANCE

- A. Qualifications of formwork manufacturers: Use only forming systems by manufacturers having a minimum of 5 years experience, except as otherwise specified, or accepted in writing by the Engineer.
- B. Regulatory requirements: Install work of this Section in accordance with local, state, and federal regulations.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Forms: Built-up plywood:
 - 1. Built-up plywood forms may be substituted for prefabricated forming system subject to following minimum requirements:
 - a. Size and material:
 - 1) Use full size 4-foot by 8-foot plywood sheets, except where smaller pieces are able to cover entire area.
 - 2) Sheet construction: 5-ply plywood sheets, 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.
 - b. Wales: Minimum 2-inch by 4-inch lumber.
 - c. Studding and wales: Contain no loose knots and be free of warps, cups, and bows.

- B. Forms: Steel or steel framed:
 - 1. Steel forms:
 - a. Rigidly constructed and capable of being braced for minimum deflection of finish surface.
 - b. Capable of providing finish surfaces that are flat without bows, cups, or dents.
 - 2. Steel framed plywood forms:
 - a. Provide forms that are rigidly constructed and capable of being braced.
 - b. Plywood paneling: 5-ply, 5/8-inch nominal or 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.
- C. Form release agent.
 - 1. Effective, non-staining, bond-breaking coating compatible with form surfaces and concrete mixes used.
 - 2. Certified for conformance to NSF 61 and leaving no taste or odor on the concrete surface.
- D. Form ties:
 - 1. General:
 - a. Provide form ties for forming system selected that are manufactured by recognized manufacturer of concrete forming equipment.
 - b. Do not use wire ties or wood spreaders of any form.
 - c. Provide ties of type that accurately tie, lock, and spread forms.
 - d. Provide form ties of such design that when forms are removed, they locate no metal or other material within 1-1/2 inches of the surface of the concrete.
 - e. Do not allow holes in forms for ties to allow leakage during placement of concrete.
 - 2. Cone-snap ties:
 - a. Cone-snap ties shall form a cone shaped depression in the concrete with minimum diameter of 1 inch at the surface of the concrete and minimum depth of 1-1/2 inches.
 - b. Provide neoprene waterseal washer that is located near the center of the concrete.
 - 3. Taper ties:
 - a. Neoprene plugs for taper tie holes: Size so that after they are driven, plugs are located in center third of wall thickness.
- E. Incidentals:
 - 1. External angles:
 - a. Where not otherwise indicated on the Drawings, provide with 3/4-inch bevel, formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, slabs, walls, beams, columns, and openings.
 - b. Provide 1/4-inch bevel formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, walls, and slabs at expansion and construction joints.
 - 2. Keyways: Steel, plastic, or lumber treated with form release agent.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site verification of conditions:
 - 1. Do not place concrete until forms have been checked for alignment, level, and strength, and mechanical and electrical inserts or other embedded items for correct location.

3.02 INSTALLATION

- A. Forms: Built-up plywood:
 - 1. Studding:
 - a. Spaced at 16 inches or 24 inches on center.
 - b. Closer spacing may be required depending upon strength requirements of the forms, in order to prevent any bulging surfaces on faces of finished concrete work.
 - c. Install studs perpendicular to grain of exterior plys of plywood sheets.
 - 2. Wales: Form wales of double lumber material with minimum size as specified in this Section.
 - 3. Number of form reuses: Depends upon durability of surface coating or overlay used, and ability to maintain forms in condition such that they are capable of producing flat, smooth, hard, dense finish on concrete when stripped.
- B. Forms: Steel or steel framed:
 - 1. Steel forms:
 - a. Adequately brace forms for minimum deflection of finish surface.
 - 2. Steel framed plywood forms:
 - a. Rigidly construct and brace with joints fitting closely and smoothly.
 - b. Number of form reuses: Depends upon durability of surface coating or overlay used.
 - 3. Built-up plywood forms: As specified in this Section may be used in conjunction with steel forms or steel framed plywood forms for special forming conditions such as corbels and forming around items which will project through forms.
- C. Forms: Incidental construction:
- D. Form bracing and alignment:
 - 1. Line and grade: Limit deviations to tolerances which will permit proper installation of structural embedded items or mechanical and electrical equipment and piping.
 - 2. Formwork:
 - a. Securely brace, support, tie down, or otherwise hold in place to prevent movement.
 - b. Make adequate provisions for uplift pressure, lateral pressure on forms, and deflection of forms.
 - 3. When second lift is placed on hardened concrete: Take special precautions in form work at top of old lift and bottom of new lift to prevent:
 - a. Spreading and vertical or horizontal displacement of forms.
 - b. Grout "bleeding" on finish concrete surfaces.
 - 4. Pipe stubs, anchor bolts, and other embedded items: Set in forms where required.

5. Cracks, openings, or offsets at joints in formwork: Close those that are 1/16-inch or larger by tightening forms or by filling with acceptable crack filler.
- E. Forms: Incidentals:
1. Keyways: Construct as indicated on the Drawings.
 2. Reentrant angles: May be left square.
 3. Level strips: Install at top of wall concrete placements to maintain true line at horizontal construction joints.
 4. Inserts:
 - a. Encase pipes, anchor bolts, steps, reglets, castings, and other inserts, as indicated on the Drawings or as required, in concrete.
 5. Pipe and conduit penetrations:
 - a. Install pipe and conduit in structures as indicated on the Drawings, and seal with materials as specified in Section 07900.
- F. Form release agent:
1. Apply in accordance with manufacturer's instructions.
- G. Form ties:
1. Cone-snap ties: Tie forms together at not more than 2-foot centers vertically and horizontally.

3.03 FORM REMOVAL

- A. Keep forms in place for at least the periods indicated in the following paragraphs.
1. Vertical forms:
 - a. Keep vertical forms in place for a minimum of 24 hours after concrete is placed.
 - b. If, after 24 hours, concrete has sufficient strength and hardness to resist surface or other damage, forms may be removed.
 2. Other forms and shoring: Keep in place:
 - a. Sides of footings: 24 hours minimum.
 - b. Vertical sides of beams, girders, and similar members: 48 hours minimum.
 - c. Bottom of slabs, beams, and girders: Until concrete strength reaches specified strength f'_c or until shoring is installed.
 - d. Shoring for slabs, beams, and girders: Shore until concrete strength reaches specified strength.
 - e. Wall bracing: Brace walls until concrete strength of beams and slabs laterally supporting wall reaches specified strength.
- B. Green concrete:
1. No heavy loading on green concrete will be permitted.

3.04 SURFACE REPAIRS AND FINISHING

- A. Immediately after forms are removed, the Contractor shall schedule an inspection and shall repair any irregularities in surfaces and finishes as specified in Section 03300.
- B. Form ties: Remove form ties from surfaces. Fill tie holes as follows:
1. Remove form ties from surfaces.
 2. Roughen cone shaped tie holes by heavy sandblasting before repair.

3. Dry pack cone shaped tie holes with dry-pack mortar as specified in Section 03600.
4. Taper ties:
 - a. After forms and taper ties are removed from wall, plug tie holes with neoprene plug as follows:
 - 1) Heavy sandblast and then clean tie holes.
 - 2) After cleaning, drive neoprene plug into each of taper tie holes with steel rod. Final location of neoprene plug shall be in center third of wall thickness. Bond neoprene plug to concrete with epoxy.
 - 3) Locate steel rod in cylindrical recess and against middle of plug during driving.
 - a) At no time are plugs to be driven on flat area outside cylindrical recess.
 - b. Dry-pack of taper tie holes:
 - 1) After installing plugs in tie holes, coat tie hole surface with epoxy bonding agent and fill with dry-pack mortar as specified in Section 03600.
 - a) Place dry-pack mortar in holes in layers with thickness not exceeding tie hole diameter and heavily compact each layer.
 - b) Dry-pack the outside of the hole no sooner than 7 days after the inside of the hole has been dry packed.
 - c) Wall surfaces in area of dry-packed tie holes: On the water side of water containing structures and the outside of below grade walls:
 - (1) Cover with minimum of 10 mils of epoxy gel.
 - (2) Provide epoxy gel coating on wall surfaces that extend minimum of 2 inches past dry-pack mortar filled tie holes.
 - (3) Provide finish surfaces that are free from sand streaks or other voids.

3.05 TOLERANCES:

- A. Finished concrete shall conform to shapes, lines, grades, and dimensions indicated on the Drawings.
- B. Construct work within the tolerances in accordance with ACI 117, except as modified in the following paragraphs or as indicated on the Drawings.
 1. General:
 - a. At certain locations in the Work, tolerances required for equipment placement and operation may be more restrictive than the general tolerance requirements of this Section.
 - b. Confirm equipment manufacturers' required tolerances for location and operation of equipment that will be installed, and construct concrete to satisfy those requirements.
 2. Slabs:
 - a. Slope: Uniformly sloped to drain when slope is indicated on the Drawings.
 - b. Slabs indicated to be level: Have maximum vertical deviation of 1/8-inch in 10-foot horizontal length without any apparent changes in grade.
 3. Circular tank walls:
 - a. The Contractor may deviate from finish line indicated on the Drawings by use of forms with chord lengths not to exceed 2 feet.
 4. Inserts and embedments:

- a. Set inserts and embedments to tolerances required for proper installation and operation of equipment or systems to which insert pertains.
- b. Maximum tolerances: As follows:

Item	Tolerance
Sleeves and inserts	Plus 1/8 Minus 1/8 inches.
Anchor bolts:	
Projected ends	Plus 1/4 Minus 0.0 inches.
Axial alignment	Not more than 2 degrees off the axis indicated on the Drawings.
Setting location	Plus 1/16 Minus 1/16 inches.

- C. Remove and replace work that does not conform to required tolerances. Procedures and products employed in and resulting from such re-work shall be acceptable to the Engineer.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03150
CONCRETE ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Waterstops.
 - 2. Joint fillers.
- B. Related sections:
 - 1. The Contract Drawings 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 the Contractor's Work.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. D 570 - Standard Test Method for Water Absorption of Plastics.
 - 2. D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 3. D 638 - Standard Test Method for Tensile Properties of Plastics.
 - 4. D 746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
 - 5. D 747 - Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
 - 6. D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
 - 7. D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 8. D 1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - 9. D 2240 - Standard Test Method for Rubber Property – Durometer Hardness.
- B. American National Standards Institute (ANSI):
 - 1. A135.4 - Basic Hardboard.
- C. U. S. Army Corps of Engineers (USACE):
 - 1. CRD-C-572, Specification for Polyvinyl Chloride Waterstop.

1.03 SUBMITTALS

- A. Product data:
 - 1. Stainless steel waterstop: Complete physical properties outlined in this Section and in accordance with ASTM A 240 and ASTM A 370.

2. Preformed expansion joint material: Sufficient information on each type of material for review to determine conformance of material to requirements specified.
- B. Samples:
1. Stainless steel waterstop.
- C. Laboratory test reports: Indicating that average properties of polyvinyl chloride waterstops material and finish conform to requirements specified in this Section.
- D. Quality control submittals:
1. Certificates of Compliance:
 2. Manufacturer's instructions: For materials specified in this Section that are specified to be installed with such instructions.

1.04 QUALITY ASSURANCE

- A. Mock-ups:
1. Welding demonstration:
 - a. Demonstrate ability to weld acceptable joints in stainless steel waterstop before installing waterstop in forms.
- B. Inspections:
1. Quality of welded joints will be subject to acceptance of Engineer.

PART 2 PRODUCTS

2.01 JOINT FILLERS

- A. General:
1. Use specific type in applications as indicated on the Drawings.
 2. Do not use scrap or recycled materials to manufacture joint fillers.
- B. Preformed expansion joint materials:
1. Bituminous fiber expansion joint material:
 - a. Properties:
 - 1) Thickness: To match joint width indicated on the Drawings.
 - 2) Asphalt-impregnated fiber in accordance with ASTM D 1751.
 - b. Manufacturers: One of the following or equal:
 - 1) Durajoint.
 - 2) W.R. Meadows, SealTight Fibre Expansion Joint.
 2. Synthetic sponge rubber expansion joint material:
 - a. Properties:
 - 1) Thickness: As recommended for width indicated on the Drawings.
 - 2) Material in accordance with ASTM D 1752, Type I.
 - b. Manufacturers: One of the following or equal:
 - 1) Durajoint.
 - 2) W.R. Meadows, SealTight Sponge Rubber.

2.02 WATERSTOPS

- A. Waterstops - stainless steel:
1. Non-expansion joint type.
 2. Fabrication: Provide shop-fabricated waterstop fittings for all intersections. Directional changes shall be miter cut and spliced by TIG welding to maintain continuity of the outside flanges and "V" expansion zone.
 3. Manufacturers: One of the following or equal:
 - a. JP Specialties, Inc., JP558.
 - b. Greenstreak Plastic Products Company, Style 499.
 4. Type 316L stainless steel waterstops shall comply with the following requirements:
 - a. Non-expansion joint type stainless steel waterstops:
 - 1) 6-inch wide, 20 gauge, in accordance with ASTM A 240 Type 316L or Type 316 ELC.
 - b. Properties as indicated in the following table.

Physical Characteristics	Test Method	Required Results
Minimum Ultimate Tensile Strength	ASTM A 370	75,000 pounds per square inch
Elongation in 2-Inch Minimum	ASTM A 370	40 percent
Rockwell B Hardness	ASTM A 370	95 maximum
Minimum Yield Strength	ASTM A 370	25,000 pounds per square inch

PART 3 EXECUTION

3.01 INSTALLATION

- A. Waterstops:
1. General:
 - a. Store waterstops so as to permit free circulation of air around waterstop material and prevent direct exposure to sunlight.
 - b. Install waterstops in concrete joints where indicated on the Drawings.
 - c. Carry waterstops in walls into lower slabs and join to waterstops in slabs with appropriate types of fittings.
 - d. In waterbearing structures: Provide all joints with waterstops, whether indicated on the Drawings or not.
 - e. Provide waterstops that are continuous.
 - f. Set waterstops accurately to position and line as indicated on the Drawings.
 - g. Hold and securely fix edges in position at intervals of not more than 24 inches so that they do not move during placing of concrete.
 - h. Position the waterstop so that symmetrical halves of waterstop are equally divided between concrete pours. Center axis of waterstop shall be coincident with centerline of the joint.
 - i. Do not drive nails, screws, or other fasteners through waterstops in vicinity of construction joints.
 - j. Use wires at not more than 24 inches on centers near outer edge of waterstop to tie waterstops into position.
 - k. Special clips may be used in lieu of wires, at Contractor's option.

- l. Terminate waterstops 3 inches from top of finish surfaces of walls and slabs unless otherwise specified or indicated on the Drawings.
 - m. When any waterstop is installed in concrete on one side of joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, take suitable precautions to shade and protect exposed waterstop from direct rays of sunlight during entire exposure and until exposed portion is embedded in concrete.
 - n. When placing concrete at waterstops in slabs, lift edge of waterstop while placing concrete below the waterstop. Manually force waterstop against and into concrete, and then cover waterstop with fresh concrete.
 - 2. Stainless steel waterstops:
 - a. Weld splices in stainless steel waterstops using TIG or MIG welding process utilizing filler metal or filler metal electrode to match stainless type. Weld all straight run material edge-to-edge with no overlapping.
 - b. Repair damaged waterstops by removing damaged portions and patching. Patching shall overlap a minimum of 1 inch onto undamaged portion of waterstop.
 - c. Ensure back side (or open end of the "V") is covered completely with tape prior to concrete pour.
- B. Joints:
 - 1. Construct construction and expansion joints as indicated on the Drawings.
 - 2. Preformed expansion joint material: Fasten expansion joint strips to concrete, masonry, or forms with adhesive. No nailing will be permitted, nor shall expansion joint strips be placed without fastening.

END OF SECTION

SECTION 03200
CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Bar supports.
 - 2. Reinforcing bars.
 - 3. Thread bars.
 - 4. Tie wires.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 318 - Building Code Requirements for Structural Concrete and Commentary.
 - 2. 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
 - 3. SP-66 – ACI Detailing Manual.
- B. American Welding Society (AWS):
 - 1. D1.4 - Structural Welding Code - Reinforcing Steel.
- C. ASTM International (ASTM):
 - 1. A 185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - 2. A 615 - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
 - 3. A 706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

1.03 DEFINITIONS

- A. Give away bars: Bars that are not required by Contract Documents, but are installed by the Contractor to support the required reinforcing bars.

1.04 SYSTEM DESCRIPTION

- A. The Drawings contain general notes concerning amount of reinforcement and placing, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete.

1.05 SUBMITTALS

- A. Shop drawings:
 - 1. Changes to reinforcing steel contract drawing requirements:
 - a. Indicate in separate letter submitted with shop drawings any changes of requirements indicated on the Drawings for reinforcing steel.

- b. Such changes will not be acceptable unless the Engineer has accepted such changes in writing.
 - 2. Reinforcement shop drawings:
 - a. Review of reinforcement shop drawings by the Engineer will be limited to general compliance with the Contract Documents.
 - b. Submit reinforcement shop drawings in a complete package for each specific structure. Partial submittals will be rejected.
- B. Samples:
 - 1. Bar support chairs: Submit samples of chairs proposed for use along with letter stating where each type of chair will be used.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
 - 1. Deliver bars bundled and tagged with identifying tags.
- B. Acceptance at site:
 - 1. Reinforcing bars: Deliver reinforcing bars lacking grade identification marks accompanied by manufacturer's guarantee of grade.

1.07 SEQUENCING AND SCHEDULING

- A. Bar supports: Do not place concrete until samples and product data for bar supports have been accepted by the Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Bar supports:
 - 1. Wire bar supports located between reinforcing bars and face of concrete:
 - a. Hot-dip galvanized steel bar support chairs with plastic tips.
 - 1) Support reinforcing for concrete placed on ground using bar support chairs with hot dip galvanized plates for resting on ground welded to the chairs.
 - 2. Wire bar supports located between mats of reinforcing bar:
 - a. Steel bar supports.
- B. Reinforcing bars:
 - 1. Reinforcing bars to be embedded in concrete:
 - a. ASTM A 615 Grade 60 deformed bars.
 - 1) Actual yield strength based on mill tests of reinforcement provided shall not exceed the minimum yield strength specified in this Section by more than 18,000 pounds per square inch.
 - 2) Ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement shall not be less than 1.25.
- C. Tie wires: Annealed steel.
- D. Welded wire fabric reinforcement:
 - 1. In accordance with ASTM A 185.

2. Fabric may be used in place of reinforcing bars if accepted by the Engineer.
3. Provide welded wire fabric in flat sheet form.
4. Provide welded wire fabric having cross-sectional area per linear foot of not less than cross-sectional area per linear foot of reinforcing bars indicated on the Drawings.

2.02 FABRICATION

- A. Shop assembly:
 1. Cut and bend bars in accordance with provisions of ACI 318, ACI 350, and ACI SP-66.
 2. Bend bars cold.
 3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions:
 1. Reinforcing bars and welded wire fabric reinforcement: Verify that reinforcement is new stock free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings which adversely affect bonding capacity when placed in the work.

3.02 PREPARATION

- A. Surface preparation:
 1. Reinforcing bars: Thin coating of red rust resulting from short exposure will not be considered objectionable. Thoroughly clean any bars having rust scale, loose mill scale, or thick rust coat.
 2. Cleaning of reinforcement materials: Remove concrete or other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent concrete placement.

3.03 INSTALLATION

- A. Reinforcing bars:
 1. No field bending of bars will be allowed.
 2. Hoop bars shall be rolled to the radius of the structure.
 3. Welding:
 - a. Weld reinforcing bars where indicated on the Drawings or acceptable to the Engineer.
 - b. Perform welding in accordance with AWS D1.4 and welding procedures accepted by the Engineer.
 - 1) Conform to requirements for minimum preheat and interpass temperatures.
 - c. Submit welding procedures.
 - d. Do not tack weld reinforcing bars.

B. Placing reinforcing bars:

1. Accurately place bars to meet tolerances of ACI 318 and adequately secure them in position.
2. Lap bars at splices as indicated on the Drawings or specified.
 - a. Unless specifically otherwise indicated on the Drawings, install bars at lap splices in contact with each other and fasten together with tie wire.
 - b. Where reinforcing bars are to be lap spliced at concrete joints, ensure that bars project from first concrete placement a length equal to or greater than the minimum lap splice length indicated on the Drawings.
 - c. Where lap splice lengths are not indicated on the Drawings, provide lap splice lengths in accordance with ACI 318 and ACI 350.
3. Bar supports:
 - a. Provide a sufficient number to prevent sagging, to prevent shifting, and to support loads during construction; but in no case less than quantities and at locations as indicated in ACI SP-66.
 - b. Do not use brick, broken concrete masonry units, spalls, rocks, wood or similar materials for supporting reinforcing steel.
 - c. Do not use give away bars that have less cover than required by the Contract Documents. Do not adjust location of reinforcement required by the Contract Documents to provide cover to the give away bars.
4. If not indicated on the Drawings, provide protective concrete cover in accordance with ACI 350 and ACI SP-66.

C. Tying of bar reinforcement:

1. Fasten bars securely in place with wire ties.
2. Tie bars sufficiently often to prevent shifting.
3. Provide at least 3 ties in each bar length.
 - a. Do not apply to dowel lap splices or to bars shorter than 4 feet, unless necessary for rigidity.
4. Tie slab bars at every intersection around periphery of slab.
5. Tie wall bars and slab bar intersections other than around periphery at not less than every fourth intersection, but at not greater than following maximum spacings:

Bar Size	Slab Bar Spacing Inches	Wall Bar Spacing Inches
Bars Number 5 and Smaller	60	48
Bars Number 6 through Number 9	96	60
Bars Number 10 and Number 11	120	96

6. After tying wire ties, bend ends of wire ties in towards the center of the concrete section.
 - a. The cover for wire ties shall be the same as the cover requirements for reinforcing bars.

D. Welded wire fabric reinforcement:

1. Install necessary wiring, spacing chairs, or supports to keep welded wire fabric in place while concrete is being placed.
2. Bend fabric as indicated on the Drawings or required to fit work.
3. Unroll or otherwise straighten fabric to make flat sheet before placing in the Work.
4. Lap splice welded wire fabric as indicated on the Drawings.

5. If lap splice length is not indicated on the Drawings, splice fabric in accordance with ACI 318 and ACI 350.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Cast-in-place concrete.
- 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 03071 - Epoxies.
 - b. Section 03150 - Concrete Accessories.
 - c. Section 03366 - Tooled Concrete Finishing.
 - d. Section 03600 - Grouting.
 - e. Section 03931 - Epoxy Injection System.
 - f. Section 07900- Joint Sealants.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 305 - Hot Weather Concreting Standard.
 - 2. 306 - Cold Weather Concreting Standard.
 - 3. 318 - Building Code Requirements for Structural Concrete and Commentary.
 - 4. 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
 - 5. Manual of Concrete Practice.
- B. ASTM International (ASTM):
 - 1. C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 2. C 33 - Standard Specification for Concrete Aggregates.
 - 3. C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 4. C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - 5. C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 6. C 88 - Standard Test Method of Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 - 7. C 94 - Standard Specification for Ready-Mixed Concrete.
 - 8. C 114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement.

9. C 117 - Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
10. C 123 - Standard Test Method for Lightweight Particles in Aggregate.
11. C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
12. C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
13. C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregate.
14. C 143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
15. C 150 - Standard Specification for Portland Cement.
16. C 156 - Standard Test Method for Water Loss from a Mortar Specimen Through Liquid Membrane-Forming Curing Compounds for Concrete.
17. C 157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
18. C 171 - Standard Specifications for Sheet Materials for Curing Concrete.
19. C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
20. C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
21. C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
22. C 289 - Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
23. C 295 - Standard Guide to Petrographic Examination of Aggregates for Concrete.
24. C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
25. C 311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
26. C 494 - Standard Specification for Chemical Admixtures for Concrete.
27. C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
28. C 856 - Standard Practice for Petrographic Examination of Hardened Concrete.
29. D 75 - Standard Practice for Sampling Aggregates.
30. D 2103 - Standard Specification for Polyethylene Film and Sheeting.

C. NSF International (NSF):

1. 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

- A. Alkali: Sum of sodium oxide and potassium oxide calculated as sodium oxide.
- B. Cementitious materials: Portland cement and fly ash.
- C. Cold weather: A period when for more than 3 consecutive days, the average daily outdoor temperature drops below 40 degrees Fahrenheit. The average daily temperature is the average of the highest and lowest temperatures during the period from midnight to midnight. When temperatures above 50 degrees Fahrenheit occur during more than half of any 24-hour duration, the period shall no longer be regarded as cold weather.

- D. Cold weather concreting: Operations for placing, finishing, curing, and protection of concrete during cold weather.
- E. Green concrete: Concrete with less than 100 percent of the specified strength.
- F. Hairline crack: Crack with a crack width of less than 4 thousandths of an inch.
- G. Hot weather: A period when project conditions such as low humidity, high temperature, solar radiation, and high winds, promote rapid drying of freshly placed concrete.
- H. Hot weather concreting: Operations for placing, finishing, curing, and protection of concrete during hot weather.

1.04 SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. General:
 - a. Except as otherwise specified, provide concrete composed of portland cement, fly ash, fine aggregate, coarse aggregate, admixtures and water so proportioned and mixed as to produce plastic, workable mixture in accordance with requirements as specified in this Section and suitable to specific conditions of placement.
 - b. Proportion materials in a manner that will secure lowest water-cementitious materials ratio that is consistent with good workability, plastic and cohesive mixture, and a mixture that is within specified slump range.
 - c. Proportion fine and coarse aggregates in manner such as not to produce harshness in placing or honeycombing.
 - 2. It is the intent of this Section to secure for every part of the Work concrete with homogeneous mixture, which when hardened will have required strength, watertightness, and durability:
 - a. It is recognized that some surface hairline cracks and crazing will develop in the concrete surfaces.
 - b. Construction and expansion have been specified and positioned in structures as indicated on the Drawings, and curing methods specified, for purpose of reducing number and size of cracks, due to normal expansion and contraction expected from specified concrete mixes.
 - c. Repair cracks which develop in walls or slabs and repair cracks which show any signs of leakage until all leakage is stopped.
 - d. Pressure inject visible cracks, other than hairline cracks and crazing, in following areas with epoxy as specified in Section 03931:
 - 1) Floors and walls of water bearing structures.
 - 2) Walls and overhead slabs of passageways or occupied spaces, outsides of which are exposed to weather or may be washed down and are not specified to receive separate waterproof membrane.
 - 3) Other items not specified to receive separate waterproof membrane: Slabs over water channels, wet wells, reservoirs, and other similar surfaces.
 - e. Walls or slabs, as specified above, that leak or sweat because of porosity or cracks too small for successful pressure injection with epoxy: Seal on water or weather side by coatings of surface sealant system, as specified in this Section.

- f. Pressure injection and sealing: Continue as specified above until structure is watertight and remains watertight for not less than 1 year after final acceptance or date of final repair, whichever occurs later in time.
- 3. Workmanship and methods: Provide concrete work, including detailing of reinforcing, conforming with best standard practices and as set forth in ACI 318, ACI 350, Manual of Concrete Practices, and recommended practices.

1.05 SUBMITTALS

- A. Cement mill tests: Include alkali content, representative of each shipment of cement for verification of compliance with specified requirements.
- B. Cold weather concreting:
 - 1. Procedures for the production, transportation, placement, protection, curing, and temperature monitoring for concrete during cold weather.
 - 2. Procedures to be implemented upon abrupt changes in weather conditions or equipment failures.
- C. Concrete mixes: Full details, including mix design calculations for concrete mixes proposed for use for each class of concrete:
 - 1. Include information on correction of batching for varying moisture contents of fine aggregate.
 - 2. Source quality test records with mix design submittal:
 - a. Include calculations for required compressive strength (f'_{cr}) based on source quality test records.
- D. Concrete aggregate tests: Certified copies in triplicate of commercial laboratory tests not more than 90 days old of all samples of concrete aggregates:
 - 1. Coarse aggregate:
 - a. Abrasion loss.
 - b. Clay lumps and friable particles.
 - c. Coal and lignite.
 - d. Materials finer than 200 sieve.
 - e. Reactivity.
 - f. Shale and chert.
 - g. Soundness.
 - 2. Fine aggregate:
 - a. Clay lumps.
 - b. Color.
 - c. Decantation.
 - d. Reactivity.
 - e. Shale and chert.
 - f. Soundness.
- E. Drying shrinkage test data. The drying shrinkage limit shall be 0.05 percent at 28 days. Data submitted shall be measured to the nearest 0.001 percent.
- F. Fine or coarse aggregate batched from more than 1 bin: Analyses for each bin, and composite analysis made up from these, using proportions of materials to be used in mix.

- G. Fly ash Certificate of Compliance: Identify source of fly ash and certify compliance in accordance with ASTM C 618.
- H. For conditions that promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind: Corrective measures for use prior to placing concrete.
- I. Hot weather concreting: Procedures for production, placement, finishing, curing, protection, and temperature monitoring for concrete during hot weather and appropriate corrective measures.
- J. Heating equipment for cold weather concreting: Information on type of equipment used for heating materials and new concrete in process of curing during excessively cold weather.
- K. Information on mixing equipment.
- L. Product data: Submit data completely describing products.
- M. Sequence of concrete placing: Submit proposed sequence of placing concrete showing proposed beginning and ending of individual placements.
- N. Sieve analysis: Submit sieve analyses of fine and coarse aggregates being used in triplicate at least every 3 weeks and at any time there is significant change in grading of materials.
- O. Trial batch test data:
 - 1. Submit data for each test cylinder.
 - 2. Submit data that identifies mix and slump for each test cylinder.
- P. Weather monitoring: Records of:
 - 1. Relative humidity.
 - 2. Site ambient temperature.
 - 3. Wind speed.
- Q. Temperature of freshly placed concrete.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
 - 1. Deliver, store, and handle concrete materials in manner that prevents damage and inclusion of foreign substances.
 - 2. Deliver and store packaged materials in original containers until ready for use.
 - 3. Deliver aggregate to mixing site and handle in such manner that variations in moisture content will not interfere with steady production of concrete of specified degree of uniformity and slump.
- B. Acceptance at site: Reject material containers or materials showing evidence of water or other damage.

1.07 PROJECT CONDITIONS

- A. Environmental requirements:

1. Monitoring weather conditions:
 - a. Install an outdoor weather station capable of measuring and recording ambient temperature, wind speed, and humidity. Furnish instruments accurate to within 2 degrees Fahrenheit, 5 percent relative humidity, and 1 mile per hour wind speed.
 - b. Measure and record temperature of fresh concrete. Furnish and use sufficient number of maximum and minimum self-recording thermometers to adequately measure temperature of concrete.
 - c. Monitor and keep records of the weather forecast starting at least 48 hours prior to placing concrete in order to allow enough time for taking appropriate measures pertaining to Hot or Cold weather concreting.
2. Hot weather concreting:
 - a. Initiate evaporation control measures when concrete and air temperatures, relative humidity of the air, and the wind velocity have the capacity to evaporate water from a free surface at a rate that is equal to or greater than 0.2 pounds per square feet per hour. Determine evaporation rate using the Menzel Formula and monograph in ACI 305 3.1.3.
 - b. When ambient air temperature is above 85 degrees Fahrenheit: Prior to placing concrete, cool forms and reinforcing steel by water cooling to below 90 degrees Fahrenheit.
 - c. Monitor weather conditions at the site including air temperature, humidity, and wind speed, to assess the need for evaporation control measures begin monitoring site conditions no later than 1 hour before the start of concrete placement. Continue to monitor site conditions at intervals of 30 minutes until concrete curing has begun.
 - d. Temperature of concrete mix at time of placement: Keep temperature below 90 degrees Fahrenheit by methods which do not impair quality of concrete.
 - e. For conditions that promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind: Take corrective measures to minimize rapid water loss from concrete:
 - f. Furnish and use sufficient number of maximum and minimum self-recording thermometers to adequately measure temperature around concrete.
3. Cold weather concreting:
 - a. Concrete placed below ambient air temperature of 45 degrees Fahrenheit and falling or below 40 degrees Fahrenheit:
 - 1) Make provision for heating water.
 - b. Follow recommendations of ACI 306 for preparation, placement, and protection of concrete during cold weather.
 - c. If materials have been exposed to freezing temperatures to degree that any material is below 35 degrees Fahrenheit: Heat such materials.
 - d. Heating water, cement, or aggregate materials:
 - 1) Do not heat in excess of 160 degrees Fahrenheit.
 - e. Protection of concrete in forms:
 - 1) Do not remove forms from concrete when outside ambient air temperature is below 50 degrees Fahrenheit until concrete has attained its minimum specified compressive strength. Evidence of strength shall be based on by testing of cylinders stored in the field under equivalent conditions to those at the concrete structure.
 - 2) Protect by means of covering with tarpaulins, or other acceptable covering acceptable to Engineer.

- 3) Provide means for circulating warm moist air around forms in manner to maintain temperature of 50 degrees Fahrenheit for at least 5 days.

1.08 SEQUENCING AND SCHEDULING

- A. Schedule placing of concrete in such manner as to complete any single placing operation to construction or expansion joint.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Admixtures:
 1. General:
 - a. Do not use admixtures of any type, except as specified, unless written acceptance has been obtained from the Engineer.
 - b. Admixtures shall be compatible with concrete and other admixtures. Admixtures other than pozzolans shall be the products of a single manufacture to ensure compatibility.
 - c. Do not use admixtures containing chlorides calculated as chloride ion in excess of 0.5 percent by weight of cement.
 - d. Use in accordance with manufacturer's recommendations. Add each admixture to concrete mix separately.
 2. Air entraining admixture:
 - a. Provide concrete with 5 percent, within 1 percent, entrained air of evenly dispersed air bubbles at time of placement.
 - b. In accordance with ASTM C 260.
 3. Water reducing admixture:
 - a. May be used at the Contractor's option.
 - b. In accordance with ASTM C 494, Type A or Type D.
 - c. Not contain air-entraining agents.
 - d. Liquid form before adding to the concrete mix.
 - e. No decrease in cement is permitted as result of use of water reducing admixture.
 4. Super-plasticizers: Are not to be used without acceptance by Engineer.
- B. Aggregate:
 1. General:
 - a. Provide concrete aggregates that are sound, uniformly graded, and free of deleterious material in excess of allowable amounts specified.
 - b. Grade aggregate in accordance with ASTM C 136 and D 75.
 - c. Provide unit weight of fine and coarse aggregate that produces in place concrete with weight of not less than 140 pounds per cubic foot.
 - d. Do not use aggregate made from recycled materials such as crushed and screened hydraulic-cement concrete, brick, and other construction materials.
 2. Fine aggregate:
 - a. Provide fine aggregate for concrete or mortar consisting of clean, natural sand or of sand prepared from crushed stone or crushed gravel.
 - b. Do not provide aggregate having deleterious substances in excess of following percentages by weight of contaminating substances.
 - 1) In no case shall total exceed percent listed.

<u>Item</u>	<u>Test Method</u>	<u>Percent</u>
Removed by decantation (dirt, silt, etc.)	ASTM C 117	3
Shale or Chert	ASTM C 123 ASTM C 295*	1 1
Clay Lumps	ASTM C 142	1
* Test Method C 123 is used to identify particles in the sample lighter than 2.40 Specific Gravity. Test Method C 295 is used to identify which of the lightweight particles are shale or chert. If the results of Test Method C 123 are less than 1 percent, Test Method C 295 is not required.		

- c. Except as otherwise specified, grade fine aggregate from coarse to fine in accordance with ASTM C 33.

3. Coarse aggregate:

- a. Provide coarse aggregate consisting of gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter, or other foreign substances.
- b. Not exceeding 15 percent by weight, of thin or elongated pieces having length greater than 5 times average thickness.
- c. Deleterious substances: Not in excess of following percentages by weight, and in no case having total of all deleterious substances exceeding 2 percent.

Item	Test Method	Percent
Shale or chert	ASTM C 123 ASTM C 295**	1.25 1
Coal and lignite	ASTM C 123	1/4
Clay lumps and friable particles	ASTM C 142	1/4
Materials finer than Number 200 sieve	ASTM C 117	1/2*
* Except when material finer than Number 200 sieve consists of crusher dust, maximum amount shall be 1 percent.		
** Test Method C 123 is used to identify particles in the sample lighter than 2.40 Specific Gravity. Test Method C 295 is used to identify which of the lightweight particles are shale, chert, coal, or lignite. If the results of Test Method C 123 are less than 1.25 percent (the minimum combined percentage of shale, chert, coal and lignite), Test Method C 295 is not required.		

- d. Grading:
- 1) Aggregate for Class A, B, C, and D concrete: In accordance with ASTM C 33, Size Number 57, except as otherwise specified or authorized in writing by the Engineer.
 - 2) Aggregate for Class CE concrete for encasement of electrical conduits:
 - a) Graded in accordance with ASTM C 33, Size Number 8.

- C. Concrete Sealer:
 - 1. Surecoat 1007 by Surecoat Systems.
- D. Concrete Stain Repellent:
 - 1. Surecoat Stain Repellent by Surecoat Systems.
- E. Conduit encasement coloring agent:
 - 1. Color: Red color concrete used for encasement of electrical ducts, conduits, and similar type items.
 - 2. Manufacturers: One of the following or equal:
 - a. Davis Company, #100 Utility Red.
 - b. I. Reiss Company, Inc., equivalent product.
 - c. Euclid Chemical Company, Increte Division, "Colorcrete Brick Red."
 - 3. Conduit encasement concrete: Mix into each cubic yard of concrete 10 pounds of coloring agent.
- F. Evaporation retardant:
 - 1. Manufacturers: One of the following or equal:
 - a. BASF, Cleveland, Ohio, Confilm.
 - b. Euclid Chemical Company, Cleveland, Ohio, Eucobar.
- G. Fly ash:
 - 1. Fly ash in accordance with ASTM C 618, Class F may be used in concrete made with Type II portland cement.
 - 2. Maximum of 15 percent by weight of fly ash to total weight of cementitious materials.
 - a. The total weight of cementitious materials shall not be less than minimum cementitious materials listed in Table A.
 - 3. Do not use in concrete made with portland-pozzolan cement.
 - 4. Loss on ignition: Not exceed 4 percent.
 - 5. In accordance with NSF 61.
- H. Keyway material: Steel, plastic, or lumber.
- I. Nonslip abrasive:
 - 1. Aluminum oxide abrasive size 8/16, having structure of hard aggregate that is, homogenous, nonglazing, rustproof, and unaffected by freezing, moisture, or cleaning compounds.
 - 2. Manufacturers: One of the following or equal:
 - a. Exolon Company, Tonawanda, New York.
 - b. Abrasive Materials, Incorporated, Hillsdale, Michigan.
 - c. "Non-Slip Aggregate", Euclid Chemical Company, Cleveland, Ohio.
- J. Portland cement:
 - 1. Conform to specifications and tests in accordance with ASTM C 150, Types II or III, low alkali, except as specified otherwise.
 - 2. Have total alkali containing not more than 0.60 percent.
 - 3. Exposed concrete in any individual structure: Use only one brand of portland cement.
 - 4. Cement for finishes or repairs: Provide cement from same source and of same type as concrete to be finished or repaired.
 - 5. In accordance with NSF 61.

- K. Sheet membrane for curing:
 - 1. Polyethylene film:
 - a. In accordance with ASTM C 171.
 - b. Color: White.
 - c. Thickness: Nominal thickness of polyethylene film shall not be less than 0.0040 inches when measured in accordance with ASTM D 2103. Thickness of polyethylene film at any point shall not be less than 0.0030 inches.
 - d. Loss of moisture: Not exceed 0.055 grams per square centimeter of surface when tested in accordance with ASTM C 156.
- L. Sprayed membrane curing compound: Clear type with fugitive dye in accordance with ASTM C 309, Type 1D.
- M. Surface sealant system: Manufacturers: One of the following or equal:
 - 1. Radcon Laboratories, Inc., Las Vegas, Nevada, Formula Number 7.
 - 2. IPA Systems, Philadelphia, Pennsylvania, Duripal.
- N. Water:
 - 1. Water for concrete, washing aggregate, and curing concrete: Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.
 - 2. Chlorides and sulfate ions:
 - a. Water for conventional reinforced concrete: Use water containing not more than 1,000 milligrams per liter of chlorides calculated as chloride ion, nor more than 1,000 milligrams per liter of sulfates calculated as sulfate ion.
 - b. Water for prestressed or post-tensioned concrete: Use water containing not more than 650 milligrams per liter of chlorides calculated as chloride ion, or more than 800 milligrams per liter of sulfates calculated as sulfate ion.

2.02 EQUIPMENT

- A. Mixing concrete:
 - 1. Mixers may be of stationary plant, paver, or truck mixer type.
 - 2. Provide adequate equipment and facilities for accurate measurement and control of materials and for readily changing proportions of material.
 - 3. Mixing equipment:
 - a. Capable of combining aggregates, cementitious materials, and water within specified time into thoroughly mixed and uniform mass and discharging mixture without segregation.
 - b. Maintain concrete mixing plant and equipment in good working order and operated at loads, speeds, and timing recommended by manufacturer or as specified.
 - c. Proportion cementitious materials and aggregate by weight.
- B. Machine mixing:
 - 1. Batch plant shall be capable of controlling delivery of all material to mixer within 1 percent by weight of individual material.

2. If bulk cementitious materials are used, weigh them on separate visible scale which will accurately register scale load at any stage of weighing operation from zero to full capacity.
3. Prevent cementitious materials from coming into contact with aggregate or with water until materials are in mixer ready for complete mixing with all mixing water.
4. Procedure of mixing cementitious materials with sand or with sand and coarse aggregate for delivery to project site, for final mixing and addition of mixing water will not be permitted.
5. Retempering of concrete will not be permitted.
6. Discharge entire batch before recharging.
7. Volume of mixed material per batch: Not exceed manufacturer's rated capacity of mixer.
8. Mixers:
 - a. Perform mixing in batch mixers of acceptable type.
 - b. Equip each mixer with device for accurately measuring and indicating quantity of water entering concrete, and operating mechanism such that leakage will not occur when valves are closed.
 - c. Equip each mixer with device for automatically measuring, indicating, and controlling time required for mixing:
 - 1) Interlock device to prevent discharge of concrete from mixer before expiration of mixing period.

C. Transit-mixed concrete:

1. Mix and deliver in accordance with ASTM C 94.
2. Total elapsed time between addition of water at batch plant and discharging completed mix:
 - a. Not to exceed 90 minutes.
 - b. Elapsed time at project site shall not exceed 30 minutes.
3. Under conditions contributing to quick setting, total elapsed time permitted may be reduced by the Engineer.
4. Equip each truck mixer with device interlocked to prevent discharge of concrete from drum before required number of turns and furnish device that is capable of counting number of revolutions of drum.
5. Continuously revolve drum after it is once started until it has completely discharged its batch:
 - a. Do not add water until drum has started revolving.
 - b. Right is reserved to increase required minimum number of revolutions or to decrease designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing. The Contractor will not be entitled to additional compensation because of such increase or decrease.

D. Other types of mixers: In case of other types of mixers, mixing shall be as follows:

1. Mix concrete until there is uniform distribution of materials, and discharge mixer completely before recharging.
2. Neither speed nor volume loading of mixer shall exceed manufacturer's recommendations.
3. Continue mixing for minimum of 1-1/2 minutes after all materials are in drum, and for batches larger than 1 cubic yard increase minimum mixing time 15 seconds for each additional cubic yard or fraction thereof.

2.03 MIXES

- A. Measurements of materials:
 - 1. Measure materials by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the Engineer.
 - 2. Furnish apparatus for weighing aggregates and cementitious materials that is suitably designed and constructed for this purpose.
 - 3. Accuracy of weighing devices: Furnish devices that have capability of providing successive quantities of individual material that can be measured to within 1 percent of desired amount of that material.
 - 4. Measuring or weighing devices: Subject to review by the Engineer. Shall bear valid seal of the Sealer of Weights and Measures having jurisdiction.
 - 5. Weighing cementitious materials:
 - a. Weigh cementitious materials separately.
 - b. Cement in unbroken standard packages (sacks): Need not be weighed.
 - c. Weigh bulk cementitious materials and fractional packages.
 - 6. Measure mixing water by volume or by weight.
- B. Concrete proportions and consistency:
 - 1. Provide concrete that can be worked readily into corners and angles of forms and around reinforcement without excessive vibration and without permitting materials to segregate or free water to collect on surface.
 - 2. Prevent unnecessary or haphazard changes in consistency of concrete.
 - 3. Ratio of coarse aggregate to fine aggregate: Not less than 1.0 or more than 2.0 for all concrete Classes, with exception of Class CE.
 - 4. Aggregate:
 - a. Obtain aggregate from source that is capable of providing uniform quality, moisture content, and grading during any single day's operation.
 - 5. Maximum concrete mix water to cementitious materials ratio, minimum cementitious materials content, and slump range: Conform to values specified in Table A in this Section.
 - 6. Concrete batch weights: Control and adjust to secure maximum yield. At all times, maintain proportions of concrete mix within specified limits.
 - 7. Mix modification: If required, by the Engineer, modify mixture within limits set forth in this Section.
- C. Concrete mixes:
 - 1. Proportioning of concrete mix: Proportion mixes based on required compressive strength f'_{cr} .
 - 2. Mixes:
 - a. Adjusting of water: After acceptance, do not change mixes without acceptance by Engineer, except that at all times adjust batching of water to compensate for free moisture content of fine aggregate.
 - b. Total water content of each concrete class: Not exceed those specified in Table A in this Section.
 - c. Checking moisture content of fine aggregate: Furnish satisfactory means at batching plant for checking moisture content of fine aggregate.
 - 3. Change in mixes: Submit new mix design and perform new trial batch and test program as specified in this Section.

D. Classes of concrete:

1. Provide concrete consisting of 5 classes: Classes A, B, C, D, and CE. Use where specified or indicated on the Drawings.
2. Weight of concrete classes: Provide classes of concrete having minimum weight of 140 pounds per cubic foot.
3. Class B concrete: Class B concrete may be substituted for Class A concrete, when high-early strength concrete is needed in areas specifically accepted by the Engineer and that do not require sulfate resistant concrete.
4. Class C concrete: Class C concrete may be used for fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and where indicated on the Drawings.
5. Class D concrete: Use Class D for precast concrete items.
6. Class CE concrete: Use Class CE for electrical conduit encasements.
7. All other concrete, unless specified or otherwise indicated on the Drawings: Use Class A concrete.

TABLE A CONCRETE WITH AIR ENTRAINMENT				
Class	Specified Compressive Strength f'_c at 28 Days (Pounds per Square Inch)	Water-to-Cementitious Materials Ratio	Cementitious Materials per Cubic Yard of Concrete by Weight (Pounds)	Slump Range (Inches)
A	4,000	0.40 to 0.45	564 to 658	2 to 4
B (Type III cement)	4,000	0.40 to 0.45	564 to 658	2 to 4
C	2,500	Maximum 0.62	Minimum 423	3 to 6
D	4,500	0.40 to 0.45	564 to 658	2 to 4
CE	2,500	Maximum 0.62	Minimum 423	3 to 6

8. Pumped concrete: Provide pumped concrete that complies with all requirements of this Section.
9. Do not place concrete with slump outside limits indicated in Table A.
10. Classes:
 - a. Classes A, C, D, and CE concrete: Make with Type II low alkali portland cement.
 - b. Class B concrete: Make with Type III low alkali portland cement.
 - c. Admixtures: Provide admixtures as specified in this Section.

E. Air entraining admixture:

1. Add agent to batch in portion of mixing water.
2. Batch solution by means of mechanical batcher capable of accurate measurement.

2.04 SOURCE QUALITY CONTROL

A. Tests:

1. Trial batches:

- a. After concrete mix designs have been accepted by Engineer, have trial batches of the accepted Class A, Class B, and Class D concrete mix designs prepared by testing laboratory acceptable to the Engineer.
- b. Prepare trial batches using cementitious materials and aggregates proposed to be used for the Work.
- c. Prepare trial batches with sufficient quantity to determine slump, workability, consistency, and finishing characteristics, and to provide sufficient test cylinders.
- d. Test cylinders: Provide cylinders having 6-inch diameter by 12-inch length and that are prepared in accordance with ASTM C 31 for tests specified in this Section.
- e. Determine slump in accordance with ASTM C 143.
- f. Test cylinders from trial batch:
 - 1) Test 8 cylinders for compressive strength in accordance with ASTM C 39:
 - a) Test 4 cylinders at 7 days and 4 at 28 days.
 - b) Establish ratio between 7 day and 28 day strength for mix. 7-day strength may be taken as satisfactory indication of 28-day strength provided effects on concrete of temperature and humidity between 7 day and 28 day are taken into account.
 - 2) Average compressive strength of 4 test cylinders tested at 28 days: Equal to or greater than required average compressive strength (f'_{cr}) on which concrete mix design is based.
- g. Drying Shrinkage:
 - 1) Prepare 5 drying shrinkage specimens in accordance with ASTM C 157, except as modified herein.
 - 2) Remove drying shrinkage specimens from molds at age of 23 hours plus or minus 1 hour after trial batching, then immediately place them in water at 73 degrees Fahrenheit plus or minus 3 degrees for at least 30 minutes and then measure specimens within 30 minutes thereafter to determine original length. Then submerge specimens in saturated limewater at 73 degrees Fahrenheit plus or minus 3 degrees for moist curing.
 - 3) Make measurement to determine expansion expressed as percentage of original length at age 7 days. Use length at age 7 days as base length for drying shrinkage calculations.
 - 4) Immediately store specimens in humidity controlled room maintained at 73 degrees Fahrenheit plus or minus 3 degrees and 50 percent plus or minus 4 relative humidity for remainder of test.
 - 5) Make and report measurements to determine shrinkage expressed as percentage of base length separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.
 - 6) Drying Shrinkage Deformation:
 - a) Measure drying shrinkage deformation of each specimen as difference between base length and length after drying at each test age.
 - b) Measure average drying shrinkage deformation of specimens to nearest 0.0001 inch at each test age.

- c) If drying shrinkage of any specimen departs from average of test age by more than 0.0004 inch, disregard results obtained from that specimen and test another specimen.
 - d) Shrinkage of trial batch concrete at 28 days drying age shall not exceed 0.045 percent maximum.
 - h. If trial batch tests do not meet specified requirements for slump, strength, workability, consistency, drying shrinkage, and finishing, change concrete mix design proportions and, if necessary, source of aggregate.
 - 1) Perform additional trial batches and tests until an acceptable trial batch is produced that meets requirements of this Section.
 - i. Perform test batches and tests required to establish trial batches and acceptability of materials without change in Contract Price.
 - j. Do not place concrete until the concrete mix design and trial batch have been accepted by Engineer.
- 2. Required average compressive strength:
 - a. Determine required average compressive strength (f'_{cr}) for selection of concrete proportions for mix design, for each class of concrete, using calculated standard deviation for its corresponding specified compressive strength (f'_c) in accordance with ACI 318 and ACI 350.
 - b. When test records of at least 30 consecutive tests that span period of not less than 45 calendar days are available, establish standard deviation as in accordance with ACI 318 and ACI 350 and as modified in this Section.
 - c. Provide test records from which to calculate standard deviation that represent materials, quality control procedures, and conditions similar to materials, quality control procedures, and conditions expected to apply in preparation of concrete for the Work.
 - d. Provide test records with materials and proportions that are more restricted than those for the Work.
 - e. Specified compressive strength (f'_c) of concrete used in test records: Within 1,000 pounds per square inch of that specified for the Work.
 - f. When lacking adequate test records for calculation of standard deviation meeting requirements, determine required average compressive strength f'_{cr} from following Table B.

TABLE B REQUIRED AVERAGE COMPRESSION STRENGTH	
Specified Compressive Strength f'_c (pounds per square inch)	Required Average Compressive Strength f'_{cr} (pounds per square inch)
Less than 3,000	$f'_c + 1,000$
3,000 to 5,000	$f'_c + 1,200$
Over 5,000	$1.10f'_c + 700$

- 3. Aggregate:
 - a. Testing of concrete aggregate is at Contractor's expense.
 - b. If there is change in aggregate source or if there is a significant change in aggregate quality or sieve analysis from same source, submit new set of design mixes covering each class of concrete and prepare new trial batches before further placing of concrete.
 - c. Sieves: Use sieves with square openings for testing grading of aggregates.
 - d. Sample aggregate in accordance with ASTM C 136 and D 75.

- e. Fine aggregate:
 - 1) Provide fine aggregate that does not contain strong alkali nor organic matter which gives color darker than standard color when tested in accordance with ASTM C 40.
 - 2) Provide aggregate having soundness in accordance with ASTM C 33 when tested in accordance with ASTM C 88.
 - 3) Provide aggregate complying with reactivity requirements in accordance with ASTM C 33 when tested in accordance with ASTM C 289.
- f. Coarse aggregate:
 - 1) Soundness when tested in accordance with ASTM C 88: Have loss not greater than 10 percent when tested with sodium sulfate.
 - 2) Abrasion Loss: Not exceed 45 percent after 500 revolutions when tested in accordance with ASTM C 131.
 - 3) Reactivity: Not exceed limits specified in Appendix of ASTM C 33 when tested in accordance with ASTM C 289.
 - 4) Fly ash:
 - a) Sampling and testing: Sample and test fly ash in accordance with ASTM C 311.
 - 5) Portland cement:
 - a) Determination of alkali content: In accordance with ASTM C 114.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Liquid evaporation retardant:
 - 1. Under conditions that result in rapid evaporation of moisture from the surface of the concrete, immediately after the concrete has been screeded, coat the surface of the concrete with a liquid evaporation retardant.
 - 2. Apply the evaporation retardant again after each work operation as necessary to prevent drying shrinkage cracks.
 - 3. Conditions which result in rapid evaporation of moisture may include one or more of the following:
 - a. Low humidity.
 - b. Windy conditions.
 - c. High temperature.
- B. Surface sealant system:
 - 1. Apply as recommended by manufacturer published instructions.
 - 2. Where concrete continues to sweat or leak, apply additional coats of surface sealant until the sweating or leaks stop.
- C. Joints and bonding:
 - 1. As far as practicable construct concrete work as monolith.
 - 2. Locations of construction, expansion, and other joints are indicated on the Drawings or as specified in this Section.
 - 3. Time between placement of adjacent concrete separated by joints:
 - a. Provide not less than 3 days (72 hours) between placement of adjacent sections for the following:

- 1) Slabs.
- 2) Walls.
- b. Provide not less than 7 days (168 hours) between placement of upper and lower pours for the following:
 - 1) Walls over slabs.
 - 2) Slabs over walls.
 - 3) Slabs keyed into the sides of walls.
4. Construction joints:
 - a. Where construction joints are not indicated on the Drawings, provide construction joints in slabs and walls at intervals not greater than 35 feet.
 - b. In order to preserve strength and watertightness of structures, make no other joints, except as authorized the Engineer.
 - c. At construction joints, thoroughly clean concrete of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter by means of heavy sandblasting.
 - d. Cleaning of construction joints:
 - 1) Wash construction joints free of sawdust, chips, and other debris after forms are built and immediately before concrete or grout placement.
 - 2) Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, use vacuum cleaner for their removal, after which flush cleaned surfaces with water.
 - 3) Provide cleanout hole at base of each wall and column for inspection and cleaning.
 - e. At horizontal joints: As initial placement over cold joints, thoroughly spread bed of cement grout as specified in Section 03600 (with a thickness of not less than 1/2 inch nor more than 1 inch).
5. Take special care to ensure that concrete is well consolidated around and against waterstops and waterstops are secured in proper position.
6. Construction and expansion Joints:
 - a. Constructed where and as indicated on the Drawings.
 - b. Waterstops, expansion joint material, synthetic rubber sealing compound, and other similar materials: As specified in Sections 03150 and 07900.
7. Repair of concrete: Where it is necessary to repair concrete by bonding mortar or new concrete to concrete which has reached its initial set, first coat surface of set concrete with epoxy bonding agent as specified in Section 03071.

D. Conveying and placing concrete:

1. Convey concrete from mixer to place of final deposit by methods that prevent separation or loss of materials.
2. Use equipment for chuting, pumping, and conveying concrete of such size and design as to ensure practically continuous flow of concrete at delivery end without segregation of materials.
3. Design and use chutes and devices for conveying and depositing concrete that direct concrete vertically downward when discharged from chute or conveying device.
4. Keep equipment for conveying concrete thoroughly clean by washing and scraping upon completion of day's placement.

E. Placing concrete:

1. Place no concrete without prior authorization of the Engineer.

2. Do not place concrete until:
 - a. Reinforcement is secure and properly fastened in its correct position and loose form ties at construction joints have been retightened.
 - b. Dowels, bucks, sleeves, hangers, pipes, conduits, anchor bolts, and any other fixtures required to be embedded in concrete have been placed and adequately anchored.
 - c. Forms have been cleaned and oiled as specified.
3. Do not place concrete in which initial set has occurred, or that has been retempered.
4. Do not place concrete during rainstorms or high velocity winds.
5. Protect concrete placed immediately before rain to prevent water from coming in contact with such concrete or winds causing excessive drying.
6. Keep sufficient protective covering on hand at all times for protection of concrete.
7. After acceptance, adhere to proposed sequence of placing concrete, except when specific changes are requested and accepted by the Engineer.
8. Notify the Engineer in writing of readiness, not just intention, to place concrete in any portion of the work:
 - a. Provide this notification in such time in advance of operations, as the Engineer deems necessary to make final inspection of preparations at location of proposed concrete placing.
 - b. Place forms, reinforcement, screeds, anchors, ties, and inserts in place before notification of readiness is given to the Engineer.
 - c. Depositing concrete:
 - 1) Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing.
 - 2) Do not deposit concrete in large quantities in one place and work along forms with vibrator or by other methods.
 - 3) Do not drop concrete freely into place from height greater than 5 feet.
 - 4) Use tremies for placing concrete where drop is over 5 feet.
 - 5) Commence placement of concrete on slopes, starting at bottom of slope.
9. Place concrete in approximately horizontal layers not to exceed 24 inches in depth and bring up evenly in all parts of forms.
10. Continue concrete placement without avoidable interruption, in continuous operation, until end of placement is reached.
11. After concrete placement begins, continue concrete placement without significant interruption. Plan and implement precautions to prevent any delay, between layers being placed, from exceeding 20 minutes.
12. If concrete is to be placed over previously placed concrete and more than 20 minutes has elapsed, spread layer of cement grout not less than 1/2 inch in thickness nor more than 1 inch in thickness over surface before placing additional concrete.
13. Placement of concrete for slabs, beams, or walkways:
 - a. If cast monolithically with walls or columns, do not commence until concrete in walls or columns has been allowed to set and shrink.
 - b. Allow set time of not less than 1 hour for shrinkage.

F. Consolidating concrete:

1. Place concrete with aid of acceptable mechanical vibrators.
2. Thoroughly consolidate concrete around reinforcement, pipes, or other shapes built into the work.

3. Provide sufficiently intense vibration to cause concrete to flow and settle readily into place and to visibly affect concrete over radius of at least 18 inches.
4. Vibrators:
 - a. Keep sufficient vibrators on hand at all times to vibrate concrete as placed.
 - b. In addition to vibrators in actual use while concrete is being placed, have on hand minimum 1 spare vibrator in serviceable condition.
 - c. Do not place concrete until it has been ascertained that all vibrating equipment, including spares, are in serviceable condition.
5. Take special care to place concrete solidly against forms to leave no voids.
6. Take every precaution to make concrete solid, compact, and smooth. If for any reason surfaces or interiors have voids or are in any way defective, repair such concrete in manner acceptable to the Engineer.

G. Footings and slabs on grade:

1. Do not place concrete on ground or compacted fill until subgrade is in moist condition acceptable to the Engineer.
2. If necessary, sprinkle subgrade with water not less than 6 or more than 20 hours in advance of placing concrete.
3. If subgrade becomes dry prior to concrete placement, sprinkle again, without forming pools of water.
4. Do not place concrete if subgrade is muddy or soft.

H. Loading concrete:

1. Green concrete:
 - a. No heavy loading of green concrete will be permitted.
2. No backfill shall be placed against concrete walls, connecting slabs, or beams until the concrete has reached the specified strength.
3. Use construction methods, sequencing, and allow time for concrete to reach adequate strength to prevent overstress of the concrete structure during construction.

I. Curing concrete:

1. General:
 - a. Cure concrete by methods specified in this Section.
 - b. Keep concrete continuously moist and at a temperature of at least 50 degrees Fahrenheit for minimum of 7 days after placement.
 - c. Cure concrete to be painted with water or sheet membrane.
 - d. Do not use sprayed membrane curing or sealing compounds on concrete surfaces that are to receive paint or upon which any material is to be bonded.
 - e. Water cure or sheet membrane cure concrete slabs that are specified to be sealed by concrete sealer.
 - f. Cure other concrete by water curing or sprayed membrane curing compound at the Contractor's option.
 - g. Floor slabs may be cured using sheet membrane curing.
2. Water curing:
 - a. Keep surfaces of concrete being water cured constantly and visibly moist day and night for period of not less than 7 days.
 - b. Each day forms remain in place count as 1 day of water curing.

- c. No further curing credit will be allowed for forms in place after contact has once been broken between concrete surface and forms.
 - d. Do not loosen form ties during period when concrete is being cured by leaving forms in place.
 - e. Flood top of walls with water at least 3 times per day, and keep concrete surfaces moist at all times during 7 day curing period.
3. Sprayed membrane curing compound:
- a. Apply curing compound to concrete surface after repairing and patching, and within 1 hour after forms are removed.
 - b. If more than 1 hour elapses after removal of forms, do not use curing compound, but use water curing for full curing period.
 - c. If surface requires repairing or painting, water cure such concrete surfaces.
 - d. Do not remove curing compound from concrete in less than 7 days.
 - e. Curing compound may be removed only upon written request by Contractor and acceptance by Engineer, stating what measures are to be performed to adequately cure concrete.
 - f. Take care to apply curing compound to construction joints. Apply to all surfaces along full profile of joints.
 - g. After curing period is complete, remove curing compound placed within construction joint profile by heavy sandblasting prior to placing any new concrete.
 - h. Contractor's Option: Instead of using curing compound for curing of construction joints, such joints may be water cured.
 - i. Apply curing compound by mechanical, power operated sprayer and mechanical agitator that will uniformly mix all pigment and compound.
 - j. Apply curing compound in at least 2 coats.
 - k. Apply each coat in direction 90 degrees to preceding coat.
 - l. Apply curing compound in sufficient quantity so that concrete has uniform appearance and that natural color is effectively and completely concealed at time of spraying.
 - m. Continue to coat and recoat surfaces until specified coverage is achieved and until coating film remains on concrete surfaces.
 - n. Thickness and coverage of curing compound: Provide curing compound having film thickness that can be scraped from surfaces at any and all points after drying for at least 24 hours.
 - o. The Contractor is cautioned that method of applying curing compound specified in this Section may require more curing compound than normally suggested by manufacturer of curing compound and also more than is customary in the trade.
 - p. Apply amounts specified in this Section, regardless of manufacturer's recommendations or customary practice.
 - q. If the Contractor desires to use curing compound other than specified curing compound, coat sample areas of concrete wall with proposed curing compound and also similar adjacent area with specified compound in specified manner for comparison:
 - 1) If proposed sample is not equal or better, in opinion of the Engineer, in all features, proposed substitution will not be allowed.
 - r. Prior to final acceptance of the work, remove, by sandblasting or other acceptable method, any curing compound on surfaces exposed to view, so that only natural color of finished concrete is visible uniformly over entire surface.

4. Sheet membrane curing:
 - a. Install sheet membrane as soon as concrete is finished and can be walked on without damage.
 - b. Seal joints and edges with small sand berm.
 - c. Keep concrete moist under sheet membrane.

J. Cold weather concreting:

1. Preparation before concreting:
 - a. Remove snow, ice, and frost from the surfaces, including reinforcement against which the concrete is to be placed.
 - b. The subgrade shall be free of frost before concrete placing begins.
 - c. Do not place concrete around any embedment that is at a temperature below freezing and is sufficiently massive as to cause the adjacent concrete to freeze.
2. Placement of concrete:
 - a. Placement temperature:
 - 1) The minimum temperature of concrete immediately after placement shall be as specified in Table C.
 - 2) The temperature of concrete as placed shall not exceed the values shown in Table C by more than 20 degrees Fahrenheit.
 - b. Protection temperature:
 - 1) Unless otherwise specified, the minimum temperature of concrete during the protection period shall be as shown Table C.
 - 2) Temperatures specified to be maintained during the protection period shall be those measured at the concrete surface, whether the surface is in contact with formwork, insulation, or air.
 - 3) Measure the temperature with a surface measuring device accurate to 2 degrees Fahrenheit.
 - 4) Measure the temperature of concrete in each placement at regular time intervals as specified in the contract documents.
 - c. Termination of protection:
 - 1) The maximum decrease in temperature measured at the surface of the concrete in a 24-hour period shall not exceed the values listed in Table C.
 - 2) Do not exceed these limits until the surface temperature of the concrete is within 20 degrees Fahrenheit of the ambient temperature of surrounding temperatures.
 - 3) When the surface temperature of the concrete is within 20 degrees Fahrenheit of the ambient temperature, all protection may be removed.

<p style="text-align: center;">Table C CONCRETE TEMPERATURE REQUIREMENTS</p>		
Least dimension of section (inches)	Minimum temperature of concrete as placed and maintained during the protection period (degrees Fahrenheit)	Maximum for gradual decrease in surface temperature during any 24 hour period after end of protection period (degrees Fahrenheit)
Less than 12	55	50
12 to less than 36	50	40
36 to 72	45	30
Greater than 72	40	20

3. Curing of concrete:
 - a. Prevent concrete from drying during the required curing period. If water curing is used, terminate use at least 24 hours before any anticipated exposure of the concrete to freezing temperatures.
4. Protection of concrete:
 - a. Combustion heaters: Vent flue gases from combustion heating units to the outside of the enclosures.
 - b. Overheating and drying: Place and direct heaters and ducts to avoid areas of overheating or drying of the concrete surface.
 - c. Maximum air temperature: During the protection period, do not expose the concrete surface to air having a temperature more than 20 degrees Fahrenheit above the values shown in Table C unless higher values are required by an accepted curing method.
 - d. Protection against freezing:
 - 1) Cure and protect concrete against damage from freezing for a minimum of 3 days, unless otherwise specified.
 - a) Maintain the surface temperature of the concrete as specified in Table C.
 - 2) During periods not defined as cold weather, but when freezing temperatures may occur, protect concrete surfaces against freezing for the first 24 hours after placing.

3.02 CONCRETE FINISHING

- A. Provide concrete finishes as specified in Section 03366.
- B. Edges of joints:
 1. Provide joints having edges as indicated on the Drawings.
 2. Protect wall and slab surfaces at edges against concrete spatter and thoroughly clean upon completion of each placement.
- C. Concrete sealer:
 1. Floors and slabs to receive concrete sealer: As specified in the Contract Documents on finish schedule.
 2. Apply concrete sealer:
 - a. Apply concrete sealer at coverage rate not to exceed 300 square feet per gallon.
 - b. Apply as soon as slab or floor will bear weight.

- c. Sealer:
 - 1) Before applying concrete sealer, sweep entire surface clean with very soft bristled brush that will not mark concrete finish and remove any standing water.
 - 2) Apply concrete sealer with sprayer.
 - 3) Use of paint rollers or mop is not acceptable.
 - 4) Workmen shall wear flat soled shoes which will not mark or scar concrete surface.
 - 5) Do not allow traffic on floors and slabs until concrete sealer has dried and hardened.

3.03 FIELD QUALITY CONTROL

- A. Testing of concrete:
 - 1. During progress of construction, the Owner will have tests made to determine whether the concrete, as being produced, complies with requirements specified.
 - 2. Tests will be performed in accordance with ASTM C 31, ASTM C 39, and ASTM C 172.
 - 3. The Contractor will coordinate with the Testing Lab and will make and deliver test cylinders to the laboratory. All testing expenses will be borne by the Contractor.
 - 4. Furnish test equipment.
 - 5. Make provisions for and furnish concrete for test specimens, and provide manual assistance to the Engineer in preparing said specimens.
 - 6. Assume responsibility for care of and providing of curing conditions for test specimens in accordance with ASTM C 31.
 - 7. Sampling frequency:
 - a. 1 set of test cylinders for each 150 cubic yards of each class of concrete.
 - b. Minimum of 1 set of test cylinders for each class of concrete placed.
 - c. Not less than 1 set of test cylinders for each half-day's placement.
 - d. At least 2 sets of test cylinders for each structure.
- B. Compressive strength tests:
 - 1. Set of 3 cylinder specimens, 6-inch diameter by 12 inch long.
 - 2. Information: Test 1 cylinder at 7 days.
 - 3. Acceptance: Test 2 cylinders at 28 days.
- C. Slump tests:
 - 1. Test slump of concrete using slump cone in accordance with ASTM C 143.
 - 2. Do not use concrete that does not meet specification requirements in regards to slump:
 - a. Remove such concrete from project site.
 - b. Test slump at the beginning of each placement, as often as necessary to keep slump within the specified range, and when requested to do so by the Engineer.
- D. Air entrainment tests:
 - 1. Test percent of entrained air in concrete at beginning of each placement, as often as necessary to keep entrained air within specified range, and when requested to do so by the Engineer.

2. Do not use concrete that does not meet Specification requirements for air entrainment.
 - a. Remove such concrete from project site.
 3. Test air entrainment in concrete in accordance with ASTM C 173.
 4. The Engineer may at any time test percent of entrained air in concrete received on project site.
- E. Enforcement of strength requirement:
1. Concrete is expected to reach a compressive strength (f'_c) than that specified in Table A.
 2. Strength level of concrete will be considered acceptable if following conditions are satisfied:
 - a. Averages of all sets of 3 consecutive strength test results is greater or equal to specified compressive strength(f'_c).
 - b. No individual strength test (average of 2 cylinders) falls below specified compressive strength (f'_c) by more than 500 pounds per square inch.
 3. Non-compliant strength tests:
 - a. Mark non-compliant strength test reports to highlight that they contain non-complying results and immediately forward copies of test reports to all parties on the test report distribution list.
 - b. Provide treatment of non-compliant concrete at no additional cost to Owner and with no additional time added to project schedule:
 - c. Initial treatment may consist of additional curing and testing of the affected concrete.
 - 1) Provide additional curing of concrete using means and duration acceptable to the Engineer.
 - 2) Upon completion of the additional curing, provide additional testing designated by the Engineer.
 - a) Obtain and test core samples for compression strength in accordance with ASTM C 42, ACI 318, and ACI 350.
 - b) Provide not less than 3 cores for each affected area. Obtain Engineer's acceptance of proposed coring locations before proceeding with that work.
 - c) Submit report of compression strength testing for Engineer's review.
 - d) If required by the Engineer, provide additional cores and obtain petrographic examination in accordance with ASTM C 856. Submit report of petrographic analysis for Engineer's review.
 - 3) If additional curing does not bring average of 3 cores taken in affected area to at least the minimum specified compressive strength (f'_c), designate such concrete in affected area as defective.

3.04 ADJUSTING

- A. Provide repair of defective concrete at no additional cost to Owner and with no additional time added to the project schedule:
- B. Make repairs using approach and means acceptable to the Engineer.
1. Provide repairs having strength equal to or greater than specified concrete for areas involved.
 2. Do not patch, repair, or cover defective work without inspection by the Engineer.

3. Acceptable means may include, but are not limited to strengthening, repair, or removal and replacement.
- C. Strengthening of defective concrete.
1. By addition of concrete.
 2. By addition of reinforcing.
 3. By addition of both concrete and reinforcing.
- D. Repairs.
1. Methods of repair:
 - a. Dry pack method:
 - 1) Use for holes having depth nearly equal to or greater than least surface dimension of hole, for cone-bolt holes, and for narrow slots cut for repair.
 - 2) Smooth holes: Clean and roughen by heavy sandblasting before repair.
 - b. Mortar replacement method:
 - 1) Use for holes too wide to dry pack and too shallow for concrete replacement.
 - 2) Comparatively shallow depressions, large or small, which extend no deeper than nearest surface reinforcement.
 - c. Concrete replacement method:
 - 1) Use when holes extend entirely through concrete section or when holes are more than 1 square foot in area and extend halfway or more through the section.
 2. Preparation of concrete for repair:
 - a. Chip out and key imperfections in the work and make them ready for repair.
 - b. Obtain Engineer's acceptance of surface preparation methods and of prepared surfaces prior to repair.
 - c. Surfaces of set concrete to be repaired: First coat with epoxy bonding agent as specified in Section 03071.
- E. Removal and replacement of defective concrete.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03366

TOOLED CONCRETE FINISHING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Tooled concrete finishes. Coordinate with all other finishing requirements shown on the Drawings.

1.02 QUALITY ASSURANCE

- A. Mock-ups:
 - 1. Test panels for concrete finishes:
 - a. Prepare test panels for F4 and F5 finishes and tie-hole repairs for review by Engineer and Owner's Representative (Plant Superintendent).
 - b. Accepted test panels serve as standard of quality and workmanship for project.
 - 2. Prepare test panel showing horizontal and vertical joints proposed for project for review by the Engineer. Refer to finishes specified in this Section.
 - 3. Test panels indicating methods for making concrete repairs: Prepare test panels for proposed repairs at beginning of project for review by Engineer:
 - a. Accepted test panels serve as standard for repairs during the project.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
 - 1. Deliver and store packaged materials in original containers until ready for use.

PART 2 PRODUCTS

2.01 MIXES

- A. Mortar mix for F4 finish: Consist of 1 part cement and 1-1/2 parts of fine sand passing Number 100 screen. Mix with enough water and emulsified bonding agent to have consistency of thick cream.
- B. Mortar mix for F5 finish: Consist of 1 part cement to 1-1/2 parts of sand which passes Number 16 screen.

PART 3 EXECUTION

3.01 CONCRETE FINISHES

- A. Cement for finishes:
 - 1. Addition of white cement may be required to produce finish which matches color of concrete to be finished.

- B. Finish vertical concrete surfaces with one of the following finishes as indicated in the Finish Schedule:
1. F1 finish: No special treatment other than repair defective work and fill depressions 1 inch or deeper and tie holes with mortar after removal of curing compound.
 2. F2 finish: No special treatment other than repair defective work, remove fins, fill depressions 1/2 inch or deeper and tie holes with mortar after removal of curing compound.
 3. F3 finish: Repair defective work, remove fins, offsets, and grind projections smooth. Fill depressions 1/4 inch or larger in depth or width and tie holes with mortar after removal of curing compound.
 4. F4 finish: Receive same finish as specified for F3 finish, and, in addition fill depressions and holes 1/16 inch or larger in width with mortar.
 - a. "Brush-Off" sandblast surfaces prior to filling holes to expose all holes near surface of the concrete.
 - b. Thoroughly wet surfaces and commence filling of pits, holes, and depressions while surfaces are still damp.
 - c. Perform filling by rubbing mortar over entire area with clean burlap, sponge rubber floats, or trowels.
 - d. Do not let any material remain on surfaces, except that within pits and depressions.
 - e. Wipe surfaces clean and moist cure.
 5. F5 finish: Receive same finish as specified for F3 finish, and, in addition, receive special stoned finish, in accordance with following requirements:
 - a. Remove forms and perform required repairs, patching, and pointing as specified in this Section.
 - b. Wet surfaces thoroughly with brush and rub with hard wood float dipped in water containing 2 pounds of portland cement per gallon.
 - c. Rub surfaces until form marks and projections have been removed.
 - d. Spread grindings from rubbing operations uniformly over surface with brush in such manner as to fill pits and small voids.
 - e. Moist cure brushed surfaces and allow to harden for 3 days:
 - 1) After curing, obtain final finish by rubbing with carborundum stone of approximately Number 50 grit until entire surfaces have smooth texture and are uniform in color.
 - 2) Continue curing for remainder of specified time.
 - f. If any concrete surface is allowed to become too hard to finish in above specified manner, sandblast and wash related surfaces exposed to view, whether finished or not.
 - 1) While still damp, rub over surface, plastic mortar, as specified for brushed surfaces and handstoned with Number 60 grit carborundum stone, using additional mortar for brushed surfaces until surface is evenly filled without an excess of mortar.
 - 2) Continue stoning until surface is hard.
 - 3) After moist curing for 3 days, make surface smooth in texture and uniform in color by use of Number 50 or Number 60 grit carborundum stone.
 - 4) After stoning, continue curing until 7 day curing period is completed.
- C. Finish horizontal concrete surfaces with one of the following finishes as indicated in the Finish Schedule after proper and adequate vibration and tamping:
1. S1 finish: Screeded to grade and leave without special finish.

2. S2 finish: Smooth steel trowel finish.
 3. S3 finish: Steel trowel finish free from trowel marks. Provide smooth finish free of all irregularities.
 4. S4 finish: Steel trowel finish, without local depressions or high points, followed by light hairbroom finish. Do not use stiff bristle brooms or brushes. Perform brooming parallel to slab-drainage. Provide resulting finish that is rough enough to provide nonskid finish. Finish is subject to review and acceptance by the Engineer.
 5. S5 finish: Nonslip abrasive: After concrete has been screeded level and hardened enough to support man standing on a board, sprinkle abrasive from shake screen into surface at uniform rate of 25 pounds for each 100 square feet of surface area, wood float into finish, then trowel abrasive into surface with steel trowel properly exposing abrasive in surface as required to provide nonslip surface.
 6. S6 finish: Roughened finish: After concrete has been screeded to grade, apply a roughened finish by use of a jitterbug roller or similar device.
- D. Finish concrete floor surfaces to which surfacing material is applied: Finish smooth with tolerance within 1/8 inch in 10 feet in any direction from lines indicated on the Drawings.

3.02 CONCRETE FINISH SCHEDULE

- A. Finish concrete surfaces as follows:
1. F4 finish for following vertical surfaces:
 - a. Concrete surfaces specified or indicated to be painted.
 - b. Concrete surfaces, interior or exterior, exposed to view.
 2. Surfaces in open channels, basins, and similar structures:
 - a. F3 finish for vertical surfaces which are normally below water surface.
 - b. F4 finish for vertical surfaces located above normal water surface and exposed to view.
 - c. Remove fins and fill tie holes from concrete surfaces located in closed boxes or channels where there is normally no access or passageway.
 3. S1 finish for following surfaces:
 - a. Projecting footings which are to be covered with dirt.
 - b. Slab surfaces which are to be covered with concrete fill.
 4. S2 finish for following surfaces:
 - a. Tops of corbels.
 - b. Tops of walls and beams not covered above in this Section.
 - c. Tops of slabs not covered above in this Section.
 - d. All other surfaces not specified to be finished otherwise.
 5. S3 finish for following surfaces:
 - a. Building and machine room floors which are not covered with surfacing material: Provide floors that are free from trowel marks.
 6. S4 finish for following surfaces:
 - a. Exterior walkways.
 - b. Tops of exterior walls or beams which are to serve as walkways.
 - c. Tops of exterior walls or beams which are to support gratings.
 - d. Top surface of slabs for basins, channels, digesters, and similar structures.

7. S6 finish for following surfaces:
 - a. Basin bottoms, or other similar slab surfaces, over which layer of basin bottom grout will be applied.

END OF SECTION

SECTION 03600

GROUTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Cement grout.
 - 2. Cement mortar.
 - 3. Dry-pack mortar.
 - 4. Epoxy grout.
 - 5. Grout.
 - 6. Non-shrink epoxy grout.
 - 7. Non-shrink grout.
- 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 03071 - Epoxies.
 - b. Section 03300 - Cast-In-Place Concrete.
 - c. Section 15050 - Basic Mechanical Materials and Methods.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch or 50-millimeter cube specimens).
 - 2. C 230 - Standard Specification for Flow Table for Use In Tests of Hydraulic Cement.
 - 3. C 531 - Standard Test Method for Liner Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 4. C 579 - Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing and Polymer Concretes.
 - 5. C 939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
 - 6. C 942 - Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.
 - 7. C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
 - 8. C 1181 - Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.

1.03 SUBMITTALS

- A. Cement grout:
 - 1. Mix design.
 - 2. Material submittals.
- B. Cement mortar:
 - 1. Mix design.
 - 2. Material submittals.
- C. Non-shrink grout: Submit manufacturer's literature.
- D. Non-shrink epoxy grout: Submit manufacturer's literature.
- E. Concrete grout: The submittal shall include data as required for concrete as delineated in Section 03300 and for fiber reinforcement as delineated herein. This includes the mix design, constituent quantities per cubic yard and the water/cement ratio.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the jobsite in their original, unopened packages or containers, clearly labeled with the manufacturer's product identification and printed instructions.
- B. Store materials in a cool dry place and in accordance with the manufacturer's recommendations.
- C. Handle materials in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Non-shrink epoxy grout:
 - 1. Manufacturers: One of the following or equal:
 - a. Five Star Products, Inc., Fairfield, CT, Five Star Epoxy Grout.
 - b. BASF Construction Chemicals, Shakopee, MN, Masterflow 648 CP Plus.
 - c. L&M Construction Chemicals, Inc., EPOGROUT.
 - 2. Non-shrink epoxy grout shall be a 100 percent solid, premeasured, prepackaged system containing a 2-component thermosetting epoxy resin and inert aggregate.
 - 3. Maintain a flowable consistency for at least 45 minutes at 70 degrees Fahrenheit.
 - 4. Shrinkage or expansion (less than 0.0006 inches/inch) when tested in accordance with ASTM C 531.
 - 5. Minimum compressive strength: 10,000 pounds per square inch at 24 hours and 14,000 pounds per square inch at 7 days when tested in accordance with ASTM C 579, Method B.
 - 6. Compressive creep: Not exceed 0.0027 inches/inch when tested under a 400 pounds per square inch constant load at 140 degrees Fahrenheit in accordance with ASTM C 1181.

7. Coefficient of thermal expansion: Not exceed 0.000018 inches per inch per degree Fahrenheit when tested in accordance with ASTM C 531, Method B.

B. Non-shrink grout:

1. Manufacturers: One of the following or equal:
 - a. Five Star Products, Inc., Fairfield, CT, Five Star Grout.
 - b. BASF Construction Chemicals, Shakopee, MN, Masterflow 928.
 - c. L&M Construction Chemicals, Inc., Omaha, NE, CRYSTEX.
2. In accordance with ASTM C 1107.
3. Proportioned and prepackaged cement-based mixture:
 - a. It shall contain no metallic particles such as aluminum powder and no metallic aggregate such as iron filings.
 - b. It shall require only the addition of potable water.
4. Water for pre-soaking, mixing, and curing: Potable water.
5. Free from the emergence of mixing water from within or the presence of water on its surface.
6. Remain at a minimum flowable consistency for at least 45 minutes after mixing at 45 degrees Fahrenheit to 90 degrees Fahrenheit when tested in accordance with ASTM C 230.
 - a. If at a fluid consistency, it shall be verified in accordance with ASTM C 939.
7. Dimensional stability (height change):
 - a. In accordance with ASTM C 1107, volume-adjusting Grade B or C at 45 degrees Fahrenheit to 90 degrees Fahrenheit.
 - b. Have 90 percent or greater bearing area under bases.
8. Have minimum compressive strengths at 45 degrees Fahrenheit to 90 degrees Fahrenheit in accordance with ASTM C 1107 for various periods from the time of placement, including 5,000 pounds per square inch at 28 days when tested in accordance with ASTM C 109 as modified by ASTM C 1107.

2.02 MIXES

A. Cement grout:

1. Consist of concrete mix with coarse aggregate removed and water quantity adjusted as required.
2. Use the same materials for cement grout that are used for concrete.
3. Use water-to-cementitious materials ratio that is no more than that specified for concrete being repaired.
4. For spreading over the surfaces of construction or cold joints. Mix with no more water used than allowed by water-to-cementitious materials ratio specified for concrete.

B. Cement mortar:

1. Consist of concrete mix with coarse aggregate removed and water quantity adjusted as required.
2. Use the same materials for cement mortar that are used for concrete.
3. Use water-to-cementitious materials ratio that is no more than that specified for concrete being repaired.
4. At exposed concrete surfaces not to be painted or submerged in water: Use sufficient white cement to make color of finished patch match that of surrounding concrete.

- C. Dry-pack mortar:
 - 1. Mix in proportions by weight of 1 part portland cement to 2 parts of concrete sand.
 - a. Portland cement: As specified in Section 03300.
 - b. Concrete sand: As specified in Section 03300.
 - 2. Use only enough water so that resulting mortar will crumble to touch after being formed into ball by hand.
- D. Epoxy grout:
 - 1. Consist of mixture of epoxy or epoxy gel and concrete sand.
 - a. Epoxy: As specified in Section 03071.
 - b. Epoxy gel: As specified in Section 03071.
 - c. Sand: Clean, bagged, graded, and kiln dried silica sand.
 - 2. Proportioning:
 - a. For horizontal work: Consist of mixture of 1 part epoxy with not more than 2 parts sand.
 - b. For vertical or overhead work: Consist of 1 part concrete epoxy gel with not more than 2 parts sand.
- E. Grout:
 - 1. Mix in proportions by weight of 1 part portland cement to 4 parts of concrete sand.
 - a. Portland cement: As specified in Section 03300.
 - b. Concrete sand: As specified in Section 03300.
- F. Non-shrink epoxy grout: Mix in accordance with manufacturer's installation instructions.
- G. Non-shrink grout: Mix in accordance with manufacturer's installation instructions such that resulting mix has flowable consistency and is suitable for placing by pouring.
- H. Concrete grout shall conform to the requirements of Section 03300 except as specified herein. It shall be proportioned with cement, coarse and fine aggregates, water, water reducer and air entraining agent to produce a mix having an average strength of 2900 psi at 28 days, or 2500 psi nominal strength. Coarse aggregate size shall be 1/2 in maximum. Slump should not exceed 5 in and should be as low as practical yet still retain sufficient workability.
- I. Synthetic reinforcing fibers shall be added to the concrete grout mix at the rate of 1.5 lbs of fibers per cubic yard of grout. Fibers shall be added from the manufacturer's premeasured bags and according to the manufacturer's recommendations in a manner which will ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.
 - 1. Synthetic reinforcing fiber for concrete shall be 100 percent polypropylene collated, fibrillated fibers as manufactured by Propex Concrete Systems Chattanooga, TN Propex or equal. Fiber length and quantity for the concrete mix shall be in strict compliance with the manufacturer's recommendations as approved by the Engineer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect concrete surfaces to receive grout or mortar and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints, impregnations, and all loose material or foreign matter likely to reduce the bond or performance of grout or mortar.

3.02 PREPARATION

- A. Surface preparation:
 - 1. Remove grease, oil, dirt, curing compounds, laitance, and other deleterious materials that may affect bond from concrete and bottoms of baseplates.
 - 2. Roughen concrete surfaces by heavy sandblasting, waterblasting, chipping, or other mechanical means.
 - a. Remove loose or broken concrete.
 - 3. Metal surfaces: Sandblast to a 2 to 3 mil peak-to-valley profile.

3.03 PLACEMENT

- A. General:
 - 1. Use mortar mixer with moving paddles for mixing grouts. For cement grouts, pre-wet the mixer and empty out excess water before beginning mixing.
- B. Cement grout:
 - 1. Exercise particular care in placing cement grout since it is required to furnish structural strength, impermeable water seal, or both.
 - 2. Do not use cement grout that has not been placed within 30 minutes after mixing.
- C. Epoxy grouts:
 - 1. Use where indicated on the Drawings.
 - 2. Wet surfaces with epoxy for horizontal work or epoxy gel for vertical or overhead work prior to placing epoxy grout.
- D. Non-shrink grout:
 - 1. Add non-shrink cement grout to a premeasured amount of water that does not exceed the manufacturer's maximum recommended water content.
 - 2. Mix in accordance with manufacturer's instructions to uniform consistency.
 - 3. May be drypacked, flowed, or pumped into place. Do not overwork grouts.
 - 4. Do not retemper grout by adding more water after stiffening.
- E. Non-shrink epoxy grout:
 - 1. Mix in complete units. Do not vary the ratio of components or add solvent to change the consistency of the mix.
 - 2. Pour the hardener into the resin and mix for at least 1 minute and until mixture is uniform in color. Pour the epoxy into a mortar mixer wheelbarrow and add the aggregate. Mix until aggregate is uniformly wetted. Over mixing will cause air entrapment in the mix.
 - 3. Keep temperature of non-shrink epoxy grout from exceeding manufacturer's recommendations.

- F. Curing:
 - 1. Cement based grouts:
 - a. Non-shrink grout: Cure in accordance with manufacturer's recommendations. Keep grout wet for a minimum of 7 days. Use wet burlap, a soaker hose, sun shading, ponding, and in extreme conditions, a combination of methods.
 - b. Maintain grout above 40 degrees Fahrenheit until it has attained a compressive strength of 3,000 pounds per square inch, or above 70 degrees Fahrenheit for a minimum of 24 hours to avoid damage from subsequent freezing.
 - 2. Concrete Grout:
 - a. All concrete grout shall be water cured per specification 03300.
- G. Epoxy based grouts:
 - 1. Cure grouts in accordance with manufacturers' recommendations.
 - a. Do not wet cure epoxy grouts.
 - 2. Do not allow any surface in contact with epoxy grout to fall below 50 degrees Fahrenheit for a minimum of 48 hours after placement.
- H. Grouting equipment bases and baseplates: As specified in Section 15050.
- I. Grouting other baseplates:
 - 1. General:
 - a. All baseplate grouting shall take place from one side of a baseplate to the other in a continuous flow to avoid trapping air.
 - b. Hydrostatic head pressure shall be maintained by keeping the level of the grout in the headbox above the bottom of the baseplate. The headbox should be filled to the maximum level and the grout worked down.
 - 2. Forms and headboxes:
 - a. Build forms for grouts of material with adequate strength to withstand the placement of grouts.
 - b. Forms shall be rigid and liquidtight. Caulk cracks and joints with an elastomeric sealant. Line forms with polyethylene for easy grout release. Forms carefully wax with 2 coats of heavy-duty paste wax will also be acceptable.
 - c. Forms shall be 4 to 6 inches higher than the baseplate on one side of the baseplate configuration when using head pressure for placement.
 - 3. Non-shrink epoxy grout:
 - a. Cut back epoxy grout after setting. Install epoxy grout with chamfer edges built into the formwork.

3.04 FIELD QUALITY CONTROL

- A. Non-shrink grout: Test for 24-hour compressive strength in accordance with ASTM C 942.
- B. Non-shrink epoxy grout: Test for 24-hour compressive strength in accordance with ASTM C 579, Method B.

END OF SECTION

SECTION 03931

EPOXY INJECTION SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Epoxy injection system.

1.02 REFERENCES

- A. ASTM International (ASTM):
1. D 638 - Standard Test Method for Tensile Properties of Plastics.
 2. D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
 3. D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.03 SUBMITTALS

- A. Product data:
1. Submit manufacturer's data completely describing epoxy injection system materials.
- B. Quality control submittals:
1. Certificates of Compliance.
 2. Manufacturer's Instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manufacturers: One of the following or equal:
1. BASF, Concessive Standard LVI.
 2. Sika Chemical Corp., Sikadur 35 Hi-Mod LV.
- B. Epoxy:
1. Use epoxy materials that are new and use them within shelf-life limitations set forth by manufacturer.
 2. Water-insensitive 2-part type low viscosity epoxy adhesive material containing 100 percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified:

Physical Characteristic	Test Method	Required Results
Tensile Strength	ASTM D 638	8,000 pounds per square inch at 14 days.
Flexure Strength	ASTM D 790	11,000 pounds per square inch at 14 days.
Compressive Strength	ASTM D 695	11,000 pounds per square inch at 24 hours.
Bond Strength	--	Concrete shall fail before failure of epoxy.
Gel Time for 5 Mil Film	--	4 hours maximum.
Elongation	ASTM D 638	1 percent minimum at 14 days.

2.02 EQUIPMENT

- A. Injection pump:
 - 1. Use positive displacement injection pump with interlock to provide in-line mixing and metering system for 2 component epoxy.
 - 2. Use pressure hoses and injection nozzle designed to properly mix of 2 components of epoxy.
 - 3. Standby injection unit may be required.

PART 3 EXECUTION

3.01 PREPARATION

- A. Surface preparation:
 - 1. Sweep or clean area in vicinity of cracks that will be injected with epoxy. Leave area in generally clean condition after epoxy injection is complete.
 - 2. Clean cracks so they are free from dirt, laitance, and other loose matter.

3.02 INSTALLATION

- A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.
- B. Mix epoxy in accordance with manufacturer's installation instructions.
- C. Do not use solvents to thin epoxy.
- D. Crack injection:
 - 1. Apply adequate surface seal to crack to prevent leakage of epoxy.
 - 2. Establish injection points at distance along crack not less than thickness of cracked member.
 - 3. Crack injection sequence:
 - a. Inject epoxy into crack at first port with sufficient pressure to advance epoxy to adjacent port.
 - b. Seal original port and shift injection to port where epoxy appears.
 - c. Continue port-to-port injection until crack has been injected for its entire length.
 - d. For small amounts of epoxy, or where excessive pressure developed by injection pump might further damage structure, premixed epoxy and use hand caulking gun to inject epoxy if acceptable to the Engineer.
 - e. Seal ports, including adjacent locations where epoxy seepage occurs, as necessary to prevent drips or run out.
 - f. After epoxy injection is complete, remove surface seal material and refinish concrete in area where epoxy was injected to match existing concrete.

END OF SECTION

SECTION 04220

CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Concrete masonry units and 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 01312 - Project Meetings.
 - b. Section 01410 - Regulatory Requirements.
 - c. Section 07900 - Joint Sealants.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 530.1 - Specification for Masonry Structures.
- B. ASTM International (ASTM):
 - 1. C 90 - Standard Specification for Loadbearing Concrete Masonry Units.
 - 2. C 140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - 3. C 426 - Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

1.03 DEFINITIONS

- A. Mortar Smears: Mortar paste smeared across the permanent masonry construction during construction and absorbed into the masonry pores.
- B. Mortar Splash: Mortar dropped splashed onto the permanent masonry construction at the base of the wall or off the scaffolding.
- C. Mortar Tag: Excess mortar between masonry units worked out of the joints during tooling or striking.
- D. Mortar Stains: Mortar paste left after mortar tags are removed.

1.04 SUBMITTALS

- A. Product data:
 - 1. Submit manufacturer's product data for standard block.
 - 2. Submit manufacturers' product data for proposed cleaning agent.
- B. Shop drawings: Include elevations of each wall indicating type and layout of units, including type of mortar joints, bond pattern, reinforcing steel, connecting dowels, joint reinforcement, grouted cells, and control joints.
- C. Samples:
 - 1. Contractor shall submit a sample of masonry matching the existing structures at the site for approval by the Owner.
- D. Test reports:
 - 1. Compressive strength.
 - 2. Linear shrinkage.
 - 3. Moisture content as a percentage of total absorption.
 - 4. Total absorption.
 - 5. Unit weight.
- E. Manufacturer's instructions:
 - 1. Submit printed or written recommendations from the masonry unit manufacturer of the cleaning procedures and cleaning agents appropriate for each type of masonry unit included in the work.
- F. Quality assurance submittals:
 - 1. If requested by the Engineer, submit a record of the Installer's evidence of qualifications.
 - 2. If requested by the Engineer, submit a record of the Masonry Cleaner's evidence of qualifications.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer qualifications:
 - a. The mason shall hold an appropriate contractor's license in the State where the work will be constructed.
 - b. The mason shall have not less than 5 years' experience and completed a minimum of 20 projects and at least 5 of which included the type of masonry units specified for this Work.
 - 2. Masonry cleaner qualifications:
 - a. The masonry cleaner shall have not less than 5 years' experience and completed a minimum of 20 projects.
- B. Pre-installation conference: Conduct as specified in Section 01312.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Transport and handle concrete masonry units as required to prevent discoloration, chipping, and breakage.

- B. Store masonry units off the ground in a dry location, covered and protected from absorbing moisture.
 - 1. Locate storage piles, stacks, and bins to protect materials from heavy traffic.
 - 2. If masonry units are delivered in shrink-wrapped packaging and condensation develops, remove shrink-wrap packaging.
- C. Remove chipped, cracked, and otherwise defective units from jobsite upon discovery.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Cold weather requirements:
 - 1. In accordance with building code as specified in Section 01410, provide adequate equipment for heating masonry materials when air temperature is below 40 degrees Fahrenheit.
- B. Hot weather requirements:
 - 1. In accordance with building code as specified in Section 01410, when ambient air temperature exceeds 100 degrees Fahrenheit, or when ambient air temperature exceeds 90 degrees Fahrenheit and wind velocity is greater than 8 miles per hour, implement hot weather protection procedures.
 - 2. Wet mortarboard before loading and cover mortar to retard drying when not being used.
 - 3. Do not spread mortar beds more than 48 inches ahead of placing masonry units.
 - 4. Place masonry units within one minute of spreading mortar.

1.08 SEQUENCING AND SCHEDULING

- A. Order concrete masonry units well before start of installation to ensure adequate time for manufacturing and minimum 28 days for curing and drying before start of installation. Protect from weather after curing period to avoid moisture increase.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Hollow load bearing concrete masonry units:
 - 1. Class: Class 3 in accordance with ASTM C 90, with minimum compressive strength of 1,900 pounds per square inch. Units to have integral water repellent, ACM Chemestries; Rainbloc, Grace Construction Products; Dry-Block or equal.
 - 2. Surface texture: As shown on Drawings
 - 3. Color: Integral, Natural gray of concrete (to match color of existing units at site).
 - 4. Typical size: 8 inches wide by 8 inches high by 16 inches long, unless otherwise indicated on the Drawings, or other sizes as needed to minimize cutting.
 - 5. Special sizes and shapes: As required for window and door openings, bond beams, piers, lintels, control joints, and other special applications to minimize cutting.

- B. Steel reinforcement: As specified in Drawings.
- C. Mortar:
 - 1. Premix Mortar: Packaged blend of Portland cement, Type II, and hydrated lime in compliance to ASTM C 270, Type S. Masonry cements shall NOT be used.
 - 2. Integral waterproofing admixture for mortar: For use with concrete masonry units containing integral water repellent. The Mortar admixture shall be provided by the same manufacturer as the concrete masonry unit integral water repellent admixture.
- D. Grout:
 - 1. Grout: ASTM C-476, 2500 psi compressive strength at 28 days.
 - 2. Aggregate: Sand meeting ASTM C 144; Pearock for grout meeting ASTM C 404, number 89.
 - 3. Mixing water shall be potable.

PART 3 EXECUTION

3.01 PREPARATION

- A. Protection:
 - 1. Protect adjacent construction with appropriate means from mortar droppings and other effects of laying of concrete masonry units.
- B. Surface preparation:
 - 1. Thoroughly clean foundations of laitance, grease, oil, mud, dirt, mortar droppings, and other matter that will reduce bond.

3.02 INSTALLATION

- A. Forms and shores:
 - 1. Where required, construct forms to the shapes indicated on the Drawings:
 - a. Construct forms sufficiently rigid to prevent deflection which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout.
 - b. Do not remove supporting forms or shores until the supported masonry has acquired sufficient strength to support safely its weight and any construction loads to which it may be subjected.
 - 1) Wait at least 24 hours after grouting masonry columns or walls before applying uniform loads.
 - 2. Wait at least 72 hours before applying concentrated loads.
- B. Concrete masonry units:
 - 1. Comply with the requirements of ACI 530.1 unless more restrictive requirements are contained in this Section.
 - 2. Lay concrete masonry units dry.
 - 3. Lay units in uniform and true courses, level, plumb, and without projections or offset of adjacent units.
 - 4. Lay units to preserve unobstructed vertical continuity of cells to be filled with grout or insulation.
 - 5. Align vertical cells to be filled with grout to maintain clear, unobstructed continuous vertical cell measuring not less than 2 by 3 inches.

6. Ensure full mortar coverage of joints on webs of cells that will be grouted solid, and face shells.
7. Butter vertical head joints for thickness equal to face shell thickness of units, and shove joints tightly together so that mortar bonds to both masonry units.
8. Solidly fill joints from face of units to inside face of cells.
9. Lay units to desired height with joints of uniform thickness.
10. Bond shall be plumb throughout.
11. Lay units to avoid formation of cracks when units are placed. Keep cells of units as free of mortar as possible as masonry wall height increases.
12. When positions of units shift after mortar has stiffened, bond is broken, or cracks are formed, relay units in new mortar.
13. Remove mortar, mortar droppings, debris, and other obstructions and materials from inside of cell walls.
14. Remove mortar tags and smears daily with a non-metallic tool.
 - a. Mortar tags and smears shall be removed after they initially set, but shall not be permitted to remain more than 24 hours.
15. Where practical, protect completed work from mortar splash by placing thin plastic sheeting around the base of walls.
 - a. Place sand, straw, sawdust or other similar material on the floor around the base of walls to protect floors and walls.
16. Turn scaffold planks over at the end of the workday to avoid mortar splashes from wet weather.
 - a. Cover tops of walls at the end of the workday and other work stoppages to prevent entry of water into the partially completed masonry.
17. Seal cleanouts after inspection and before grouting.

C. Bond pattern:

1. Lay concrete masonry units in running bond pattern, unless otherwise indicated on the Drawings.

D. Mortar joints:

1. Make joints straight, clean, smooth, and uniform in thickness.
2. Tool exposed joints, slightly concave. Strike concealed joints flush.
3. Make vertical and horizontal joints 3/8-inch thick.
4. Where fresh masonry joins totally or partially set masonry, clean and roughen set masonry before laying new units.
5. Remove mortar that protrudes more than 1/2 inch into the cells of units that are to be grouted.

E. Wire joint reinforcement:

1. Lap splice longitudinal wire joint reinforcement minimum 75 wire diameters.
2. Place longitudinal wires in approximate centers of mortar beds with minimum 5/8-inch mortar cover on exposed faces.
3. Provide intersecting masonry walls with prefabricated wire joint reinforcement tees.
4. Rake intersecting joints 1/2 inch and caulk joints.

F. Grouting and reinforcement:

1. Where horizontal and vertical bars are spliced and adjacent lap splices are separated by more than 3 inches, the lap splice length shall be 72 bar diameters. Where adjacent lap splices are separated by 3 inches or less, the lap splice length shall be increased by 1.3 times or the lap splices shall be staggered at least 24 bar diameters with no increase in length.
2. Hold vertical reinforcing bars in position at top and bottom and at intervals not exceeding 200 bar diameters. Use steel wire bar positioners to position bars. Tie reinforcing bars to dowels with wire ties.
3. Obtain acceptance of reinforcement placement before grouting.
4. Fill spaces and cells containing reinforcing bars solidly with grout.
 - a. Low-lift grouting:
 - 1) Hollow unit masonry to be grouted by the low lift method shall be constructed and grouted in lifts not exceeding 5 feet.
 - 2) Slushing with mortar will not be permitted.
 - b. High-lift grouting:
 - 1) Hollow unit masonry shall be allowed to cure at least 24 hours before grouting.
 - 2) Grout shall be placed in lifts not to exceed 6 feet in depth.
 - 3) Each lift shall be allowed to set for 10 minutes after initial consolidation of grout before successive lift is placed.
 - 4) The full height of each section of wall shall be grouted in 1 day.
5. Grout in cells shall have full contact with surface of concrete footings.
6. When grouting stops for 1 hour or longer, form horizontal construction joints by stopping grout placement 1-1/2 inches below top of uppermost unit containing grout.
7. After placement, consolidate grout using mechanical immersion vibrators designed for consolidating grout.
8. Placement:
 - a. Use a hand bucket, concrete hopper, or grout pump.
 - b. Place grout in final position within 1-1/2 hours after mixing. Place grout so as to completely fill the grout spaces without segregation of the aggregates.
 - c. Do not insert vibrators into lower grout placements that are in a semi-solidified state.
 - d. Remove grout spills immediately by hand washing with a bucket and brush.

G. Bond beams:

1. Starting courses at bottom of walls shall be bond beams.
2. Place horizontal reinforcement and solidly grout bond beam units in place.
3. Provide wire mesh at openings in bottom of bond beams to support grout where walls are not grouted solid.

H. Cutting concrete masonry units:

1. When possible, use full units of the proper size in lieu of cut units. Cut units as required to form chases, openings, for anchorage, and for other appurtenances.
2. Cut and fit units with power-driven carborundum or diamond disc blade saw.

I. Control joints:

1. Provide in masonry walls at locations indicated on the Drawings.

2. Make full height and continuous in appearance.
 3. Run bond beams and bond beam reinforcing bars continuously through control joints.
 4. Insert control joint filler in joints as wall is constructed.
 5. Apply sealant as specified in Section 07900.
- J. Openings and lintels:
1. Place horizontal reinforcement in fully grouted bond beam units.
 2. Use lintel block units where underside of lintel will be exposed.
 3. Provide minimum of 8-inch bearing at each end of lintel.
 4. Embed reinforcing bars minimum 24 inches or 48 bar diameters, whichever is longer, into wall past edges of openings or as indicated on the Drawings:
 - a. At corners, provide 90-degree bend with equivalent total embedment.
- K. Bearing plates:
1. Provide minimum of 12 inches of grouted concrete unit masonry below steel bearing plates and beams bearing on masonry walls.
- L. Anchor bolts:
1. Hold anchor bolts in place with template during grouting to assure precise alignment.
 2. Do not cut or ream members being anchored or use other means to accommodate misaligned anchor bolts in roof deck support angles.
 3. Provide minimum 6-inch wide grouted concrete unit masonry entirely around anchor bolts and other attachment devices.
- M. Enclosures:
1. Where concrete masonry units enclose conduit, pipes, stacks, ducts, and similar items, construct chases, cavities, and similar spaces as required, whether or not such spaces are indicated on the Drawings.
 2. Point openings around flush mounted electrical outlet boxes with mortar, including flush joints above boxes.
 3. Do not cover enclosures until inspected and when appropriate, tested.
- N. Other embedded items:
1. Build in wall plugs, accessories, flashings, pipe sleeves, and other items required to be built-in as the masonry work progresses.
- O. Patching:
1. Patch exposed concrete masonry units at completion of the Work and in such manner that patching will be indistinguishable from similar surroundings and adjoining construction.
- P. Water curing:
1. Protect concrete masonry units from drying too rapidly by frequently fogging or sprinkling so walls will always be visibly damp for minimum 3 days.
- Q. Miscellaneous:
1. Build in required items, such as anchors, flashings, sleeves, frames, structural steel, lintels, anchor bolts, and metal fabrications, as required for complete installation.

- R. Grouting equipment:
1. Grout pumps:
 - a. Do not pump grout through aluminum tubes.
 - b. Operate pumps to produce a continuous stream of grout without air pockets.
 - c. Upon completion of each days pumping, eject grout from pipeline without contamination or segregation of the grout:
 - 1) Remove waste materials and debris from the equipment.
 - 2) Dispose of waste materials, debris, and all flushing water outside the masonry.
 2. Vibrators:
 - a. Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout.
 - b. Maintain at least 1 spare vibrator, at the site at all times.
 - c. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine.
 - d. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

3.03 CONSTRUCTION

- A. Site tolerances: Lay masonry plumb, true to line, and with courses level. Keep bond pattern plumb throughout. Lay masonry within the following tolerances:
1. Maximum variation from the plumb in the lines and surfaces of columns, walls, and in the flutes and surfaces of fluted or split faced blocks:
 - a. In adjacent masonry units: 1/8 inch.
 - b. In 10 feet: 1/4 inch.
 - c. In any story or 20 feet maximum: 3/8 inch.
 - d. In 40 feet or more: 1/2 inch.
 2. Maximum variations from the plumb for external corners, expansion joints, and other conspicuous lines:
 - a. In any story or 20 feet maximum: 1/4 inch.
 - b. In 40 feet or more: 1/2 inch.
 3. Maximum variations from the level or grades indicated on the Drawings for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
 - a. In any bay or 20 feet maximum: 1/4 inch.
 - b. In 40 feet or more: 1/2 inch.
 4. Maximum variations of the linear building lines from established position in plan and related portion of columns, walls, and partitions:
 - a. In any bay or 20 feet maximum: 1/2 inch.
 - b. In 40 feet or more: 3/4 inch.
 5. Maximum variation in cross sectional dimensions of columns and in thickness of walls:
 - a. Minus: 1/4 inch.
 - b. Plus: 1/2 inch.

3.04 FIELD QUALITY CONTROL

- A. Site tests:
1. Owner will have tests performed by an independent laboratory.

2. Have minimum 3 concrete masonry units of each type proposed for Project tested in accordance with ASTM C 90, C 140, and C 426 to verify conformance to Specifications.
3. Tests shall include compressive strength, linear shrinkage, moisture content as percent of total absorption, total absorption, and unit weight.

3.05 FINAL CLEANING

A. General:

1. Final cleaning shall be performed within 7 to 14 days after construction of masonry work.
2. Protect adjacent materials and equipment that may be damaged by cleaning.
3. Pre-wet masonry before applying cleaning agent, but do not saturate masonry.
4. Remove mortar stains, smears, and splash, efflorescence, and grout stains on exposed surfaces with the submitted cleaning agent as directed by the masonry unit manufacturer's recommendations.
5. Do not use muriatic acid as cleaning agent.
6. Cleaning agents shall be applied when the masonry surface and air temperatures are at least 50 degrees Fahrenheit.
 - a. Dilute cleaning agents in accordance with manufacturer's recommendations.
 - b. Do not allow cleaning agents to dry on the masonry.
7. Clean wall from the top to the bottom, without overlapping areas being cleaned for consistency.
8. If pressure cleaning equipment is used, the following limitations shall be observed:
 - a. Apply cleaning agent to pre-wetted wall with low pressure (less than 50 pounds per square inch).
 - b. Use a 25° to 50° flared-tip nozzle (not a pointed tip).
 - c. Maintain a consistent distance from the spray nozzle to the masonry surface no closer than 12 inches.
 - 1) Masonry cleaner shall use a combination of pressure, nozzle, and distance from tip to masonry that does not damage the masonry surface.
9. Rinse cleaning agents off the wall with potable water.
10. Dispose of debris, refuse, and surplus material offsite legally.

3.06 PROTECTION

A. Provide temporary protection for exposed masonry corners subject to damage.

B. Bracing:

1. Unless wall is adequately supported by permanent supporting elements so wall will not overturn or collapse, adequately brace masonry walls over 8 feet in height to prevent overturning and to prevent collapse.
2. Keep bracing in place until permanent supporting elements of structure are in place.

C. Limited access zone:

1. Establish limited access zone prior to start of masonry wall construction.
2. Zone shall be immediately adjacent to wall and equal to height of wall to be constructed plus 4 feet by entire length of wall on unscaffolded side of wall.

3. Limit access to zone to workers actively engaged in constructing wall. Do not permit other persons to enter zone.
4. Keep zone in place until wall is adequately supported or braced by permanent supporting elements to prevent overturning and collapse.

END OF SECTION

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 Submittal Procedures; and
 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	Type 304* or 316**
Bars and shapes	A 276	Type 304* or 316**
* Use Type 304L if material will be welded.		
** Use Type 316L if material will be welded.		

- B. Where stainless steel is welded, use extra low-carbon stainless steel (304L or 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.

1. 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 in 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 – ADHESIVE

- A. Epoxy bonding of reinforcing bars, all thread rods, and threaded inserts in concrete: As specified in Section 03055.

2.04 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.

2.05 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 05500

METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Aluminum grating stair tread.
 - 2. Aluminum stair nosing.
 - 3. Cast iron stop plank grooves.
 - 4. Concrete inserts.
 - 5. Handrails and guardrails.
 - 6. Ladders.
 - 7. Manhole frames and covers.
 - 8. Metal gratings.
 - 9. Metal tread plate.
 - 10. Preformed channel pipe supports.
 - 11. Stairs.
 - 12. Miscellaneous metals.
 - 13. Associated accessories to the above 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 09960 - High Performance Coatings.
 - b. Section 15061 - Pipe Supports.

1.02 REFERENCES

- A. Aluminum Association (AA):
 - 1. DAF-45: Designations from Start to Finish.
 - a. M12-C22-A41.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. Standard Specifications for Highway Bridges.
- C. ASTM International (ASTM):
 - 1. A 36 - Standard Specification for Carbon Structural Steel.
 - 2. A 48 - Standard Specification for Gray Iron Castings.
 - 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 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications.
 6. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
 7. A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 8. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 9. A 380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 10. A 489 - Standard Specification for Carbon Steel Lifting Eyes.
 11. A 490 - Standard Specification for Structural Bolts, Alloy Steel, Heat-Treated, 150 ksi Minimum Tensile Strength.
 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 635 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 15. A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 16. A 992 - Standard Specification for Structural Steel Shapes.
 17. B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 18. B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 19. B 308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
 20. B 429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 21. F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- D. American Welding Society (AWS):
1. A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- E. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

- A. Passivation: Removal of exogenous iron or iron compounds from the surface of a stainless steel by means of chemical dissolution resulting from treatment with an acid solution that removes the surface contamination but does not significantly affect the stainless steel itself.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Aluminum grating stair tread.
 - 2. Aluminum stair nosing.
 - 3. Cast iron stop plank grooves.
 - 4. Handrail and guardrail.
 - 5. Manhole frames and covers.
 - 6. Metal grating.
- B. Shop drawings:
 - 1. Handrails and guardrails:
 - a. Including details on connection attachments, gates, kick plates, ladders, and angles.
 - b. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - c. Include erection drawings, elevations, and details where applicable.
 - d. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Ladders.
 - 3. Metal grating.
 - 4. Metal tread plate.
 - 5. Stairs.
 - 6. Miscellaneous metals.
- C. Samples:
 - 1. Guardrails with specified finishes.
- D. Quality control submittals:
 - 1. Design data.
 - 2. Test reports:
 - a. Guardrails: 3 copies of certified tests performed by an independent testing laboratory certifying that guardrails meet current State and OSHA strength requirements.
 - b. Gratings:
 - 1) Grating manufacturers' calculations showing that gratings will meet specified design load, stress, and deflection requirements for each size grating for each span.
 - 2) Reports of tests performed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General: Unless otherwise specified or indicated on the Drawings, structural and miscellaneous metals in accordance with the standards of the ASTM, including the following:

Item	ASTM Standard No.	Class, Grade Type or Alloy No.
Cast Iron		
Cast Iron	A 48	Class 40B
Steel		
Galvanized sheet iron or steel	A 653	Coating G90
Coil (plate)	A 635	--
Structural plate, bars, rolled shapes, and miscellaneous items (except W shapes).	A 36	--
Rolled W shapes	A 992	Grade 50
Standard bolts, nuts, and washers	A 307	--
High strength bolts, nuts, and hardened flat washers	A 325 A 490	--
Eyebolts	A 489	Type 1
Tubing, cold-formed	A 500	--
Tubing, hot-formed	A 501	--
Steel pipe	A 53	Grade B
Stainless Steel		
Plate, sheet, and strip	A 240	Type 304* or 316**
Bars and shapes	A 276	Type 304* or 316**
Bolts (Type 304)	F593	Group 1 Condition CW
Bolts (Type 316)	F593	Group 2 Condition CW
Aluminum		
Flashing sheet aluminum	B 209	Alloy 5005-H14, 0.032 inches minimum thickness
Structural sheet aluminum-	B 209	Alloy 6061-T6
Structural aluminum	B 209 B 308	Alloy 6061-T6
Extruded aluminum	B 221	Alloy 6063-T42
* Use Type 304L if material will be welded. ** Use Type 316L if material will be welded.		

1. Stainless steels are designated by type or series defined by ASTM.
2. Where stainless steel is welded, use low-carbon stainless steel.

2.02 MANUFACTURED UNITS

- A. Aluminum grating stair tread:
 - 1. Manufacturers: One of the following or equal:
 - a. IKG Borden Industries, Aluminum Grating Stair Tread with Mebac nosing.
 - b. McNichols Co., Type A-Standard with Corrugated Angle Nosing.
 - 2. Material: Welded aluminum grating tread with non-slip nosing and integral end plates for bolt on attachment to stair stringers
 - 3. Size:
 - a. Tread width: To equal tread spacing plus 1 inch minimum.
 - b. Tread length: Length to suit stringer-to-stringer dimension indicated on the Drawings.
 - c. Depth: 1-3/4 inches.
 - 4. Bolts: Type 316 stainless steel.
- B. Aluminum stair nosing:
 - 1. Manufacturers: One of the following or equal:
 - a. Wooster Products, Inc., Type 101 Nosing.
 - b. American Safety Tread Co., Inc., Style 801 Nosing.
 - 2. Material: Cast aluminum abrasive nosings with aluminum oxide granules integrally cast into metal, forming permanent, nonslip, long-wearing surface.
 - 3. For installation in cast-in-place stairs.
 - 4. Configuration: 4 inches wide, fabricated with integrally cast stainless steel anchors at approximately 12-inch centers. Length to extend within 3 inches of stair edge on each side.
- C. Cast iron stop plank grooves:
 - 1. Manufacturers: One of the following or equal:
 - a. Neenah Foundry Company, R-7500 Series, Type A.
 - b. McKinley Iron Works, Type L.
 - 2. Size: 2-inch wide groove opening by 1-1/2 inch deep, unless otherwise indicated on the Drawings.
 - 3. Recess groove with the cast iron surface of the groove set flush with the concrete surface.
- D. Concrete inserts:
 - 1. Concrete inserts for supporting pipe and other applications are specified in Section 15061.
- E. Handrails and guardrails:
 - 1. General:
 - a. Design and fabricate assemblies to conform to current local, State, and OSHA standards and requirements.
 - b. Coordinate layout of assemblies and post spacings to avoid conflicts with equipment and equipment operators.
 - 1) Indicate on the shop drawings locations of such equipment.
 - 2) Highlight locations where railings cannot be made continuous, and obtain Engineer's directions on how to proceed before fabricating or installing railings.
 - 2. Aluminum handrails and guardrails (nonwelded pipe):
 - a. Rails, posts, and fitting-assembly spacers:

- 1) In accordance with ASTM B 429, 6005, 6063, or 6105, minimum Schedule 40, extruded aluminum pipe of minimum 1.89-inch outside diameter and 0.14-inch wall thickness.
- b. Kick plates: 6061 or 6105 aluminum alloy.
- c. Fastenings and fasteners: As recommended or furnished by the manufacturer.
- d. Other parts: 6063 extruded aluminum, or F214 or F514.0 aluminum castings:
 - 1) Fabrications: In accordance with ASTM B 209 or ASTM B 221 extruded bars:
 - a) Bases: 6061 or 6063 extruded aluminum alloy.
 - 2) Plug screws or blind rivets: Type 305 stainless steel.
 - a) Other parts: Type 300 series stainless steel.
- e. Finish of aluminum components:
 - 1) Anodized finish, 0.7 mil thick, applied to exposed surfaces after cutting. Aluminum Association Specification M12-C22-A41, mechanical finish non specular as fabricated, chemical finish-medium matte, anodic coating-clear Class I Architectural.
 - 2) Pretreat aluminum for cleaning and removing markings before anodizing.
- f. Fabrication and assembly:
 - 1) Fabricate posts in single, unspliced pipe length.
 - 2) Perform without welding.
 - 3) Do not epoxy bond the parts.
 - 4) Maximum clear opening between assembled railing components as indicated on the Drawings.
- g. Manufacturers: One of the following or equal:
 - 1) Moultrie Manufacturing Company, Wesrail.
 - 2) Golden Railings, Golden, CO, Riveted System.
 - 3) Craneveyor Corporation Enerco Metals, C-V Rail.
3. Guardrail gates:
 - a. Supplied by guardrail manufacturer:
 - 1) Of same material, quality, and workmanship as specified for guardrail system in which they will be installed.
 - 2) Of design similar to that of handrail or railing system in which they will be installed.
 - b. Components: Gate frame, stainless steel self-closing device, hinges, gate stops, and durable self-locking type latch. Fabricate components in conformance with OSHA minimum strength requirements.
4. Fastenings and fasteners: As recommended or furnished by guardrail manufacturer for use with this system.

F. Ladders:

1. General:
 - a. Type: Safety type conforming to local, State, and OSHA standards as minimum. Furnish guards for ladder wells.
 - b. Size: 18 inches wide between side rails of length, size, shape, detail, and location indicated on the Drawings.
2. Aluminum ladders:
 - a. Materials: 6063-T5 aluminum alloy.

- b. Rungs:
 - 1) 1-inch minimum solid square bar with 1/8-inch grooves in top and deeply serrated on all sides.
 - 2) Capable of withstanding 1,000 pound load without failure.
- c. Side rails: Minimum 4-inch by 1/2-inch flat bars.
- d. Finish of aluminum components:
 - 1) Anodized finish, 0.7 mil thick, applied to exposed surfaces after cutting. Aluminum Association Specification M12-C22-A41, mechanical finish non specular as fabricated, chemical finish-medium matte, anodic coating-clear Class I Architectural.
 - 2) Pretreat aluminum for cleaning and removing markings before anodizing.
- e. Fabrication:
 - 1) Welded construction, of size, shape, location, and details indicated on the Drawings.
 - 2) For ladders over 20 feet high, furnish standard ladder cages or fall prevention system designed in accordance with State and OSHA requirements.
- f. Fall prevention system: Include but not limit to railing, brackets, clamps, 2 sleeves, and 2 belts, satisfying OSHA safe climbing requirements:
 - 1) Manufacturers: One of the following or equal:
 - a) North Consumer Products, Saf-T-Climb.
 - b) Swager Communications, Climbers Buddy System.

G. Manhole frames and covers:

- 1. Material: Gray iron castings, in accordance with ASTM A 48, Class 30-B.
- 2. Type: Heavy-duty traffic type, with combined minimum set weight of 265 pounds.
- 3. Machine horizontal and vertical bearing surfaces to fit neatly, with easily removable cover bearing firmly in frame without rocking.
- 4. Frame:
 - a. Bottom flange type.
 - b. Approximately 4-1/2 inches frame height.
 - c. Dimensions as indicated on the Drawings.
 - 1) Minimum inside clear dimension may not be smaller than nominal diameter minus 2 inches.
- 5. Cover:
 - a. Skid-resistant grid pattern design stamped with name of utility service provided by manhole, such as "ELECTRICAL," "SEWER," "TELEPHONE," or "REUSE WATER."
 - b. Solid type without ventilation holes.
- 6. Finish: Unpainted.

H. Metal gratings:

- 1. General:
 - a. Fabricate grating to cover areas indicated on the Drawings.
 - b. Unless otherwise indicated on the Drawings, grating over an opening shall cover entire opening.
 - c. Make cutouts in grating where required for equipment access or protrusion, including valve operators or stems, and gate frames.
 - d. Band ends of grating and edges of cutouts in grating:

- 1) End banding: 1/4 inch less than height of grating, with top of grating and top edge of banding flush.
 - 2) Cutout banding: Full-height of grating.
 - 3) Use banding of same material as grating.
 - 4) Panel layout: Enable installation and subsequent removal of grating around protrusions or piping.
 - 5) Openings 6 inches and larger: Lay out grating panels with edges of 2 adjacent panels located on centerline of opening.
 - 6) Openings smaller than 6 inches: Locate opening at edge of single panel.
 - 7) Where an area requires more than 1 grating section to cover area, clamp adjacent grating sections together at 1/4-points with fasteners acceptable to Engineer.
 - 8) Fabricate steel grating sections in units weighing not more than 50 pounds each.
 - 9) Fabricate aluminum grating sections in units weighing not more than 50 pounds each.
 - e. When requested by Engineer, test 1 section of each size grating for each span length involved on the job under full load:
 - 1) Furnish a suitable dial gauge for measuring deflections.
 - f. Grating shall be aluminum, unless otherwise specified or indicated on the Drawings.
2. Aluminum grating:
- a. Material for gratings, shelf angles, and rebates: 6061-T6 or 6063-T6 aluminum alloy, except crossbars may be 6063-T5 aluminum alloy.
 - b. Shelf angle concrete anchors: Type 304 or Type 316 stainless steel.
 - c. Grating rebate rod anchors: 6061-T6 or 6063-T6 aluminum alloy.
 - d. Bar size and spacing: As determined by manufacturer to enable grating to support design load.
 - e. Design live load: A minimum of 100 pounds per square foot uniform live load on entire grating area, but not less than the live load indicated on the Drawings for the area where grating is located.
 - f. Maximum fiber stress for design load: 12,000 pounds per square inch.
 - g. Maximum deflection due to design load: 1/240 of grating clear span.
 - h. Maximum spacing of main grating bars: 1-1/8 inches clear between bars.
 - i. Minimum grating height: 1-1/2 inches.
 - j. Manufacturers: One of the following or equal:
 - 1) IKG Borden Industries, grooved aluminum I-bar.
 - 2) Brodhead Steel Products, Inc., grooved aluminum I-bar.
3. Aluminum grating planks:
- a. Materials: Meet requirements previously specified for aluminum grating.
 - b. Fabrication:
 - 1) Meet requirements previously specified for aluminum grating.
 - c. Have unpunched surface with cross hatched anti-skid surface.
 - d. Minimum weight of 3-1/4 pounds per square foot.
 - e. Provide 1 inch diameter hole with smooth edges at each end for each plank.
 - f. Furnish planks in 2 foot widths.
 - g. Manufacturers: One of the following or equal:
 - 1) IKG, Heavy Duty Aluminum Plank Grating HD-P.

- pw://Carollo/Documents/Client/FL/Daytona Beach/8290U10/Specifications/Structural/05500 (IFB.)

- a) If degreasing is required before cleaning to remove scale or iron oxide, cleaning (pickling) treatments with citric acid are permissible; however, these treatments shall be followed by inorganic cleaners such as nitric-hydrofluoric acid.
 - 2) Provide acid descaling (pickling) in accordance with Table A1.1 of Annex A1 of ASTM A 380.
 - 3) After pickling, final cleaning of stainless steel shall conform to Part II of Table A2.1 of Annex A2 of ASTM A 380.
 - e. After cleaning, inspect 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 job site.
- N. Miscellaneous structural steel:
- 1. Provide miscellaneous steel items not specified in this Section as indicated on the Drawings or specified elsewhere.
 - a. Fabricate and install in accordance with the best practices of the trade.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. General: Install products as indicated on the Drawings, and in accordance with shop drawings and manufacturer's printed instructions, as applicable except where specified otherwise.
- B. Aluminum stair nosing:
- 1. Install stair nosings on treads of concrete stairs, including top tread on upper concrete slab.
 - 2. Omit stair nosings where concrete is submerged.
 - 3. Coat aluminum surfaces in contact with concrete as specified in Section 09960.
 - 4. Cast stair nosings in fresh concrete, flush with tread and riser faces. Install nosing in center of step approximately 3 inches from each stair edge.
- C. Cast iron stop plank grooves:
- 1. Recess stop plank grooves with cast iron surfaces of groove set flush with concrete surface.
- D. Handrails and guardrails:
- 1. General:
 - a. Fasten pipe rails to fittings with Series 300 stainless steel pop rivets or flush set screws.

- b. Make pipe cuts clean and straight, free of burrs and nicks, and square and accurate for minimum joint-gap.
 - c. Drill and countersink holes to proper size, as required for a tight flush fit of screws and other component parts.
 - d. Space attachment brackets as indicated in the manufacturer's instructions.
2. Aluminum pipe handrails and guardrails:
- a. During construction, keep exterior surfaces of handrails and guardrails covered with 0.4 millimeters, minimum, heat shrink polyethylene film.
 - b. Do not remove protective film before handrails and guardrails have been accepted by Engineer nor before other work in proximity of handrails and guardrails has been completed.
 - c. Discontinue handrails and guardrails at lighting fixtures.
 - d. Provide 1/8-inch diameter weep hole at base of each post.
 - e. Where protection is applied for prevention of dissimilar materials electrolysis, make application such that none of the protective material is visible in the completed assembly.
 - f. Space posts as indicated on the Drawings.
 - g. Anchor posts into concrete by grouting posts into formed holes in concrete, into stainless steel sleeves cast in concrete; or bracket mount to face of concrete surfaces as specified and indicated on the Drawings.
 - h. Space rails as indicated on the Drawings.
 - i. Make adequate provision for expansion and contraction of kick plates and rails.
 - 1) Make provisions for removable sections where indicated on the Drawings.
 - j. Make lower rails a single, unspliced length between posts, or continuous.
 - k. Make top rails continuous whenever possible, and attach single, unspliced lengths to 3 posts minimum.
 - l. Draw up fasteners tight with hand wrench or screw driver.
 - m. Space attachment brackets as indicated on shop drawings or in manufacturer's installation instructions.
 - n. Completed installation shall have handrails and railings rigid and free of play at joints and attachments.
 - o. Protect handrail and guardrail finish from scratches, gouges, dents, stains, and other damage.
 - p. Replace damaged or disfigured handrails and guardrails with new.
 - q. Shortly before final acceptance of the work, and after removal of protective polyethylene film, clean handrails and guardrails with mild detergent or with soap and water.
 - 1) After cleaning, thoroughly rinse handrails and guardrails and wipe with soft cloth.
 - r. Erect guardrail straight, level, plumb, and true to the positions as indicated on the Drawings. Correct deviations from true line of grade, which are visible to the eye.
3. Guardrail gates:
- a. Install gate to be a vertical plane with the guardrail when in the closed position.
 - b. Install hinges so that each gate can swing 180 degrees from the closed position to the fully open position.
 - c. Install so that the gates swing to the walkway side of the guardrail only.

- 1) Install gate stops on the stationary railing posts to prohibit gates from swinging in the wrong direction.
 - d. Install gate frames, hinges, stops, and latches in conformance with OSHA minimum strength requirements.
- E. Ladders:
1. Secure to supporting surface with bent plate clips providing minimum 8 inches between supporting surface and center of rungs.
 2. Where exit from ladder is forward over top rung, extend side rails 3 feet 3 inches minimum above landing, and return the rails with a radius bend to the landing.
 3. Where exit from ladder is to side, extend ladder 5 feet 6 inches minimum above landing and rigidly secure at top.
 4. Erect rail straight, level, plumb, and true to position indicated on the Drawings.
 - a. Correct deviations from true line or grade which are visible to the eye.
- F. Manhole frames and covers:
1. Installation.
- G. Metal gratings:
1. General:
 - a. Allow 1/8-inch maximum clearance between ends of grating and inside face of vertical leg of shelf angles.
 - b. Horizontal bearing leg of shelf angles shall be 2 inches minimum.
 - c. Install aluminum plate or angles where necessary to fill openings at changes in elevation and at openings between equipment and grating.
 - d. Install angle stops at ends of grating.
 - e. Installed grating shall not slide out of rebate or off support.
 - f. Weld stops in place, unless otherwise specified or indicated on the Drawings.
 - g. Top surfaces of grating sections adjacent to each other shall lie in same plane.
 2. Aluminum grating:
 - a. Coat surfaces of aluminum shelf angles, rebates, and rod anchors in contact with concrete as specified in Section 09960.
 - b. Aluminum grating: Support on aluminum shelf angles or rebates.
 3. Aluminum grating planks:
 - a. Support and install planks as specified for aluminum grating.
 4. Steel grating:
 - a. Support on hot-dip galvanized structural steel shelf angles or rebates.
 5. Heavy-duty steel grating:
 - a. Support on hot-dip galvanized structural steel rebates embedded and anchored in concrete.
 - b. Use for roadways, traffic areas, and where indicated on the Drawings.
- H. Stairs:
1. General:
 - a. Install guard railings around stair wells as indicated on the Drawings or specified.
- I. Stainless Steel
1. Welding.

- a. Passivate field-welded surfaces.
 - 1) Provide cleaning, pickling, and passivating as specified in this Section.
 - 2) Clean using Derustit Stainless Steel Cleaner, or equal.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07900

JOINT SEALANTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Acrylic-Latex sealant.
 - 2. Precast concrete joint sealant.
 - 3. Silicone sealant.
 - 4. Synthetic rubber sealing compound.
 - 5. Synthetic sponge rubber filler.
 - 6. Related materials.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. M 198 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
- B. ASTM International (ASTM):
 - 1. C 920 - Standard Specification for Elastomeric Joint Sealants.
 - 2. C 990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
 - 3. D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
 - 4. D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

1.03 SUBMITTALS

- A. Product data.
- B. Samples, include color selections.
- C. Manufacturer's Installation Instructions.
- D. Warranty.

1.04 QUALITY ASSURANCE

- A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.
- B. Installer qualifications: Manufacturer approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.

1.05 PROJECT/SITE CONDITIONS

- A. Environmental requirements: Do not apply sealant on wet or frosty surfaces or when surface temperature is higher than 100 degrees Fahrenheit or lower than recommended by the manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products in accordance with manufacturer's recommendations.
- B. Code date packages. Do not use material older than manufacturer's published shelf life. Store materials at temperatures lower than 80 degrees Fahrenheit. Condition materials in accordance with manufacturer's instructions prior to installation.

1.07 SEQUENCING AND SCHEDULING

- A. Caulk joints prior to painting.

1.08 WARRANTY

- A. Warrant to correct defective products for minimum 1 year in accordance with manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 ACRYLIC-LATEX SEALANT

- A. Permanently flexible, nonstaining, and nonbleeding latex modified acrylic sealant compound, colors as selected by Engineer from manufacturer's standard options. Manufacturers: One of the following or equal:
 - 1. Tremco, Tremflex 834.
 - 2. Pecora Corp., Number AC-20.
 - 3. Sonneborn, Sonolac.

2.02 PRECAST CONCRETE JOINT SEALANT

- A. Preformed, cold-applied, ready-to-use, flexible joint sealant in accordance with ASTM C 990 and AASHTO M 198. Manufacturers: One of the following or equal.
 - 1. Henry Corporation, Ram-Nek.
 - 2. Concrete Sealants Division, ConSeal.

2.03 SILICONE SEALANT

- A. ASTM C 920, Type S, Grade NS, Class 25, single component silicone sealant. Manufacturers: One of the following or equal:
 - 1. Tremco, Proglaze.
 - 2. Pecora Corp., Number 864.
 - 3. Dow Corning, Number 795.
 - 4. General Electric, Number 1200 Series.

2.04 SYNTHETIC RUBBER SEALING COMPOUND

- A. Manufacturer: One of the following or equal:
 - 1. Sika Corporation, Lyndhurst, NJ, Sikaflex 2c NS or SL.
 - 2. Polymeric Systems, Inc., PSI 275.
 - 3. Pacific Polymers, Garden Grove, CA, Elastothane 227R.
- B. Material: In accordance with ASTM C 920 Type M, Grade P (pourable), Class 25 and Type M, Grade NS (non-sag), Class 25; multi-part polyurethane; able to cure at room temperature to firm, highly resilient polymer; able to perform satisfactory when continuously submerged in water or sewage and exposed to direct sunlight in dry condition; with the following properties determined at 75 degrees Fahrenheit and 50 percent relative humidity:
 - 1. Base: Polyurethane rubber.
 - 2. Solids: Minimum 97 percent.
 - 3. Application time: Minimum 2 hours.
 - 4. Cure time: Maximum 3 days.
 - 5. Tack free time: 24 hours.
 - 6. Ultimate hardness: Non-sag 25, Pourable/SL 40, within 5 Shore A.
 - 7. Tensile strength: Non-sag 120 pounds per square inch minimum and self-leveling minimum 170 pounds per square inch when tested in accordance with ASTM D 412.
 - 8. Ultimate elongation: Minimum 490 percent when tested in accordance with ASTM D 412.
 - 9. Tear resistance: Non-sag 45 pounds per inch minimum and self-leveling minimum 85 pounds per inch when tested in accordance with ASTM D 624, Die C.
 - 10. Service temperature range: Minus 25 degrees to 158 degrees Fahrenheit.
- C. Color: Gray to match concrete, unless indicated on the Drawings.

2.05 SYNTHETIC SPONGE RUBBER FILLER

- A. Closed-cell expanded sponge rubber manufactured from synthetic polymer neoprene base, or resilient polyethylene foam backer rod. Manufacturers: One of the following or equal:
 - 1. Presstite, Number 750.3 Ropax Rod Stock.
 - 2. Rubatex Corp., Rubatex-Cord.
- B. Characteristics:
 - 1. Suitable for application intended.
 - 2. Strength: As necessary for supporting sealing compound during application.
 - 3. Resiliency: Sufficient resiliency to prevent significant load transfer across joint.
 - 4. Resistance to environmental conditions of installation.
 - 5. Bonding: No bonding to the sealing compound.
 - 6. Structure: Cellular, prevents wicking or absorption of water.
 - 7. Compatibility with other materials in joint and acceptance by manufacturer of sealing compound.
 - 8. Size: Minimum 25 percent greater than nominal joint width.

2.06 RELATED MATERIALS

- A. Primer: Nonstaining type, recommended by sealant manufacturer to suit application.

- B. Joint cleaner: Noncorrosive, nonstaining, compatible with joint forming materials and as recommended by sealant manufacturer.
- C. Bond breaker tape: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify acceptability of joint dimensions, physical, and environmental conditions.
- B. Verify that surfaces are dry, clean, and free of dirt, grease, curing compound, and other residue which might interfere with adhesion of sealants.

3.02 PREPARATION

- A. Allow concrete to cure thoroughly before caulking.
- B. Synthetic sponge rubber filler:
 - 1. Prepare surfaces designated to receive filler in accordance with manufacturer's installation instructions.
 - 2. Do not stretch filler beyond its normal length during installation.
- C. Caulking:
 - 1. Verify that surfaces are dry, clean, and free of dirt, grease, curing compounds, and other residue that might interfere with adhesion of sealant.
 - 2. Concrete, masonry, wood, and steel surfaces: Clean and prime in accordance with manufacturer's instructions prior to caulking.
- D. Synthetic rubber sealing compound:
 - 1. Ensure surfaces to which synthetic rubber must bond are dry and free of dust, dirt, and other foreign residue.
 - 2. Heavy sandblasted caulking groove to sound surface, and prime with manufacturer's recommended primer for particular surface.
- E. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but neither more than 5/8 inches deep nor less than 3/8 inches deep.
- F. For normal moving building joints sealed with elastomeric sealants not subject to traffic, fill joints to depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
- G. For joints sealed with acrylic-latex sealants, fill joints to depth in range of 75 percent to 125 percent of joint width.
- H. Use joint filler to achieve required joint depths, to allow sealants to perform properly.
- I. Prepare surfaces and install synthetic sponge rubber filler in accordance with manufacturer's recommendations.

- J. Do not stretch filler beyond normal length during installation.
- K. Apply bond breaker when recommended by joint sealer manufacturer.

3.03 INSTALLATION

- A. Synthetic sponge rubber filler: Install filler in accordance with manufacturer's installation instructions.
- B. Caulking, joints, and sealing:
 - 1. Construct expansion, contraction, and construction joints as indicated on the Drawings.
 - 2. Install pipe and conduit in structures as indicated on the Drawings.
 - 3. Caulk doors, windows, louvers, and other items installed in or over concrete openings inside and out.
 - 4. Use synthetic rubber sealing compound for caulking where indicated on the Drawings or as specified, except for masonry construction and where specified otherwise.
 - 5. Complete caulking prior to painting.
 - 6. Verify that concrete is thoroughly cured prior to caulking.
 - 7. When filler compressible material is used, use untreated type.
 - 8. Apply caulking with pneumatic caulking gun.
 - 9. Use nozzles of proper shape and size for application intended.
 - 10. Maintain continuous bond between caulking and sides of joint to eliminate gaps, bubbles, or voids and fill joint in continuous operation without layering of compound.
 - 11. Employ experienced applicators to caulk joints and seams in neat workmanlike manner.
 - 12. To hasten curing of compound when used on wide joints subject to movement, apply heat with infrared lamps or other convenient means.
 - 13. Apply synthetic rubber sealing compound with pneumatic caulking tool or other acceptable method.

3.04 CLEANING

- A. Clean surfaces adjacent to sealant as work progresses.
- B. Remove excess uncured sealant by soaking and scrubbing with sealant cleaning solvent.
- C. Remove excess cured sealant by sanding with Number 80 grit sandpaper.
- D. Leave finished work in neat, clean condition.

3.05 SCHEDULE

- A. Acrylic latex:
 - 1. Use where indicated on the Drawings.
 - 2. Interior joints with movement less than 7.5 percent and not subject to wet conditions.
- B. Silicone:
 - 1. Use where indicated on the Drawings.

2. Joints and recesses formed where window, door, louver and vent frames, and sill adjoin masonry, concrete, stucco, or metal surfaces.
 3. Door threshold bedding.
 4. Moist or wet locations, including joints around plumbing fixtures.
 5. Stainless steel doors and frames, including joints between applied stops and frames, and around anchor bolts.
 6. Plenum joints.
- C. Synthetic rubber sealing compound, non-sag Type II:
1. Use where indicated on the Drawings.
 2. Water-bearing and earth-bearing concrete structures.
 3. Joints in masonry, concrete vertical surfaces, and metal-faced panels in vertical surfaces.
 4. Joints between sheet metal flashing and trim.
 5. Joints between sheet metal flashing and trim, and vertical wall surfaces.
 6. Small voids between materials requiring filling for weathertight performance in vertical surfaces.
 7. Perimeters of frames of doors, windows, louvers, and other openings where bonding is critical to airtight performance.
 8. Expansion and control joints in masonry vertical surfaces.
- D. Synthetic rubber sealing compound, self-leveling Type I:
1. Use where indicated on the Drawings.
 2. Expansion and control joints in masonry, concrete horizontal surfaces, and metal panels in horizontal surfaces.
 3. Small voids between materials requiring filling for weathertight performance in horizontal surfaces.
 4. Pavement joints.
 5. Perimeters of frames of doors, windows, louvers, and other openings in horizontal surfaces where bonding is critical to airtight performance.

END OF SECTION

SECTION 08120

ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This Section specifies aluminum exterior doors and frames.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 sections apply to this Section.
- B. Related work in other Sections:
 - 1. Section 03300 - Cast-In-Place Concrete.
 - 2. Section 07900 - Joint Sealants.
 - 3. Section 08710 - Door Hardware.
 - 4. Section 09910 – Painting.

1.03 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. FBC, Florida Building Code, (5th Edition) 2014.
 - 2. ADAAG, American with Disabilities Act Accessibility Guidelines.
 - 3. NFPA 101, Life Safety Code.
 - 4. NFPA 80, Standard for Fire Doors and Fire Windows.
- B. Use skilled workmen who are trained and experienced and who are familiar with the installation of the products specified herein.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract:
 - 1. Product data including Manufacturer's literature demonstrating compliance with these specifications.
 - 2. Shop drawings showing the specifications and construction details of all components of the doors and frames. Include details of each frame type, elevations of door design types, gauges and joints. Shop drawings shall show details of anchoring of frames to the structure.
 - 3. Schedule of doors and frames using the same reference numbers as the Drawings.
 - 4. If required by the building jurisdiction, provide calculations for the connection details compiled by a registered structural engineer.
 - 5. If required by the building jurisdiction, provide product approvals.

1.05 WARRANTY

- A. Provide a written warranty that all work under this section will be free from defects of materials and workmanship for a period of two years upon acceptance by the Owner, except that frame reinforcement for hinges shall be warranted for the life of the building.

1.06 PRODUCT HANDLING

- A. Comply with pertinent provisions of Division 1.

PART 2 PRODUCTS

2.01 ALUMINUM DOORS

- A. Doors shall meet the following criteria:
 - 1. Face sheet shall be smooth 0.040" aluminum sheet, 5005-H14 alloy, laminated to 0.125" tempered hardboard.
 - 2. Core material shall be ISO-25 polyisocyanurate foam, closed cell, with a minimum density of 2.0 lbs. / cu. ft.
 - 3. Door rails shall be square edge, aluminum extrusion 6063-T5 alloy.
 - 4. Doors shall be equal to Cline Series 100BE.

2.02 ALUMINUM FRAMES

- A. Frames shall meet the following criteria:
 - 1. Extruded aluminum alloy 6063-T5 with minimum wall thickness of 0.125".
 - 2. Frame dimensions shall be as shown on the drawings.
 - 3. Corners shall be cut square and fastened using concealed stainless steel screws.
 - 4. Reinforce frame for hinges.

2.03 FINISH

- A. Doors and frames to be finished as follows:
 - 1. Anodized in accordance with Aluminum Association #MM12C22A31, Class II, dark bronze.

2.04 ACCEPTABLE MANUFACTURERS

- A. Cline Aluminum Doors, Inc.
- B. Any other manufacturer who can demonstrate compliance with this specification.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the areas where the doors and frames will be installed and bring any unsatisfactory conditions to the attention of the Contractor. Do not proceed with installation until the unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Install the doors and frames at locations indicated on the drawings.
- B. Install all items in accordance with the manufacturer's recommendations.
- C. Coordinate as required with other trades prior to installation.

3.03 CLEANUP

- A. Clean up any loose material upon completion of installation.
- B. Clean doors, frames and all related items upon completion of installation and ensure that all items are in working condition.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08331

OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Aluminum overhead coiling doors for chain hoist operation.
- B. Provide operating door assemblies, door curtain, guides, hardware, operators, and installation of accessories.

1.03 DEFINITIONS

- A. Operation Cycle: One complete cycle of a door begins with the door in the closes position. The door is then moved to the open position and back to the closed position.

1.04 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
 - 1. Wind Load: Uniform pressure (velocity pressure) per drawings, acting inward and outward.
- B. Operation-Cycle Requirements: Design overhead coiling door components and operator to operate for not less than 20,000 cycles.
 - 1. Include tamperproof cycle counter.

1.05 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory include details of construction relative to materials, dimensions of individual components, profiles, and finishes in accordance with Section 01330. Provide roughing-in diagrams, operating instructions, and maintenance information. Include the following:
 - 1. Setting drawings, templates, and installation instructions for built-in or embedded anchor devices.

- B. Shop Drawings: For special components and installations not dimensioned or detailed in manufacturer's data sheets.
 - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring and between components provided by door manufacturer and those provided by others.
- C. Samples for Verification: Of each type of exposed finish required, prepared on Samples of size indicated below and of same thickness and material indicated for Work. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.
 - 1. Curtain Slats: 12-inch length.
- D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

1.06 QUALITY ASSURANCE

- A. Manufacturer: Rolling doors shall be manufactured by a firm with a minimum of five years experience in the fabrication and installation of rolling doors.
- B. Installer Qualifications: Engage an experienced installer who is an authorized representative of the overhead coiling door manufacturer for both installation and maintenance of units required for this Project.
- C. Source Limitations: Obtain overhead coiling doors through one source from a single manufacturer.
 - 1. Obtain operators and controls from the overhead coiling doors manufacturer.
- D. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Atlas Door Corp.; Div. of Clopay Building Products Co.
 - 2. The Cookson Company.
 - 3. Cornell Iron Works Inc.
 - 4. McKeon Rolling Steel Door Company, Inc.
 - 5. Overhead Door Corporation.
 - 6. Raynor Garage Doors.
 - 7. Wayne-Dalton Corp.
- B. Exterior Doors: Series 625 with F-265I slat, powder coat finish with color selected by Owner, by Overhead Door Corporation, or approved equal.

2.02 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtain: Fabricate overhead coiling door curtain of interlocking slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of material thickness recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Aluminum Door Curtain Slats: ASTM B 209 or ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 - a. Provide slats equal to those specified above.
 - 2. Insulation: Fill slat with manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation complying with maximum flame-spread and smoke-developed indices of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within aluminum slat faces.
 - 3. Inside Curtain Slat Face: To match material of outside metal curtain slat and as follows:
 - a. Aluminum Sheet Thickness: Same thickness as outside aluminum curtain face slat.
- B. Endlocks: Malleable-iron castings galvanized after fabrication, secured to curtain slats with galvanized rivets, or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- C. Windlocks: Malleable-iron castings secured to curtain slats with galvanized rivets or high-strength nylon, as required to comply with wind load.
- D. Bottom Bar: Consisting of 2 angles, each not less than 1-1/2 by 1/8 inch thick, aluminum extrusion to suit type of curtain slats.
 - 1. Astragal: provide a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene, between angles or fitted to shape, as a cushion bumper for interior door.
- E. Curtain Jamb Guides: Fabricate curtain jamb guides of steel angles, or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Build up units with not less than 3/16-inch thick galvanized steel sections complying with ASTM A 36, and guides to prevent overtravel of curtain and a continuous bar for holding windlocks.

2.03 HOODS AND ACCESSORIES

- A. Hood: Form to entirely enclose coiled curtain and operating mechanism at opening head and act as wetherseal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.
 - 1. Fabricate aluminum hoods, complying with ASTM B 2019, alloy and temper recommended by aluminum doors. Hood to be painted to match curtain slats.
 - 2. Shape: Round.
 - 3. Exterior Mounted Door: Fabricate hood with sealant-joint bead profile for applying joint sealant.

- B. Weatherseals: provide replaceable, adjustable, continuous, compressible weather-stripping gaskets fitted to bottom and at top of exterior doors, unless otherwise indicated. At door head, use 1/8-inch thick, replaceable, continuous sheet secured to inside of curtain coil hood.
 - 1. In addition, provide replaceable, adjustable, continuous, flexible, 1/8-inch thick seals of flexible vinyl, rubber or neoprene at door jambs for a weathertight installation.
- C. Push/Pull Handles: For push-up-operated or emergency-operated doors, provide galvanized steel lifting handles on each side of door.
 - 1. Provide pull-down straps or pole hooks for doors more than 84 inches high.
- D. Fabricated locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
 - 1. Locking Bars: Single-jamb side, operable from inside only.
 - 2. Provide Lock cylinder for electric operation with interlock switch.
- E. Chain Lock Keeper: Suitable for padlock.

2.04 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of adjustable-tension steel helical torsion spring, mounted around a steel shaft and contained in a spring barrel connected to door curtain with required barrel rings. Use grease-sealed bearings of self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in. / ft. of span under full load.
- C. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast-steel barrel plugs to secure ends of springs to barrel and shaft.
- D. Fabricate torsion rod for counterbalance shaft of cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Provide mounting brackets of manufacturer's standard design, either cast-iron or cold-rolled steel plate with bell-mouth guide groove for curtain.

2.05 MANUAL DOOR OPERATORS

- A. Chain Hoist Operator: Provide manual chain hoist operator consisting of endless steel hand chain, chain pocket wheel and guard, and geared reduction unit with a maximum 35-lb pull for door operation. Furnish alloy steel hand chain with chain holder secured to operator guide.

2.06 FINISHES, GENERAL

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.07 ALLUMINUM FINISHES

- A. Where surfaces are not to be painted provide manufacturer's standard anodized class I finish.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordination and Measurements: Measurements shall be taken at the building to assure proper erection of the work. Check all dimensions, whether or not shown on the Drawings, upon which the accurate fitting and installation of the door may depend, or which would affect the proper operation of the door.

3.02 INSTALLATION

- A. Install overhead coiling doors in accordance with the instructions and recommendations of the manufacturer and in such a manner that will prevent damage or deformation. Doors shall be stored at the job site before installation on platforms or pallets. During storage, doors shall be stored in a weathertight area, and shall be covered to protect the door from dust, dirt and damage.
- B. Doors shall be installed plumb, level and true to line in accordance with the details shown on the approved shop drawings. Hardware shall be applied and adjusted to achieve quiet and smooth operation.
- C. Install the doors securely in appropriate frames and adjusted for proper operation without sticking or binding.
- D. Install door and operating equipment complete with necessary hardware, jamb, and head mold strips, anchors, inserts, hangers, and equipment supports in accordance with approved shop drawings, manufacturer's instructions, and as specified herein.
- E. Upon completion of installation including work by other trades, lubricate, test and adjust doors to operate easily, free from warp, twist or distortion and fitting weathertight for the entire perimeter.

3.03 PROTECTION

- A. Protect door installation from damage until the date of final acceptance. Damaged work shall be repaired or replaced to the satisfaction of the Owner and the Engineer at no additional cost to the Owner.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Door hardware.
- 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 08120 - Aluminum Doors and Frames.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 2. E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- B. Builders Hardware Manufacturers Association (BHMA):
 - 1. A156.7 - Template Hinge Dimensions.
 - 2. A156.18 - Materials and Finishes.
- C. Underwriters Laboratories, Inc.

1.03 SUBMITTALS

- A. Product Data.
- B. Hardware schedule: Include references to Engineer's hardware group number, door type designations, locations, other pertinent data, and manufacturer names or suitable abbreviation opposite items scheduled.
- C. Samples: Include for each different type and manufacturer for review of finish.
- D. Construction key distribution list: Submit upon Owner's request.

- E. Templates:
 - 1. Furnish hardware templates to fabricators of doors, frames, and other work to be factory-prepared for hardware.
 - 2. Check shop drawings of other work to confirm that adequate hardware backing is available.
- F. Project record documents: Include corrected hardware schedule.

1.04 REGULATORY REQUIREMENTS

- A. Provide hardware for fire-resistive rated openings that complies with UL and listed by UL.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hardware where directed in unopened packages with items packed separately, complete and ready for installation with necessary fittings, trim, fasteners, and accessories.
- B. Provide packages bearing the manufacturers' labels with each item or group of items identified according to the accepted hardware schedule.

1.06 SCHEDULING AND SEQUENCING

- A. Upon receipt of accepted hardware schedule, coordinate accepted hardware schedule, templates, reinforcing units, and template instructions to door and frame sections.

PART 2 PRODUCTS

2.01 FASTENERS

- A. Types:
 - 1. To concrete, marble, or masonry: Machine screws and flush shells.
 - 2. To wood: Wood screws.
 - 3. On gypsum board or plaster: Screws of sufficient length to provide solid connection to framing or backing behind gypsum board or plaster.
 - 4. To mineral and hollow core doors: Sex bolts.
 - 5. Of exit devices to doors: Thru-bolts, unless otherwise specified.
- B. Screws, exposed: Phillips-head type, full-threaded screws, not combination type.
- C. Sizes: Suitable for heavy use.
- D. Finish: Stainless steel.

2.02 HINGES

- A. Manufacturers: One of the following or equal:
 - 1. Stanley.
 - 2. Hager.

- 3. McKinney.
- 4. Ives.
- B. Material:
 - 1. Interior doors in corrosive environments: Stainless steel.
 - 2. Exterior doors: Stainless steel.
- C. Knuckles, number of: Minimum 5.
- D. Ball bearings: Concealed with interior self-lubricating bushings.
- E. Type for doors with closers: Ball bearing.
- F. Material for fire-resistive rated doors: Steel.
- G. Pins for interior doors: Non-rising.
- H. Pins for exterior doors: Non-removable.
- I. Template hinges: BHMA A156.7.
- J. Tips: Flat button.
- K. Height: As follows, unless otherwise specified:
 - 1. Doors 1-3/8-inch thick: 3-1/2 inches.
 - 2. Doors 1-3/4-inch thick and up to 41 inches wide: 4-1/2 inches.
 - 3. Doors 1-3/4-inch thick and from 41 to 48 inches wide: 4-1/2 inches, extra heavy.
 - 4. Doors 2 inches thick or over 48 inches wide: 5 inches, extra heavy.
- L. Widths: Sufficient to clear trim projection when door swings 180 degrees, unless otherwise specified.
- M. Number per door leaf: As follows, unless otherwise specified:
 - 1. 3 hinges on door to 7 feet, 6 inches in height.
 - 2. 1 additional hinge for each additional 2 feet, 6 inches of height or fraction thereof.

2.03 LOCKSETS

- A. Manufacturers typical: One of the following or equal:
 - 1. Schlage ND Series Rhodes design, non-keyed.
 - 2. Yale 4700 (LN) Series Augusta design, non-keyed.
- B. Cylinders:
 - 1. Number of pins: Minimum 6.
 - 2. Cases: Steel, cylindrical.
 - 3. Interior parts: Non-corrosive with non-plastic, non-die-cast, non-aluminum mechanisms.
 - 4. Accessibility to key-in-knob type cylinders: Not requiring removal of lockset from door.
 - 5. Plugs: Extruded brass bar material fully round without flattened areas.

- C. Strikes:
 - 1. Material: Same as lock trim.
 - 2. Lock and latch boxes: Wrought.
 - 3. Lips: Extended, able to protect trim from marring by latch bolt.
 - 4. Cutouts at metal frames: In accordance with ANSI, unless otherwise specified.
- D. Levers: Type that returns to within 1/2 inch of door.
- E. Backset: 2-3/4 inches.
- F. Trim materials: As follows, unless otherwise specified:
 - 1. Typical: Stainless steel.
 - 2. Corrosive environments: Stainless steel.

2.04 PUSH/PULL PLATES

- A. Manufacturers: One of the following or equal:
 - 1. Ives.
 - 2. Trimco.
 - 3. Rockwood.
- B. Pulls:
 - 1. Material: As scheduled.
 - 2. Size: Minimum 8 inches center to center, minimum grip diameter of 3/4 inch, minimum projection of 2-1/4 inch.
- C. Pull plates:
 - 1. Material: As scheduled.
 - 2. Plate size: Minimum 3 by 12 inches by 0.050-inch thick, with beveled edges on 4 sides with pull.
 - 3. Pull size: Minimum 8 inches center to center, minimum grip diameter of 3/4 inch, minimum projection of 2-1/4 inch.
- D. Push plates:
 - 1. Material: As scheduled.
 - 2. Size: Minimum 3 by 12 inches by 0.050-inch thick, with beveled edges on 4 sides.

2.05 CLOSERS

- A. Manufacturers:
 - 1. Features:
 - a. Heavy-duty.
 - b. Non-handed and non-sized.
 - c. Adjustable spring power from size 1 through 4.
 - d.
 - 2. One of the following or equal:
 - a. Sargent, 351 Series.
 - b. LCN, Super Smoothee Model 4041 Series.
 - c. Norton Door Controls, Multi-Size Door Closers Model 7500BF Series.
- B. Type: Full rack and pinion type with steel spring and non-gumming, non-freezing hydraulic fluid.

- C. Controls: Separate set for regulating sweep speed, latch speed, backcheck and backcheck positioning, or where schedules, spring power.
- D. Sizes: As recommended by accepted manufacturer.
- E. Covers: Metal, capable of receiving finishes to match adjacent hardware finishes, unless otherwise specified.
- F. Narrow frame provisions: Drop plates.
- G. Effort to operate: As follows:
 - 1. Exterior: Maximum 8-1/2 pounds.
 - 2. Interior: Maximum 5 pounds.
 - 3. Fire-resistive rated doors: Maximum 15 pounds.
- H. Adjust closers in accordance with manufacturer's directions for size of door.

2.06 MISCELLANEOUS DOOR HARDWARE

- A. Wall stops: As scheduled.
 - 1. Manufacturers: One of the following or equal:
 - a. Ives.
 - b. Trimco.
 - c. Rockwood.
- B. Exit/Panic Device: As scheduled.
 - 1. Manufacturers: One of the following or equal:
 - a. Adams Rite.
 - b. Vdams Rite.
 - c. Duprin.
 - d. Arrow.
- C. Floor stops: As scheduled with strike of suitable height to compensate for clearance between door and floor.
 - 1. Manufacturers: One of the following or equal:
 - a. Ives.
 - b. Trimco.
 - c. Rockwood.
- D. Mechanical holders: Foot-operated plunger with instant release by touch of toe and integral spring to keep constant shoe pressure against floor; brass.
 - 1. Manufacturers: The following or equal:
 - a. Glynn-Johnson.
- E. Automatic flush bolts: Mortise, bar with stop-mounted coordinator and strikes; materials as scheduled.
 - 1. Manufacturers: One of the following or equal:
 - a. Glynn-Johnson.
 - b. Hager Hinge Co.

- F. Kick plates: As scheduled, 0.050-inch thick, beveled edges, 10 inches high, 1-1/2 inches narrower than single doors, 1 inch narrower than leaf of door pairs.
 - 1. Manufacturers: One of the following or equal:
 - a. Ives.
 - b. Trimco.
- G. Gasketing systems: As scheduled, self-adhesive silicone seal, continuous at head and jambs, rated for fire and smoke in accordance with ASTM E 283, sound rated in accordance with ASTM E 90.
 - 1. Manufacturers: One of the following or equal:
 - a. Pemko Mfg. Co.
 - b. National Guard Products Inc.
 - c. Reese.
- H. Weatherstripping for exterior doors and smoke, light, and sound seals for interior doors.
- I. Thresholds: As scheduled, extruded aluminum, maximum 1/2-inch high, maximum slope of 1 foot in 2 feet.
 - 1. Manufacturers: One of the following or equal:
 - a. National Guard Products Inc.
 - b. Pemko Mfg. Co.
- J. Dustproof strike: As scheduled.
 - 1. Manufacturers: One of the following or equal:
 - a. Ives.
 - b. Trimco.
- K. Coordinator with filler bar: As scheduled, non-handed, series type length as required for door sizes indicated, complete with filler lengths as required, with mounting brackets and carry bars when required for proper operation; steel with manufacturer's standard prime finish capable of receiving painted finish.
 - 1. Manufacturers: One of the following or equal:
 - a. Glynn-Johnson Coordinators, Model COR Series.
 - b. Ives, Door Co-Ordinator, Model 900 Series.
- L. Door bottoms: As scheduled, extruded aluminum with vinyl insert, surface mounted, length equal to door width minus 2 inches, automatic, recessed in bottom of door.
 - 1. Manufacturers: One of the following or equal:
 - a. Pemko.
 - b. Reese.
- M. Astragals: As specified in Section 08120.
- N. Silencers: As scheduled, pneumatic gray rubber.
 - 1. Manufacturers: One of the following or equal:
 - a. Trimco.
 - b. Ives.
 - c. Rockwood.

2.07 FINISHES

- A. Brass and bronze: BHMA A156.18 626 (US26D), satin chrome.

- B. Steel: BHMA A156.18 652 (US26D), satin chrome.
- C. Stainless steel: BHMA A156.18 630 (US32D), satin stainless steel.
- D. Aluminum: BHMA A156.18 628 (US28).
- E. Plastic closer covers: Spray paint to match typical door hardware finish.
- F. Metal closer covers: Plate covers to match typical door hardware finish.
- G. Electromagnetic hold open devices: Manufacturer's standard brushed zinc finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect doors and door frames for damage or defects and examine hardware for compatibility with receiving conditions and suitable to intended use.
- B. Verify that required wall backing has been installed.

3.02 INSTALLATION

- A. Install finish hardware in accordance with manufacturer's templates and instructions.
- B. Accurately and properly fit hardware.
- C. Securely fasten fixed parts for smooth, trouble-free, non-binding operation.
- D. Fit faces of mortise parts snug and flush.
- E. Ensure that operating parts move freely and smoothly without binding, sticking, or excessive clearance.
- F. Protection:
 - 1. Protect door hardware from damage or marring of finish during construction, use strippable coatings, removable tapes, or other acceptable means.
 - 2. Ensure door hardware displays no evidence of finish paint after final building cleanup.
- G. Latch guard and dead bolts: Install so that bolts automatically engage in keeper, whether activated by closer or by manual pressure.
- H. Closers:
 - 1. Mount on opposite sides of corridors or vestibules, except at exterior doors.
 - 2. Mount for 180-degree swing wherever possible.
 - 3. Mount with drop plates at narrow top rail doors.
 - 4. Adjust to operate noiselessly and evenly.
 - 5. Have closer manufacturer regulate closers prior to final acceptance of project.

- I. Kick plates: Screw on push side of doors, unless otherwise indicated on the Drawings.
- J. Gasketing: Mount to provide complete contact between door and frame, finished floor, or both; and weathertight enclosure.
- K. Thresholds:
 - 1. Install immediately before inspection for final acceptance or protect from heavy traffic damage during construction.
 - 2. Cope to fit door frame profile and drill to suit required flush bolts and panic bolts.
 - 3. Unless indicated on the Drawings to be set in grout, set in double bead of sealant, tightly fit at jambs, and make waterproof.
 - 4. Fasten to concrete slab with 5/16-inch stainless steel flat head countersunk machine screws and concrete anchors at 8-inch centers.
- L. Silencers: Insert into predrilled holes in frames.

3.03 ADJUSTING

- A. Examine hardware in place for complete and proper installation. Lubricate bearing surfaces for proper function.
- B. Replace, rework, or otherwise correct defective door hardware, including incorrect hand or function.

3.04 CLEANING

- A. Remove protective materials and devices and thoroughly clean exposed surfaces of hardware.
- B. Check for surface damage prior to final cleaning for acceptance of project.

3.05 HARDWARE SCHEDULE

HARDWARE GROUP HW-1 (EXTERIOR DOUBLE DOOR – 1 ACTIVE LEAF AND SINGLE DOOR)		
Hinges	6	Ives, 5BB1, 4-1/2 x 4-1/2, US32D
Threshold	1	Pemko, 170 A
Exit Device	1	Von Duprin, 98/99 Series
Weatherstrip	1 Set	Pemko, 303 AS
Door Bottom	2	Pemko, 222 AV
Kick Plate	2	Ives, 8400, 8 x 34, US32D
Flush Bolts	1 Set	Ives, FB457, US26D
Lockset	1	Schlage, ND10S RHO RD 626

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.
- 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.

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.
- 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.
- 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. 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. Carboline: Carboline, St. Louis, MO.
 - 2. ICI/Devoe: ICI/Devoe/AkzoNobel, Strongsville, OH.
 - 3. Rustoleum: Rustoleum Corp., Sommerset, NJ.
 - 4. S/W: Sherwin-Williams Co., Cleveland, OH.
 - 5. Tnemec: Tnemec Co., Kansas City, MO.
- B. Submit requests for substitutions as specified in Section 01600:
 - 1. Include certified ingredient analyses.
 - 2. Provide colors that match specified colors.

2.02 PRETREATMENT, PRIMERS, PRIMER-SEALERS, AND WOOD STAIN

- A. Aluminum primer: One of following or equal:
 - 1. Carboline: Carbocrylic 120.
 - 2. ICI/Devoe: Devflex 4020 DTM.
 - 3. S/W: DTM Wash Primer.
- B. Concrete masonry filler/primer: One of following or equal:
 - 1. Carboline: Sanitile 100.
 - 2. ICI/Devoe: Bloxfill 4000.
 - 3. S/W: HD Block Filler, B42W46.
 - 4. Tnemec:
 - a. Series 130, Envirofill.
 - b. Series 180, Tneme-crete.
- C. Concrete, porous, filler/primer: One of following or equal:
 - 1. Carboline: Sanitile 100.
 - 2. ICI/Devoe: Bloxfill 4000.

3. S/W: HD Block Filler, B42W46.
 4. Tnemec:
 - a. Series 130, Envirofill.
 - b. Series 180, Tneme-crete.
- D. Concrete, smooth, filler/primer: One of following or equal:
1. Carboline: Sanitile 100.
 2. Carboline: Carbocrylic 120.
 3. ICI/Devoe:
 - a. Bloxfill 4000.
 - b. Prep & Prime, Bond Prep 3030.
 4. S/W:
 - a. HD Block Filler, B42W46.
 - b. Epoxy Masonry Tilt Primer White B42WW49.
 5. Tnemec: Series 180, Tneme-Crete.
- E. Ferrous metal primer: One of following or equal:
1. Carboline: Carbocrylic 890.
 2. ICI/Devoe: Barrust 233.
 3. S/W: Macropoxy 646.
 4. Tnemec: Series 104.
- F. Galvanized metal surface pretreatment materials: One of following or equal:
1. Carboline: Surface Cleaner 3.
 2. ICI/Devoe: Devprep 88.
- G. Galvanized metal surface primer: One of following or equal:
1. Carboline: Carbocrylic 890.
 2. ICI/Devoe: Barrust 233.
 3. S/W: Macropoxy 646.
 4. Tnemec: Series 104.
- H. Plaster sealer: One of following or equal:
1. Carboline: Sanitile 120.
 2. ICI/Devoe: Prep & Prime, Bond Prep 3030.
 3. S/W:
 - a. Promar 200 Primer B28W8200.
 - b. Loxon Masonry Primer A24W300.
- I. Plywood, latex finishes: One of following or equal:
1. Carboline: Sanitile 120.
 2. ICI/Devoe:
 - a. Exterior: Prep & Prime, Hydrosealer 6001.
 - b. Interior: Prep & Prime, Hi Hide Wall 1000.
 3. S/W: A100 Latex Primer B42W8041.
- J. Wood primer for opaque finish paint, interior exposure: One of following or equal:
1. Carboline: Sanitile 120.
 2. ICI/Devoe: Prep & Prime, Gripper 3210.
 3. S/W: PrepRite Latex Primer B28W111.
- K. Wood primer for opaque finish paint, exterior exposure: One of following or equal:
1. Carboline: Sanitile 120.

2. S/W: A-100 Primer B42W.
3. ICI/Devoe: Prep & Prime, Hydrosealer 6001.
4. Wood stain: One of following or equal:
 - a. S/W:
 - 1) Interior: Wood Classic.
 - 2) Exterior: Woodscapes.
 - b. Approved equal.

2.03 PAINTS, INTERIOR EXPOSURE

- A. Latex, flat: One of following or equal:
 1. Carboline: Carbocrylic 3359 flat.
 2. ICI/Devoe:
 - a. Dulux Ultra 1201.
 3. S/W: Promar 200, B30W200.
- B. Latex, semi-gloss: One of following or equal:
 1. Carboline: Carbocrylic 3359.
 2. ICI/Devoe:
 - a. Dulux Ultra 1407.
 3. S/W: Promar 200, B77W3402D.
- C. Alkyd, gloss: One of following or equal:
 1. ICI/Devoe: Glidden Lifemaster Oil 1508.
 2. S/W:
 - a. Industrial Enamel, B54Z.
 - b. Water based Industrial Enamel, B53W311.
- D. Acrylic, semi-gloss: One of following or equal:
 1. Carboline: Carbocrylic 3359.
 2. ICI/Devoe:
 - a. Dulux Ultra 1407.
 3. S/W: Promar 200, B77W3402D.
 4. Tnemec: Series 1029, Enduratone.
- E. Urethane varnish, clear: One of following or equal:
 1. ICI/Devoe: Woodpride 1802 Clear Interior Water-based Varnish.
 2. S/W: Wood Classics Waterborne Polyurethane Varnish Gloss Clear A68V91.
- F. Oil: The following or equal:
 1. Watco Danish Oil.

2.04 PAINTS, EXTERIOR EXPOSURE

- A. Latex, flat: One of following or equal:
 1. Carboline: Carbocrylic 3359 flat.
 2. ICI/Devoe:
 - a. Dulux Professional 2200V.
 3. S/W: A-100, Flat Exterior Latex A6-100.
 4. Tnemec: 1028 Enduratone.

- B. Alkyd, gloss: One of following or equal:
 - 1. ICI/Devoe: Glidden Lifemaster Oil 1508.
 - 2. S/W:
 - a. Industrial Enamel, B54Z.
 - b. Water based Industrial Enamel B53W311.
- C. Acrylic latex, semi-gloss: One of following or equal:
 - 1. Carboline: Carbocrylic 3359 flat.
 - 2. ICI/Devoe:
 - a. Dulux Professional 2406V.
 - 3. S/W: A-100, Flat Exterior Latex A6-100.
 - 4. Tnemec: 1028 Enduratone.
- D. Urethane varnish, clear: One of following or equal:
 - 1. ICI/Devoe: FLOOD Spa-N-Deck Waterborne System.

2.05 PENETRATING WATER REPELLENTS

- A. Silane, Penetrating Water Repellent: Clear, containing 20 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals, LLC; Hydrozo 100 Plus.
 - b. Pecora Corporation; KlereSeal 940-S VOC KlereSeal 9100-S.
 - c. PROSOCO, Inc.; SLX100.
 - d. Tnemec Inc.; Dur A Pell 100.

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. Aluminum:
 - a. Remove surface contamination by steam, high-pressure water, or degreasers.
 - b. Abrade surface by abrasive blasting, power tool cleaning or hand tool cleaning.
 - c. Apply etching primer.
 - 2. Reinforced concrete panels:
 - a. Remove dirt, powdery residue, and foreign matter.
 - b. Paint immediately; both sides when applicable.
 - 3. Canvas and cotton insulation coverings: Remove dirt, grease, and oil.
 - 4. Concrete floors:

- a. Remove contamination, abrasive blast or acid etch and rinse with clear water.
 - b. Ensure required acid-alkali balance is achieved. Allow to dry thoroughly.
5. Copper for paint finish:
 - a. Remove contamination by steam, high-pressure water, or degreasers.
 - b. Abrade surface by abrasive blasting, power tool cleaning or hand tool cleaning.
 - c. Apply vinyl etch primer.
6. Copper for oxidized finish:
 - a. Remove contamination.
 - b. Apply oxidizing solution of copper acetate and ammonium chloride in acetic acid.
 - c. Rub on repeatedly for correct effect.
 - d. Once attained rinse surfaces well with clear water and allow to dry.
7. Gypsum wallboard:
 - a. Remove contamination and prime to show defects.
 - b. Repair and prime defects.
8. Galvanized surfaces:
 - a. Remove surface contamination and oils and wash with degreasers.
 - b. Apply coat of etching type primer.
9. Zinc coated surfaces: Remove surface contamination and oils and prepare for priming in accordance with metal manufacturer's recommendations.
10. Concrete and concrete masonry:
 - a. Remove dirt, loose mortar, scale, powder and other foreign matter.
 - b. Remove oil and grease with solution of tri-sodium phosphate.
 - c. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate.
 - d. Rinse well and allow to thoroughly dry.
 - e. Spot prime exposed metal with alkyd primer.
11. Plaster:
 - a. Fill hairline cracks, small holes and imperfections with patching plaster.
 - b. Smooth off to match adjacent surfaces.
 - c. Wash and neutralize high alkali surfaces where they occur.
12. Unprimed steel and iron: Remove grease, rust, scale, dirt and dust by wire brushing, sandblasting or other necessary method.
13. 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.
14. Wood and millwork:
 - a. Sandpaper to smooth even surface.
 - b. Wipe off dust and grit prior to priming.
 - c. Spot coat knots, pitch streaks, and sappy sections with sealer.
 - d. Fill nail holes and cracks after primer has dried and sand between coats.
15. Exterior wood siding:
 - a. Remove dust, grit, and foreign matter.
 - b. Seal knots, pitch streak, and sappy sections.
 - c. Fill nail holes with exterior caulking compound after prime coat has been applied.

16. Mildew:
 - a. Remove by scrubbing with solution of tri-sodium phosphate and chlorine bleach.
 - b. Rinse with clean water and allow surface to dry completely.
17. Glue laminated woods:
 - a. Remove grease and dirt.
 - b. Wash down surfaces with degreasers.

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. Where clear finishes are required ensure tint fillers match wood.
 1. Work fillers well into grain before set.
 2. Wipe excess from surface.
- G. Backprime exterior woodwork, which is to receive paint finish, with exterior primer paint.
- H. Backprime interior woodwork, which is to receive paint or enamel finish, with enamel undercoat paint.
- I. Backprime interior and exterior woodwork, which is to receive stain or varnish finish, with gloss varnish reduced 25 percent with mineral spirits.
- J. Prime top and bottom edges of wood and metal doors with enamel undercoat when they are to be painted.
- K. Prime top and bottom edges of wood doors with gloss varnish when they are to receive stain or clear finish.

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 interior surfaces of air ducts, convector, and baseboard heating cabinets that are visible through grilles and louvers with 1 coat of flat black paint, to limit of sight line.
- G. Paint dampers exposed immediately behind louvers, grilles, convector, and baseboard cabinets to match face panels.
- H. Paint exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.
- I. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.
- J. 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 PIPING COLOR CODE AND MARKER SCHEDULE

Service Fluid	Pipe Color	Marker Legend
Chemical Drain	Charcoal	CHEMICAL DRAIN
Drain	Charcoal	DRAIN
Instrumental Air	Purple	INSTRUMENTATION AIR

Service Fluid	Pipe Color	Marker Legend
Sample	Green	FLUID BEING SAMPLED
Sanitary Drain	Charcoal	SANITARY DRAIN
Service Air	Green	SERVICE AIR
Tank Drain	Charcoal	TANK DRAIN
Vent Pipe	Yellow	VENT PIPE

Letters	Color of Pipe	Color of Bands	Color of Letters
Nonpotable or Raw	Light blue	Dark Gray	Black
Sample	Dark Blue	Black	White
Fire Protection	Red	None	Black
Hydrants	Aluminum	None	Black
Drain	Dark Gray	None	White
Stainless Steel Pipe	White	Red	White
Compressed Air	Light Green	None	Black
Instrument Air	Light Green	Dark Green	Black
Backwash Air (Low Pressure)			
Stainless Steel Pipe	None	None	Black
Other Pipe	Light Green	None	Black

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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: Conduct as specified in Section 01312 - Project Meetings.
- 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 SEQUENCING AND SCHEDULING

- A. Sequence and Schedule: As specified in Section 01140 - Work Restrictions.

1.10 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-Ild 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.
- 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 convector 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 convector 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 tote storage secondary containment and fill station 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, dust, 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

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. Refer to mechanical and instrumentation drawings for additional requirements.
- B. Coordinate with the Belt Filter Press manufacturer to integrate 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 CONTRACTOR:
 - 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 FRP skid mounted control panel for each polymer blending unit (2 in total) and all drivers, controllers, and microprocessors 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. Coordinate with Belt Filter Press manufacturer 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.
 - 5. Submit process flow schematic of the skid mounted system.
- 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. As specified in Section 01600 - Product Requirements.

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, 20 days prior to the bid date for review and approval.

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. Downsize the flowmeter size as needed for the accurate flow range with appropriate reducer fittings as recommended by the Polymer skid supplier.
 - 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-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. Thermal flow switch shall be as recommended by the pump supplier and provide necessary relay, wirings, etc. in the Vendor Supplied Control Panel.
- j. Controllers:
 - 1) SCR motor controllers or VFDs located in the vendor supplied 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. Polymer blending unit manufacture shall coordinate with the Belt Filter Press Manufacturer and the Instrumentation System Supplier 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 from the Plant PLC system, 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.
 - g. The controller/PLC in the control panel shall be pre-programmed from the factory by the manufacturer's software programmer.
- 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) The controller/PLC and VFD (or SCR) unit shall be either mounted in a vendor supplied control panel or in two separate panels. Provide UPS for controller/PLC system. Each panel shall be provided with all necessary din-rail, switches, LED indication lights, relays, wiring, etc. for a complete and functional system.
 - 2) Front panel controls:
 - a) Provide in accordance with Section 17000 and as shown on instrumentation drawings.
 - 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, unless VFD controller is adjustable at the VCP without needing to open the panel.
 - f) Booster pump HAND/OFF/AUTO switch (if applicable and provided by the MANUFACTURER). If booster pump is needed, provide NEMA starter in the vendor control panel.
 - g) Main power ON light/Running Indication.
 - h) LCD display:
 - (1) Metering pump rate.
 - (2) Water flow rate.
 - (3) Solution concentration, if applicable.
 - i) Low water 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 as shown on drawings and as describes herein:
 - a) Provide dry relay contact outputs for the following:
 - (1) System running.
 - (2) In 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 skid mounted and will not accept external stand-alone control panel to be mounted away from the skid. 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 Belt Filter Press manufacturer in coordination with the polymer blender manufacturer and the instrumentation Contractor(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 vendor control 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 from the plant PLC system.
 - 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 Belt Filter Press manufacturer in strict conformance with the manufacturer's installation instructions and with favorable review shop drawings. Contractor and his instrumentation subcontractor shall be fully responsible and lead all necessary coordination with the manufacturers.

- 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. Contractor shall take the lead and responsibility to coordinate with the manufacturers as described below.
- B. Testing to be conducted by the polymer blending unit manufacturer's representative, Belt Filter Press 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. Belt Filter Press 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 Belt Filter Press 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 Contractor shall coordinate with the Belt Filter Press manufacturer and the Polymer Blending Unit manufacturer and 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

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11313

HORIZONTAL SPLIT-CASE CENTRIFUGAL WASHWATER PUMPS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Split-case centrifugal pumps with drivers and components for Belt Filter Press washwater application.
- 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 01140 - Construction Sequence.
 - b. Section 01600 - Product Requirements.
 - c. Section 01756 - Testing, Training and Facility Start-up.
 - d. Section 01782 - Operating and Maintenance Data.
 - e. Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
 - f. Section 09960 - High-Performance Coatings.
 - g. Section 15050 - Common Work Results for Mechanical Equipment.
 - h. Section 15958 - Mechanical Equipment Testing.
 - i. Division 16 - Electrical.

1.02 REFERENCES

- A. American Bearing Manufacturers Association (ABMA):
 - 1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. American Society of Mechanical Engineers (ASME):
 - 1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250.
 - 2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
- C. ASTM International (ASTM):
 - 1. A 48 - Standard Specification for Gray Iron Castings.
 - 2. A 108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - 3. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 4. A 283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
 - 5. A 322 - Standard Specification for Steel Bars, Alloy, Standard Grades.
 - 6. A 532 - Standard Specification for Abrasion-Resistant Cast Irons.

7. A 536 - Standard Specification for Ductile Iron Castings.
 8. A 582 - Standard Specification for Free-Machining Stainless Steel Bars.
 9. A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 10. B 505 - Standard Specification for Copper Alloy Continuous Castings.
 11. E 10 - Standard Test Method for Brinell Hardness of Metallic Materials.
 12. F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 13. F 594 - Standard Specification for Stainless Steel Nuts.
- D. Hydraulic Institute (HI):
1. 1.1-1.2 - Centrifugal Pumps for Nomenclature and Definitions.
 2. 1.3 - Rotodynamic (Centrifugal) Pumps for Design and Application.
 3. 1.6 - Centrifugal Pump Tests.
 4. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application, and Sound Measurement and Decontamination.

1.03 DEFINITIONS

- A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 1.1-1.2, 1.3, 1.6, and 9.1-9.5 and as modified in this Section.
- B. Flow, head, efficiency, and driver horsepower specified in this Section are minimums unless stated otherwise.

1.04 SYSTEM DESCRIPTION

- A. Split-case centrifugal pumps with components: Pump, driver, motors, and drive arrangements as scheduled with seals or packing, couplings, base plates, guards, supports, anchor bolts, necessary valves, gauges, taps, lifting eyes, stands, and other items as specified and as required for a complete and operational system.
- B. Pumps suitable for intermittent or continuous service with up to 10 milligrams per liter residual chlorine concentration.
- C. Pumps will draw suction from a gravity plant reuse water main supplied with 39 ft of static head from the vertical chlorine contact chamber and will maintain the pressure at the BFP spray bars at around 100 psi.
- D. Design requirements:
1. Pump performance characteristics:
 - a. As specified in the Pump Schedule.
 - b. Performance tolerances shall be the same as the test tolerances specified in Section 15958.
 2. Motor characteristics: As specified in the Pump Schedule.

1.05 SUBMITTALS

- A. Submit as specified in Section 15050.
- B. Torsional analysis: Submit as specified in Section 15050 when scheduled.

- C. Furnish motor submittals as specified in Division 16.
- D. Submit training materials.
- E. Submit field testing procedures.
- F. Manufacturer's Representatives qualifications as specified in Section 01756.
- G. Provide vendor operation and maintenance manual as specified in Section 01782.

1.06 QUALITY ASSURANCE

- A. As specified in Section 15050.
- B. Provide pumps in this Section from same manufacturer.
- C. Manufacture's Certificate of Installation and Functionality Compliance as specified in Section 01756.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 15050.

1.08 PROJECT CONDITIONS

- A. Environmental requirements: As required by the federal, state, and local regulatory agencies.

1.09 SEQUENCING AND SCHEDULING:

- A. Coordinate work with restrictions as specified in Section 01140.
- B. Coordinate work with Start-up /Check-out as specified in Section 01756.

1.10 WARRANTY

- A. Warranty:
 - 1. The Manufacturer shall provide a five (5)-year warranty on defects in materials and workmanship.
 - 2. The Warranty period shall start from the date of Substantial Completion and also meet the Contractor's General Warranty as defined in Contract General Conditions.
 - 3. The Contractor shall provide an executed copy of the warranty upon Substantial Completion as defined in Contract General Conditions.

1.11 MAINTENANCE

- A. Special tools: For each type or size of pump specified, manufacture shall provide 1 set of all special tools required for complete assembly or disassembly of all pump system components.
- B. Provide spare parts as recommended by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Pumps:
 - 1. Goulds Pumps, model as scheduled.
 - 2. No substitutions.

2.02 MATERIALS

- A. General: Materials in the Pump Schedule shall be the type and grade as specified in this Section.
- B. Cast iron: ASTM A 48, Class 30 minimum.
- C. Hi-chrome cast iron: ASTM A 532, Class III, Type A at 450 Brinell hardness.
- D. Ductile iron: ASTM A 536, Grade as scheduled.
- E. Bronze or leaded tin bronze: ASTM B 505, Alloy C92700.
- F. Type 304 stainless steel: ASTM A 276, Type 304 stainless steel.
- G. Type 316 stainless steel: ASTM A 276, Type 316 stainless steel or ASTM A 666, Type 316 stainless steel.
- H. Type 416 stainless steel: ASTM A 582, Type 416 stainless steel.
- I. Steel: ASTM A 108, Grade as scheduled.
- J. Hot-wrought alloy steel: ASTM A 322, Grade 4140, UNS Alloy G41400.
- K. Structural steel: ASTM A 283, Grade D.
- L. Neoprene: Polychloroprene rubber.

2.03 GENERAL PUMP CONSTRUCTION

- A. Type: Industrial (heavy) duty, split-case pumps meeting performance and design requirements and features as specified in this Section.
- B. Fasteners: Provide Type 316 stainless steel fasteners per ASTM F 593 and ASTM F 594.

2.04 PUMP CASINGS

- A. Type: Axially split case; allow removal of rotating element without disturbing piping connections or alignment; mounted horizontally or vertically as scheduled.
- B. Material: As scheduled.
- C. Construction: Of sufficient strength, weight, and thickness to provide accurate alignment and prevent excessive deflection.

- D. Design working pressure: Minimum 1.10 times maximum shutoff total dynamic head with maximum installable impeller diameter at maximum operating speed plus maximum suction static head.
- E. Hydrostatic test: 5-minute hydrostatic test minimum 1.5 times design working pressure.
- F. Casing assembly: Lifting eye bolts for removable half and doweling to facilitate alignment of bolted halves.
- G. Suction and discharge: Single suction as scheduled; piping connections in lower half of casing with side entry and exit unless otherwise indicated on the Drawings.
- H. Suction and discharge piping connections: Flanged, meeting ASME B16.1, Class 125, or ASME B16.5, Class 150, or higher pressure class as required to meet design working pressure.
- I. Vent and taps:
 - 1. Provide casings with bolt 3/4-inch threaded high-point and low-point drain taps.
 - 2. Provide 1/2-inch threaded tap with valve and pressure gauge on the suction and discharge flanges.

2.05 IMPELLERS

- A. Type: As scheduled.
- B. Material: As scheduled.
- C. Maximum number of vanes: As scheduled.
- D. Design with smooth water passages to prevent clogging by stringy or fibrous materials. Passages shall be capable of passing solids with sphere size as scheduled.
- E. Design impeller and volute for automatic unattended self-priming and repriming with a dry suction leg and without reliance on a suction check valve to maintain prime.
- F. Design impeller with integral pump out vanes on the back shroud.
- G. Method of securing to shafts: Threaded or Keyed and secured by bronze nut locked in place, but readily removable without use of special tools.
- H. Adjustment of axial clearance: Through jacking screws and lock nuts placed between frame and outboard bearing housing or by shims held in place by frame housing.
- I. Rotation: Clockwise looking from top, unless otherwise indicated on the Drawings.
- J. Balance: As specified in Section 15050 to meet vibration criteria as specified in Section 15958.

2.06 WEAR RINGS

- A. Impeller wear-ring material:
 - 1. When low lead bronze impeller is scheduled, provide bronze alloy meeting the requirements of NSF 61 and 372.
 - 2. When bronze impeller is scheduled, provide UNS Alloy C93200 wear ring.
 - 3. When zincless-bronze impeller is scheduled, provide UNS Alloy C93700 wear ring.
 - 4. When cast-iron impeller is scheduled, provide ASTM A48, Class 30 cast-iron wear ring.
 - 5. When stainless steel impeller is scheduled, provide Stainless Steel ASTM A276 CD4MCU wear ring.
 - 6. Impeller wear ring shall have a Brinell Hardness Number at least 50 less than the casing wear ring Brinell Hardness Number when tested in accordance with ASTM E10.
- B. Casing wear-ring material: Same material as impeller wear ring.
- C. Features:
 - 1. Able to allow compensation for minimum 1/8-inch wear.
 - 2. Removable.
 - 3. Fastened with recessed screws or keyed to casing to prevent relative rotation.

2.07 SHAFT

- A. Material:
 - 1. When low lead bronze impeller is scheduled, provide bronze alloy meeting the requirements of NSF 61 and 372.
 - 2. When bronze impeller scheduled, provide ASTM A582, Type 416 stainless steel shaft.
 - 3. When zincless-bronze impeller scheduled, provide ASTM A276, Type 316 stainless steel shaft.
 - 4. When cast-iron impeller scheduled, provide ASTM A108, Grade 1141 steel shaft.
 - 5. When stainless steel impeller is scheduled, provide Stainless Steel ASTM A276 Type 316 stainless steel shaft.
- B. Strength: Able to withstand minimum 1.5 times maximum operating torque and other loads.
- C. Resonant frequency: As specified in Sections 15050 and 15958.
- D. Deflection: Maximum 0.002 inches under operating conditions.
- E. Impeller attachment: Threaded on.
- A. Shaft sleeve:
 - 1. When low lead bronze impeller is scheduled, provide bronze alloy meeting the requirements of NSF 61 and 372.
 - 2. When bronze impeller scheduled, provide ASTM B505, UNS Alloy C93200 shaft sleeve.
 - 3. When zincless-bronze impeller scheduled, provide ASTM A276, Type 316 stainless-steel shaft sleeve.

4. When cast-iron impeller scheduled, provide ASTM A582, Type 416 stainless-steel shaft sleeve.
 5. When stainless steel impeller is schedule, provide Stainless Steel ASTM A276 Type 316 stainless steel shaft.
- B. Renewable, key locked or set screws in stuffing box, gland area, and bearings; able to protect shaft from pumped liquid and wear.
- C. Pump shaft seal:
1. Single, Cartridge.
 2. Carbide rotating and silicon stationary seal faces.
 3. Viton elastomers.
 4. Stainless steel cage and spring.
 5. Stuffing box shall be integral to the suction casing.

2.08 BEARING

- A. Bearing type: Anti-friction in accordance with ABMA standards; self-aligning spherical roller type radial bearings; angular contact ball type, or tapered roller for thrust bearings.
- B. Bearing lubrication:
1. Provide oil lubrication:
 - a. Separate oil reservoir type system.
 - b. External level indicator gauge.
 2. Size sufficiently to safely absorb heat energy normally generated in bearing under maximum ambient temperature of 60 degrees Celsius.
- C. Bearing life: Minimum L10 life of 100,000 hours at rated design point but not less than 24,000 hours in accordance with ABMA 9 or 11 at bearing design load imposed by pump shutoff with maximum-sized impeller at rated speed, whichever provides longest bearing life in intended service.
- D. Pump bearing frames:
1. 1-piece rigid construction with bearing housing at outboard (pump) end and at inboard (driver) end.
 2. Materials:
 - a. Pump bearing frame: ASTM A48, Class 30 minimum, cast iron.
 - b. Bearing housing and end cover: ASTM A48, Class 30 minimum, cast iron.
- E. Bearing frame drain hole: Tapped, located as low as possible to drain leakage when adjacent to packing or seal.

2.09 SHAFT STUFFING BOX

- A. Provide stuffing box suitable for shaft-seal type scheduled and as specified in Section 15050.
- B. Seal flushing: Use pumped fluid; pipes and passages by pump manufacturer with external replaceable filter, pressure-regulating device, seal-flush pressure gauge (with shutoff valve), and site flow indicator.

2.10 COUPLINGS

- A. Type: As scheduled, and as specified in Section 15050.
- B. Flexible coupling life: Infinite at up to 0.3-degree misalignment angle total or per disk for disk type at maximum operating loads.
- C. Design coupling to withstand a minimum of 1.5 times the maximum operating torque and other imposed loads.

2.11 SUPPORTS, PEDESTALS, AND BASEPLATES

- A. Materials: Same as pump casing or ASTM A 283 steel, hot-dip galvanized after fabrication and coated as specified in Section 09960.
- B. Pump and driver support strength: Able to withstand minimum 1.5 times maximum imposed operating loads or imposed seismic loads, whichever is greater.
- C. Configuration: Allow easy access to stuffing boxes, bearing frames, and couplings.
- D. Design a structural steel base and support system for the drive arrangement specified in this Section and as schematically indicated on the Drawings.
- E. Anchor bolts: As specified in Section 05190.

2.12 EQUIPMENT GUARDS

- A. Provide equipment safety guards as specified in Section 15050.

2.13 DRIVERS

- A. Horsepower:
 - 1. As scheduled.
 - 2. Listed driver horsepower is the minimum to be supplied:
 - a. Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
 - b. When scheduled driver is a motor, increase motor horsepower if required to prevent operation in the service factor.
 - c. Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.
- B. Motors: Provide motors as specified in Division 16 and as specified in this Section:
 - 1. Revolutions per minute: As scheduled.
 - 2. Enclosure: As scheduled.
 - 3. Electrical characteristics: As scheduled.
 - 4. Efficiency, service factor, insulation, and other motor characteristics: As specified in Division 16.
 - 5. Motor accessories: As specified in Division 16 and in this Section.
 - 6. Motor shall be premium efficiency as per Division 16.

2.14 FINISHES

- A. Pump manufacturer to factory prime and coat pump/motor and discharge elbow as specified in Section 09960.
- B. Contractor to provide touch-up field coatings as specified in Section 09960.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall be as indicated on the Drawings, in accordance with written instructions of the manufacturer, and as specified in Section 15050.

3.02 COMMISSIONING AND PROCESS START-UP REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services:

Source Testing (Witnessed or Non-witnessed)	Manufacturer Rep Onsite							
	Training Requirements		Installation Testing		Functional Testing		Process Operational Period	
	Maintenance (hrs per session)	Operation (hrs per session)	Trips	Days (each trip)	Trips	Days (each trip)	Trips	Days (each trip)
Non-Witnessed	2	2	1	1	1	1	24 hour on-call	

- C. Source Testing:
 - 1. Pump:
 - a. Test witnessing: As scheduled and as specified in Section 01756.
 - b. Performance test: Test level as scheduled; test as specified in Section 15958.
 - c. Vibration test: Test level as scheduled; test as specified in Section 15958.
 - d. Noise test: Test level as scheduled; test as specified in Section 15958.
 - 2. Pump casing: Hydrostatic pressure tests if specified in this Section.
 - 3. Motor: Test as specified in Division 16.
- D. Functional Testing:
 - 1. Pump assembly:
 - a. Performance test: Test level as scheduled; test as specified in Section 15958.
 - b. Vibration test: Test level as scheduled; test as specified in Section 15958.
 - c. Noise test: Test level as scheduled; test as specified in Section 15958.
 - 2. Motor: Test as specified in Division 16.

3.03 PUMP SCHEDULE

Tag Numbers		WW-PMP-01, WW-PMP-02
<u>General Characteristics:</u>		
Service	Belt Filter Press Washwater (using plant reclaimed Water)	
Total Suspended Solids in washwater	≤ 5 mg/L	
Residual chlorine in washwater	2 - 5 ppm (average)	
Quantity	2	
First Named Manufacturer's Model Number	3196 STi	
Torsional Analysis	Not Required	
Minimum Pumped Fluid Degrees Fahrenheit	50	
Normal Pumped Fluid Degrees Fahrenheit	70	
Maximum Pumped Fluid Degrees Fahrenheit	85	
<u>Pump Characteristics:</u>		
Impeller Type	Open	
Impeller, Maximum Number Vanes	5	
Shaft Seal Type	Single Mechanical	
Coupling Type	Spacer	
Speed Control	None	
Maximum Pump revolutions per minute	1800	
Pump Size	1x1.5-8	
<u>Rated Design Point:</u>		
Flow, gallons per minute	120	
Minimum Suction Head available, feet	12	
Additional Discharge Head required, feet	231	
Minimum Efficiency, percent	55	
<u>Other Conditions:</u>		
Shut Off Head, feet	255	
Maximum NPSHr at Every Specified Flow, feet	7.9	
Minimum Suction Static Head, feet (see note 1)	0.5	
Maximum Suction Static Head, feet (see note 1)	0.8	
<u>Pump Materials:</u>		
Pump Casing	Ductile Iron	
Impeller	316 Stainless	
Shaft	316 Stainless	

Tag Numbers		WW-PMP-01, WW-PMP-02
Stuffing Box		Cast Iron
Seal Water connection and solenoid valve		Yes
<u>Driver Characteristics:</u>		
Driver Type		Motor
Drive Arrangement		Horizontal, Coupled
Minimum Driver Horsepower		20
Maximum Driver Speed, revolutions per minute		3600
<u>Motor Characteristics (when motor is driver type):</u>		
Inverter Duty Rated		No
Motor Voltage/Phases/Hertz		460/3/60
Enclosure Type		TEFC
120VAC Space Heater		Yes
Motor Winding Thermostat		Yes
<u>Source Testing:</u>		
Test Witnessing		Not Witnessed
Performance Test Level		2
Vibration Test Level		None
Noise Test Level		None
<u>Functional Testing:</u>		
Performance Test Level		2
Vibration Test Level		1
Noise Test Level		1
<u>Notes:</u> <ol style="list-style-type: none"> Pump will draw water from a 10-inch gravity reuse water main with 39ft of static head to supply washwater from the old vertical chlorine contact chamber. This static head will be constant. 		

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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 Contractor and his Instrumentation Controls subcontractor shall furnish the BFPs and associated local control panels, including programming of the local control panels. The Contractor shall coordinate with the manufacturers of the shaftless screw conveyors, and the polymer blending units. After completion of the project, the Contractor shall provide laminated panel wiring diagrams (11x17) inside each new local control panel related to belt filter press units. Panel wiring diagrams shall incorporate the red-line mark-ups during the start-up and testing phase. Wiring diagrams without including the red-line mark-ups will be rejected and will need to recreate them without additional cost to the Owner.
- C. The Contractor shall provide BFP local control panel (LCP) as shown on Instrumentation drawings and as described 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).
- D. 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.
- E. 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).

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
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. Contractor in coordination with the BFP MANUFACTURER shall be fully responsible to take field measurements 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 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 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. BFP local control panel HMI screen shall have all information and control relating to the associated belt filter press system.
- 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. As specified in Section 01600 - Product requirements.

1.08 SCHEDULE AND SEQUENCING

- A. Coordinate with 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 Contractor (as applicable). Coordinate with Contractor on this.
 - 2. Contractor 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 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 Contractor 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 inch 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

Test	Value
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 1/2 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:
 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 or as per layout drawings.

- 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 PLC/CPU with I/O (input/output) system and PLC 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 with I/O system including power supply, CPU 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 7 graphic terminal color, 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 CMAR project, there will be two TSS analyzers installed and connected to the existing PLC in the Electrical Room No.2. The BFP master PLC program shall message with other Plant PLC to get the TSS values and will let the operator to select the desired meter to use for control. 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.

J. Miscellaneous Plant Signals:

1. Each BFP local control panel PLC system shall communicate with other plant PLC system to exchange some data such as signals/controls related to the BFP feed pumps, washwater pumps, existing TSS meters, etc.

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 SYSTEM PLC PROGRAMMING AND COORDINATION MEETINGS

- A. The PLC programming for local belt filter press control panel and associated HMI touchscreen panel shall be fully programmed by the BFP supplier. BFP local control panel PLC system shall communicate with other plant PLC system to exchange other necessary information as describes in other section of this specification. BFP control panel supplier shall provide HMI screens to the installing Instrumentation Contractor to include in the BFP Master Control Panel and stand-alone HMI 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. BFP supplier shall copy the HMI screens from the Installing Instrumentation Contractor and load them into the BFP local control panel HMI touchscreen panel and adjust the HMI database as needed.
- B. Belt filter press manufacturer shall include a minimum of three coordination meetings with the installing Instrumentation Contractor to coordinate the PLC programming. 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.

2.19 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.

2.20 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

- 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 Contractor 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

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 13446
MANUAL ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Valve and gate actuators.
 - 2. Handwheel actuators.
 - 3. Key operated valves.
 - 4. Bench stands.
 - 5. Floor stands.
 - 6. Accessory equipment and floor boxes.
- 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 09960 - High-Performance Coatings.
 - b. Section 15050 - Common Work Results for Mechanical Equipment.

1.02 REFERENCES

- A. Aluminum Association (AA):
 - 1. DAF-45 - Designation System for Aluminum Finishes.
- B. American Water Works Association (AWWA).

1.03 SUBMITTALS

- A. Shop drawings: Include shop drawings for hydraulic gate lifts with shop drawings for gates as integrated units.

1.04 QUALITY ASSURANCE

- A. Provide valve actuators integral with valve or gate, except for valve actuators utilizing T-wrenches or keys, and portable actuators intended to operate more than 1 valve.
- B. Provide similar actuators by 1 manufacturer.
- C. Provide gates and hand operating lifts by 1 manufacturer.

- D. Provide hydraulic gate lifts by 1 manufacturer.
- E. Provide hydraulic valve actuators and motorized actuators by 1 manufacturer.

1.05 WARRANTY

- A. As specified in Section 15050.

1.06 MAINTENANCE

- A. Extra materials:
 - 1. Key operated valve keys or wrenches: Furnish a minimum 4 keys with 4-foot shafts and 3-foot pipe handles or wrenches with 4-foot shafts and 3-foot handles for operating key operated valves.

PART 2 PRODUCTS

2.01 VALVE AND GATE ACTUATORS

- A. Stem covers:
 - 1. Aluminum pipe; threaded cap on top; bolted aluminum flange on bottom; 1- by 12-inch slots cut at 18 inches on center in front and back of pipe; capable of covering threaded portion of greased stems that project above actuators when gates or valves are opened or closed.
- B. Stem cover flanges, pipes and caps:
 - 1. After fabrication, etch and anodize to produce the following chemical finishes in accordance with AA publication DAF-45:
 - a. A 41 - Clear Anodic Coating.
 - b. C 22 - Medium Matte Finish.
- C. Gate stem covers: Concentric with stem.
- D. Position indicators:
 - 1. Tail rods on hydraulic cylinders, or dial indicators with clear full-open and closed position indicators, calibrated in number of turns or percentage of opening.
- E. Manual or power actuator size:
 - 1. Sized to deliver maximum force required under most severe specified operating condition, including static and dynamic forces, seat and wedge friction, and seating and unseating forces with safety factor of 5, unless otherwise specified.
- F. Actuator size: Capable of supporting weight of suspended shafting unless carried by bottom thrust bearings; shaft guides with wall mounting brackets.
- G. Provisions for alternate operation: Where specified or indicated on the Drawings, position and equip crank or handwheel operated geared valve actuators or lifts for alternate operation with tripod mounted portable gate actuators.
- H. Operation: Counterclockwise to open with suitable and adequate stops, capable of resisting at least twice normal operating force to prevent overrun of valve or gate in open or closed position.

- I. Open direction indicator: Cast arrow and legend indicating direction to rotate actuator on handwheel, chain wheel rim, crank, or other prominent place.
- J. Buried actuator housing: Oil and watertight, specifically designed for buried service, factory packed with suitable grease, completely enclosed space between actuator housing and valve body so that no moving parts are exposed to soil; provide actuators with 2-inch square AWWA operating nut.
- K. Worm gear actuators: Provide gearing on worm gear actuators that is self-locking with gear ratio such that torque in excess of 160 foot-pounds will not need to be applied to operate valve at most adverse conditions for which valve is designed.
- L. Traveling nut actuators: Capable of requiring maximum 100 foot-pounds of torque when operating valve under most adverse condition; limit stops on input shaft of manual actuators for fully open and closed positions; non-moving vertical axis of operating nut when opening or closing valve.

2.02 HANDWHEEL ACTUATORS

- A. Manufacturers: One of the following or approved equal:
 - 1. Rodney Hunt Company.
 - 2. Waterman Industries, Incorporated.
- B. Coating: Handwheel as specified in Section 09960.
- C. Mounting: Floor stand or bench stand. Unless otherwise indicated on the Drawings position actuator 36 inches (nominal) above top of walkway surface.
- D. Bearings above and below finished threaded bronze operating nut: Ball or roller.
- E. Wheel diameter: Minimum 24 inches.
- F. Indicator: Counterclockwise opening with arrow, and word OPEN cast on top of handwheel indicating direction for opening.
- G. Pull to operate: Maximum 40 pounds pull at most adverse design condition.
- H. Stem travel limiting device: Setscrew locked stop nuts above and below lift nut.
- I. Grease fittings: Suitable for lubrication of bearings.

2.03 HAND-CRANKED GEARED ACTUATORS

- A. Type: Single removable crank; fully enclosed.
- B. Mounting: Floor and bench stand. Unless otherwise indicated on the Drawings position actuator 36 inches (nominal) above top of walkway surface.
- C. Operating nut: When scheduled for portable actuators.
- D. Geared lifts: 2-speed with minimum ratio of 4 to 1.
- E. Teeth on gears, spur pinions, bevel gears, and bevel pinions: Cut.
- F. Lift nuts: Cast manganese bronze.

- G. Exterior surfaces on cast-iron lift parts: Smooth.
- H. Bearings above and below flange on lift nuts: Ball or roller; capable of taking thrust developed by opening and closing of gates under maximum operating head; with bronze sleeve bearings and sufficient grease fittings for lubrication of moving parts, including bearings and gears.
- I. Crank rotation indicator: Cast arrow with word OPEN in prominent location readily visible indicating correct rotation of crank to open gate.
- J. Hand cranks: 15-inch radius; requiring maximum 25 pounds pull to operate gate at maximum operating head; with:
 - 1. Revolving brass sleeves.
 - 2. Gears, spur pinions, bevel gears, and bevel pinions with cut teeth.
 - 3. Cast manganese bronze lift nuts.
 - 4. Cast-iron lift parts with smooth exterior surfaces.
- K. Indicator: Dial position type mounted on gear actuator; enclosed in cast-iron or aluminum housing with clear plastic cover; marked with fully open, 3/4, 1/2, 1/4, and closed positions.

2.04 FLOOR BOXES

- A. Manufacturers: One of the following or equal:
 - 1. Waterman industries, Inc.
- B. Floor boxes: Cast-iron; with:
 - 1. Counter type indicator.
 - 2. Hinged, lockable lid with directional arrow.
 - 3. 2-inch square AWWA operating nut.
 - 4. Packing gland providing drip-tight seal around valve shaft.

2.05 FLOOR STAND

- A. Manufacturers: One of the following or equal:
 - 1. Rodney Hunt Company.
 - 2. Waterman industries, Inc.
- B. Floor stand assemblies: Heavy-duty cast-iron, suitable for mounting specified actuator.

2.06 BENCH STANDS

- A. Manufacturers: One of the following or equal:
 - 1. Rodney Hunt Company.
 - 2. Waterman industries, Inc.
- B. Bench stands: Handwheel actuators or hand crank, geared actuators conforming to hand-cranked geared actuator requirements, except capacity to be mounted on haunch, wall bracket, or self-contained gate yoke.

2.07 ACCESSORY EQUIPMENT

- A. Wall brackets or haunches: As indicated on the Drawings.
- B. Stems: Stainless steel; sized to match output of actuator; minimum gate or valve operating stem diameter; maximum 200 slenderness ratio.
- C. Stem couplings: Stainless steel; internally threaded to match stem; lockable to stem by set screw.
- D. Stem guides: Cast-iron with silicon bronze bushing; maximum 200 slenderness ratio; capable of being mounted with wall bracket; adjustable in 2 directions.
- E. Wall brackets: Cast-iron, capable of withstanding output of actuator, adjustable in 2 directions.
- F. Stem stuffing boxes: Cast-iron, with adjustable gland and packing.
- G. Fasteners and anchor bolts: Type 316 stainless steel.
- H. Geared valve actuators: Provided with cut gears, either spur or worm; sized to operate valves at most adverse design condition; with maximum 40-pound pull at handwheel or chain wheel rim.
- I. Geared valve traveling nut actuators: Acceptable only where specified or indicated on the Drawings.
- J. Accessory equipment for valves and gates requiring remote actuators: Operating stems, stem couplings, stem guides, wall brackets, and stem stuffing boxes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install floor boxes in concrete floor with lid flush with floor.
- B. After installation of gate and stem covers, mark stem covers at point where top of stems are at full-open position and at closed position.
- C. Attach floor stand to structure with anchor bolts.
- D. Install stem stuffing boxes where operating stems pass through intermediate concrete floor slabs.

3.02 SCHEDULES

- A. Geared actuators: Provide geared actuators for following valves:
 - 1. Butterfly valves larger than 6 inches, nominal size, on liquid service.
 - 2. Butterfly valves larger than 10 inches, nominal size, on gas and air service.
 - 3. Plug valves 6 inches, nominal size, and larger.

- B. Handwheel actuators: Provide handwheel actuators for valves mounted 6 feet or less above floors.
- C. Chain wheel actuators: Provide chain wheel actuators for valves mounted more than 6 feet to centerline above floors.

END OF SECTION

SECTION 13448

INTELLIGENT ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Electric motor-driven actuators for valves.
- 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 14555 - Shaftless Screw Conveyor.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C504 - AWWA Standard for Rubber-Seated Butterfly Valves.
 - 2. C540 - AWWA Standard for Power-Actuating Devices for Valves and Slide Gates.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

1.03 DEFINITIONS:

- A. NEMA:
 - 1. Type 4X enclosure in accordance with NEMA 250, Type 4/6.

1.04 SUBMITTALS

- A. Product data:
 - 1. Electrical ratings:
 - a. Voltage and number of phases.
 - b. Starting and running current.
 - c. Voltage levels and source for control and status.
 - 2. Description of integral control interface.
 - 3. Environmental ratings, including NEMA enclosure rating and submergence capabilities.
 - 4. Gear ratios for both manual and motorized actuation.
 - 5. Opening and closing directions.
 - 6. Allowable starts per hour.
 - 7. List of all included options and accessories.

8. Full travel times.
 9. Gearbox data including gear ratio, and gearbox efficiency.
 10. Affidavit in accordance with AWWA C540.
- B. Shop drawings:
1. Wiring diagrams:
 - a. Include all options and expansion cards furnished with each actuator.
 2. Dimensioned drawings of each valve and actuator combination.
 3. Dimensioned drawings of each valve gearbox.
 4. Electric motor data.
- C. Calculations: Submit the following for each valve/gate size and class:
1. Operating torque calculations.
 2. Maximum torque calculations for seating and unseating.
 3. Maximum operating torque at starting and normal operation.
- D. Test reports:
1. Factory test report and certificate.
- E. Manufacturer's instructions:
1. Include manufacturer's instructions, description of system operation, start-up data, and troubleshooting checklists.
- F. Operations and maintenance data:
1. Include manufacturer's literature; cleaning procedures, replacement part lists, wiring diagrams, and repair data.
 2. Include a list of all configurable parameters, and the final values for each.
 3. List of recommended spare parts.
 4. List of special tools necessary for proper operation and/or maintenance.
 5. Exploded view drawings that illustrate all assemblies, sub-assemblies, and components.
 6. Routine test procedures for all electronic and electrical circuits.
 7. Troubleshooting chart covering the complete valve and controls/electrical power systems, showing description of trouble, probable cause, and suggested remedy.
 8. Certified factory and field-test results.

1.05 QUALITY ASSURANCE

- A. Obtain required information from the valve/gate supplier, including but not limited to:
1. Interface to gate or valve.
 2. Operating range:
 - a. Quarter turn or multi-turn.
 - b. Required turns for full travel on multi-turn applications.
 3. Direction of rotation for opening and closing.
 4. Maximum and normal torque requirements.
- B. All motorized, intelligent actuators shall be the product of a single manufacturer for all valve and gate applications on this project, regardless of gate or valve type, manufacturer, or supplier.

1.06 SPARE PARTS

- A. Provide the following spare parts (minimum 10 percent of total number of actuators of each model type furnished, but not less than 1 for each model of actuator furnished):
 - 1. Stem nut.
 - 2. Worm shaft subassembly.
 - 3. Drive sleeve subassembly.
 - 4. Complete actuator seal kit.
 - 5. Actuator gearbox oil (sufficient quantity to fill 4 gearboxes).
 - 6. Encoder.
 - 7. Control module.
- B. Provide 1 spare motor for each size motor furnished.
- C. All spare parts should be labeled on the outside of the container what equipment the part belongs.

1.07 WARRANTY

- A. Each actuator shall be warranted for a minimum of 24 months of operation up to a maximum of 36 months from shipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Equipment will one of the following only. No exceptions will be acceptable:
 - 1. Limitorque.

2.02 CHARACTERISTICS

- A. Provide actuators complete and operable with all components and accessories required for operation. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits, and configuration of the indication contacts etc. shall be carried out without the removal of any actuator covers. Sufficient commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators. Commissioning tools must be capable of restricting access for secure authorized release. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool.
- B. Power supply:
 - 1. Voltage and phases as indicated in the Schedule.
 - 2. Valve or gate motion independent of power supply phase rotation.
An external 24VDC backup power source must be provided to maintain settings and track valve position when main power is off. In the event of a (main) power (supply) loss or failure, the position contacts must continue to be able to supply remote position feedback and maintain interlock capabilities.

- C. Size actuator to move gates or valves from full open to closed position within the time indicated in the Schedule:
 - 1. If an operating time is not indicated on the Schedule, size the actuator to move gates or valves at minimum 12 inches per minute under maximum load. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.
 - 2. Size actuators so that gear boxes are not required where possible.
- D. Control interface:
 - 1. Configuration:
 - a. Input devices from the actuator for output settings, control values, ranges, torque switch settings, valve positions switch settings, and options.
 - 2. Local interface, integral to actuator:
 - a. Non-intrusive, non-contacting Hall effect sensor selector switches:
 - 1) LOCAL-OFF-REMOTE:
 - a) Motor actuator operation is prevented with the switch in OFF.
 - 2) OPEN-STOP-CLOSE:
 - a) Controls the valve when LOCAL-OFF-REMOTE is in LOCAL.
 - b) Configurable between maintained (actuator runs until end of travel, high torque, or a LOCAL-OFF-REMOTE is switched to OFF) and momentary (actuator stops when lever is released).
 - b. Local display:
 - 1) Valve fully open and fully closed indicators.
 - 2) Numerical display showing actual valve position in percent of travel.
 - 3. Control inputs:
 - a. Capable of using 120 VAC or 24 VDC inputs.
 - b. Controls the valve when LOCAL-OFF-REMOTE is in REMOTE.
 - c. Isolated inputs capable of operating from external control voltage source or internal power supply:
 - 1) Furnish a 120 VAC or 24 VDC control power supply within the actuator.
 - d. Provide the following inputs:
 - 1) OPEN.
 - 2) CLOSE.
 - 3) STOP.
 - e. OPEN and CLOSE inputs configurable between maintained (actuator runs until end of travel, high torque, or a STOP input) and momentary (actuator stops when command is removed).
 - 4. Status outputs:
 - a. Monitor relay output: Dry contact, normally closed, opens when actuator is not in REMOTE or in the event of any internal fault or alarm condition.
 - b. Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
 - 1) Fully closed.
 - 2) Fully open.
 - 3) LOCAL-OFF-REMOTE in REMOTE position.
 - 4) Fault.
 - c. All output contacts rated for 5 amps, 120 VAC and 24 VDC.
 - 5. Analog input:
 - a. Provide a 4-20 milliampere analog input for analog modulating valves when indicated on the Drawings.
 - b. Modulate valve to maintain position based on analog input value.
 - c. Maximum input impedance 250 ohms.

6. Analog output[s]:
 - a. Provide an isolated 4-20 milliampere analog output(s) when indicated on the Drawings:
 - 1) Loop power sourced from the actuator power supply.
 - 2) Capable of driving into a load up to 500 ohms.
 - 3) Output proportional to process value(s) indicated on the Drawings.
 - 4) Valve or gate position.
 - 5) Operating torque.

2.03 FEATURES

- A. Time delay on reversal: Incorporate time delay between stopping actuator and starting in opposite direction to limit excessive current, torque, and heating from instantaneous reversal.
- B. Data logging/Display:
 1. The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operational, alarm, configuration, and graphical datalogger information. The text display shall be English.
 2. Datalogger graphical displays should as a minimum be able to display log and trend graphs on the local LCD for the following:
 - a. Torque versus Position.
 - b. Number of Starts versus Position.
 - c. Number of Starts per hour.
 - d. Dwell Time.
 - e. Average Temperature.
 3. The main display shall be capable of indicating 4 different home-screens of the following configuration:
 - a. Position and Status.
 - b. Position and Torque (analog).
 - c. Position and Torque (digital).
 - d. Position and Demand (positioning).
 4. Provision shall be made for the addition of an optional environmental cover to protect the display from high levels of UV radiation or abrasive materials.
 5. The local controls and display shall be rotatable through increments of 90 degrees to suit valve and actuator orientation.
 6. In the event of a (main) power (supply) loss or failure, an external 24VDC power supply shall be required so the position contacts will continue to be able to supply remote position feedback and maintain interlock capabilities.

2.04 MATERIALS

- A. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.

2.05 COMPONENTS

- A. Motors:
 1. Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.

2. Torque ratings equal to or greater than that required for valve seating and dynamic torques with a 25 percent factor of safety:
 - a. Design requirements for rubber-seated AWWA butterfly valves:
 - 1) Design actuators for maximum gate or valve operating torque, in accordance with and using safety factors required in AWWA C504 and AWWA C542:
 - a) Valve actuator torque requirement for open-close service: Not less than the required valve-seating and dynamic torques under design operating conditions in accordance with AWWA C504.
 - b) Valve actuator torque requirement for modulating service: Not less than twice the required valve dynamic torque under design operating conditions in accordance with AWWA C504.
 - b. Design requirements for slide gates, gate valves, knife gate valves, globe valves, and diaphragm valves:
 - 1) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C542.
 - 2) Design for the maximum torque and thrust running load over the full cycle.
 - 3) Maximum torque or thrust rating: The actuator stall torque or maximum thrust output shall not exceed the torque or thrust capability of the valve or gate, as determined by the valve or gate manufacturer.
 3. Capable of being removed and replaced without draining the actuator gear case.
 4. Motor bearings shall be amply proportioned of the anti-friction type and permanently lubricated.
 5. Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius:
 - a. Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
 - b. 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
 6. Provide the following motor protection features:
 - a. Jammed valve (no valve motion detected through a time delay).
 - b. High motor temperature (sensed by an embedded thermostats).
 - c. High torque.
 - d. Single phasing protection.
- B. Enclosures:
1. Actuator housing ratings as indicated in the Schedule.
 2. Stainless steel external fasteners.
 3. Actuators shall be o-ring sealed, watertight to IP66/IP68 26feet for 96hrs, NEMA 4X. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed on site for cabling, the terminal compartment having the same ingress protection rating as the actuator with the terminal cover removed.
 4. Provide the following minimum enclosure ratings:
 - a. NEMA Type 4X enclosure for all applications.

5. Position Actuators that are not accessible shall have the capability of remote mounting the entire motor control assembly and shall be suitable for remote connection to the electric actuator up to 100 m distance, include local control facilities, a backlit LCD display and terminals for communication highway connection to the host actuator housed within a self-contained, double-sealed enclosure. In order to maintain the integrity of the enclosure, setting of the actuator torque levels, position limits, and configuration of the indication contacts etc. shall be carried out without the removal of any covers via a Bluetooth® wireless interface.
- C. Position sensing:
1. Electronic and adjustable using a solid-state encoder wheel:
 - a. Mechanical limit switches and potentiometers are not acceptable.
 2. Capable of retaining position and monitoring valve or gate motion when valve is manually actuated and when main power is not present.
 3. Valve range and position switch outputs field adjustable.
- D. Torque sensing:
1. Torque shutdown setting: 40 percent to 100 percent rated torque:
 - a. Adjustable in 1 percent increments.
 2. Capable of interrupting control circuit during both opening and closing and when valve torque overload occurs.
 3. Electrical or electronic torque sensing.
 4. Independent of variations in frequency, voltage, or temperature.
 5. Provide a temporary inhibit of the torque sensing system during unseating or during starting in mid-travel against high inertia loads.
 6. Provide visible verification of torque switch status without any housing disassembly.
- E. Manual actuators:
1. Hand wheel for manual operation:
 - a. The handwheel, when declutched, shall operate independently of any motor driven gear sets.
 - b. Maximum 80 pound pull on rim when operating gate or valve under maximum load.
 - c. Provide pull chain when motorized actuator is located more than 6 feet above floor surface (see mechanical drawings for elevations):
 - 1) Chain shall be of sufficient length to reach approximately 4 feet above the operating level.
 - 2) Where the chain obstructs an aisle or walkway, provide holdback or other means to ensure chain does not create a nuisance or hazard to operating personnel.
 2. Declutch lever: Padlockable, capable of mechanically disengaging motor and related gearing and freeing hand wheel for manual operation.
- F. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set:
1. Accurately cut to assure minimum backlash.
- G. Bearings:
1. Anti-friction bearing with caged balls or rollers throughout.
 2. Sealed-for-life type thrust bearings housed in a separate thrust base.

- H. Drive bushing:
 - 1. Easily detachable for machining to suit the valve stem or gearbox input shaft.
 - 2. Positioned in a detachable base of the actuator.
- I. Lubrication:
 - 1. Provide totally enclosed actuator gearing with grease filled gear case suitable for operation at any angle.
 - 2. Actuators requiring special or exotic lubricants are not acceptable.

2.06 ACCESSORIES

- A. Software:
 - 1. Furnish PC-based diagnostic and configuration software to display diagnostic data and configure actuators.
- B. Termination Module Cover:
 - 1. For actuators on a valve network provide a means to keep the valve network in service, in the event where the actuator must be removed.
 - 2. All actuators including the part-turn gearbox (if applicable) shall include a mechanical dial position indicator (MDPI) for the purpose of providing position indication.

2.07 SOURCE QUALITY CONTROL

- A. Factory test:
 - 1. Test each actuator in the factory, and submit an individual test certificate for each actuator.
 - 2. Perform a high potential test and record the following information:
 - a. Test voltage.
 - 3. Simulate a maximum and typical valve loads and record the following information:
 - a. Current and power factor at maximum and set torque values.
 - b. Torque as measured by the actuator.
 - c. Actuator output speed or operating time.
 - 4. Performance testing: Conduct performance test for each actuator simulating valve operating torque from full-open to full-close and from full-close to full-open. The following information shall be recorded during each performance test:
 - a. Torque at maximum torque setting.
 - b. Current at maximum torque setting.
 - c. Test voltage and frequency.
 - d. Actuator output speed and operating time for full-open to full-close.
 - e. Amperage draw on motors at breakaway and under normal operation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install actuators in accordance with manufacturer's instructions.

3.02 ON-SITE START-UP ASSISTANCE

- A. Prior to start up, Contractor shall inform service technicians of all requirements of the certificate of proper installation. All forms and documentation required for the certificate of proper installation shall be given to service technician prior to start up. Minimum of 1 day per two actuators.

3.03 MOTORIZED ACTUATOR SCHEDULE

- A. Provide all actuators required by the Drawings:
 - 1. Major process actuators are listed in the Intelligent Actuator Schedule.
 - 2. The schedule does not include all number and types of actuators required for the Project.
- B. Abbreviations relating to type:
 - 1. BFV = Butterfly Valve.
 - 2. BV = Ball Valve.
 - 3. PV = Plug Valve.
 - 4. SG = Slide Gate.
- C. Abbreviations relating to actuator type:
 - 1. O/C = Open and Close Service.
 - 2. MOD = Modulating Service.
- D. Abbreviations relating to controls:
 - 1. PA = Profibus PA.
 - 2. DP = Profibus DP.
 - 3. DN = DeviceNet.
 - 4. FF = Foundation Fieldbus H1.
 - 5. MB = Modbus RTU (RS-485).
 - 6. NET = Manufacturer's proprietary network.
 - 7. A = Analog (4-20mA) control, modulating duty.
 - 8. D = Discrete control, modulating duty.
 - 9. D-O/C = Discrete Open/Close.

END OF SECTION

INTELLIGENT ACTUATOR SCHEDULE										
Item	Quantity	Tag Number	Type	Size	Actuator Type	Rating	Voltage	Notes	Open Time	Controls
Westside Regional WRF Truck Loading Station Conveyor Slide Gate No. 1	1	L-CON-001-GAT-001	SG		O/C	4	480/3/60	1	60 s	D-O/C
Westside Regional WRF Truck Loading Station Conveyor Slide Gate No. 2	1	L-CON-001-GAT-002	SG		O/C	4	480/3/60	1	60 s	D-O/C
Westside Regional WRF Truck Loading Station Conveyor Slide Gate No. 3	1	L-CON-001-GAT-003	SG		O/C	4	480/3/60	1	60 s	D-O/C
Westside Regional WRF Truck Loading Station Conveyor Slide Gate No. 4	1	L-CON-001-GAT-004	SG		O/C	4	480/3/60	1	60 s	D-O/C
Westside Regional WRF Truck Loading Station Conveyor Slide Gate No. 5		L-CON-001-GAT-005	SG		O/C	4	480/3/60	1	60 s	D-O/C
Westside Regional WRF Truck Loading Station Conveyor Slide Gate No. 6	1	L-CON-001-GAT-006	SG		O/C	4	480/3/60	1	60 s	D-O/C
Notes: (1) Field verify characteristics prior to sizing motor actuator.										



**CONTRACT DOCUMENTS FOR
CONSTRUCTION OF THE
BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS
AT THE
WESTSIDE REGIONAL WATER RECLAMATION FACILITY**

ISSUED FOR BID

FEBRUARY 2020

**SPECIFICATIONS VOLUME 2
(DIVISIONS 14-17)**



CA 8571

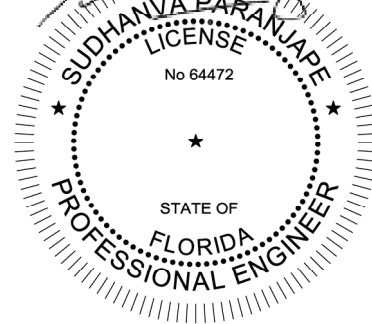
THIS PAGE INTENTIONALLY LEFT BLANK

**CITY OF DAYTONA BEACH
DESIGN OF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS
AT THE
WESTSIDE REGIONAL SLUDGE DEWATERING FACILITY IMPROVEMENTS**

Sudhanva Paranjape, P.E.
FL PE No.64472

Carollo Engineers, Inc.
CA 8571
200 East Robinson St., Ste. 1400
Orlando, Florida 32801
PHONE: (407) 478-4642 • FAX: (407) 478-4643

Digitally signed by Sudhanva Paranjape
Contact Info: Carollo Engineers, Inc.
Date: 2020.02.10 11:33Z -0500

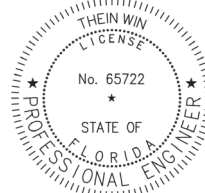


Printed copies of this document are not
considered signed and sealed and the signature
must be verified on any electronic copies.

Responsible for: 01010, 01140, 01292, 01294, 01312,
01324B, 01329, 01330, 01400, 01410, 01420, 01460,
01568, 01600, 01610, 01710, 01720, 01756, 01770, 01782,
11360, 11362, 13446, 13448, 14555, 15050, 15052, 15061,
15075, 15076, 15110, 15111, 15116, 15120, 15121, 15211,
15247, 15249, 15286, 15812, 15820, 15830, 15852, 15954,
15956, 15958

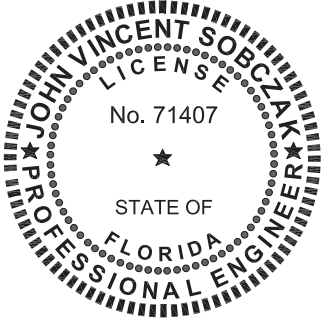
THIS PAGE INTENTIONALLY LEFT BLANK

**CITY OF DAYTONA BEACH
DESIGN OF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS
AT THE
WESTSIDE REGIONAL SLUDGE DEWATERING FACILITY IMPROVEMENTS**

<p style="text-align: center;">Thein Win, P.E. FL PE No. 65722</p> <p style="text-align: center;">Hillers Electrical Engineering, Inc. EB 0006877 23257 State Road 7, Suite 100 Boca Raton, FL 33428 PHONE: (561) 451-9165 • FAX: (561) 451-4886</p>	<div></div> <div><p>Digitally signed by Thein Win Date: 2020.02.07 11:07:10 -05'00'</p></div> <div><p><small>This item has been digitally signed and sealed by Thein Win, PE. on the date adjacent to the seal.</small></p><p><small>Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.</small></p></div>
<p>Responsible for: 16010, 16015, 16050, 16110, 16120, 16405, 16450, 16480, 16485, 16500, 16950, 17000</p>	

THIS PAGE INTENTIONALLY LEFT BLANK

**CITY OF DAYTONA BEACH
DESIGN OF BIOSOLIDS DEWATERING SYSTEM IMPROVEMENTS
AT THE
WESTSIDE REGIONAL SLUDGE DEWATERING FACILITY IMPROVEMENTS**

<p style="text-align: center;">John Sobczak, P.E. FL PE No. 71407</p> <p style="text-align: center;">Wekiva Engineering, LLC CA 31920 711 N. Orange Ave., Suite A Winter Park, FL 32789 Phone: (321)972-4989</p>	<p style="text-align: center;">John Sobczak c=US, o=Wekiva Engineering LLC, ou=A01410C0000016BC 320B0D400001FCD, cn=John Sobczak 16:09:19 2020.02.07 '00'05- 2019.021.20061</p>  <p style="text-align: center;">Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.</p>
<p>Responsible for: 03055, 03071, 03102, 03150, 03200, 03300, 03366, 03600, 03931, 05120, 05140, 05190, 05500, 07900, 08120, 08710, 09910, 09960</p>	

THIS PAGE INTENTIONALLY LEFT BLANK

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

TABLE OF CONTENTS
VOLUME 1 OF 2

DIVISION 01 – GENERAL REQUIREMENTS

SECTION NO.	TITLE
01010	SUMMARY OF WORK
01140	WORK RESTRICTIONS
01150	MEASUREMENT AND PAYMENT
01292	SCHEDULE OF VALUES
01294	APPLICATIONS FOR PAYMENT
01312	PROJECT MEETINGS
01324B	PROGRESS SCHEDULES AND REPORTS
01329	SAFETY PLAN
01330	SUBMITTAL PROCEDURES
01400	TEMPORARY FACILITIES
01410	REGULATORY REQUIREMENTS
01420	TESTING AND TESTING LABORATORY SERVICES
01460	CONTRACTOR QUALITY CONTROL PLAN
01568	TEMPORARY EROSION AND SEDIMENTATION CONTROL
01600	PRODUCT REQUIREMENTS
01610	PROJECT DESIGN CRITERIA
01710	PROJECT HOUSEKEEPING/CLEANING
01720	AS-BUILTS/RECORD DOCUMENTS
01756	TESTING, TRAINING, AND FACILITY START-UP
01770	CLOSEOUT PROCEDURES
01782	OPERATION AND MAINTENANCE DATA

DIVISION 02 - SITE CONSTRUCTION

SECTION NO.	TITLE
02050	SOILS AND AGGREGATES FOR EARTHWORK
02200	SITE CLEARING
02300	EARTHWORK
02318	TRENCHING
02722	AGGREGATE BASE COURSES
02742	ASPHALTIC CONCRETE PAVING
02952	PAVEMENT RESTORATION AND REHABILITATION

DIVISION 03 - CONCRETE

SECTION NO.	TITLE
03055	ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS
03071	EPOXIES
03102	CONCRETE FORMWORK
03150	CONCRETE ACCESSORIES
03200	CONCRETE REINFORCING
03300	CAST-IN-PLACE CONCRETE
03366	TOOLED CONCRETE FINISHING
03600	GROUTING
03931	EPOXY INJECTION SYSTEM

DIVISION 04 - MASONRY

SECTION NO.	TITLE
04220	CONCRETE UNIT MASONRY

DIVISION 05 - METALS

SECTION NO.	TITLE
05120	STRUCTURAL STEEL
05140	STRUCTURAL ALUMINUM
05190	MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY
05500	METAL FABRICATIONS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

**SECTION
NO. TITLE**

07900 JOINT SEALANTS

DIVISION 08 - DOORS AND WINDOWS

**SECTION
NO. TITLE**

08120 ALUMINUM DOORS AND FRAMES

08331 OVERHEAD COILING DOORS

08710 DOOR HARDWARE

DIVISION 09 - FINISHES

**SECTION
NO. TITLE**

09910 PAINTING

09960 HIGH-PERFORMANCE COATINGS

DIVISION 11 - EQUIPMENT

**SECTION
NO. TITLE**

11246 POLYMER BLENDING AND FEED EQUIPMENT-LIQUID

11313 HORIZONTAL SPLIT-CASE CENTRIFUGAL WASHWATER PUMPS

11362 BELT FILTER PRESS

DIVISION 13 - SPECIAL CONSTRUCTION

**SECTION
NO. TITLE**

13446 MANUAL ACTUATORS

13448 INTELLIGENT ACTUATORS

VOLUME 2 OF 2

DIVISION 14 – CONVEYING SYSTEMS

SECTION NO.	TITLE
14555	SHAFTLESS SCREW CONVEYORS

DIVISION 15 - MECHANICAL

SECTION NO.	TITLE
15050	COMMON WORK RESULTS FOR MECHANICAL EQUIPMENT
15052	COMMON WORK RESULTS FOR GENERAL PIPING
15061	PIPE SUPPORTS
15075	EQUIPMENT IDENTIFICATION
15076	PIPE IDENTIFICATION
15110	COMMON WORK RESULTS FOR VALVES
15111	BALL VALVES
15116	PLUG VALVES
15120	PIPING SPECIALTIES
15121	PIPE COUPLINGS
15211	DUCTILE IRON PIPE: AWWA C151
15247	POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE
15249	POLYVINYL CHLORIDE (PVC) PIPE: SCHEDULE TYPE
15740	HEAT PUMPS
15954	TESTING, ADJUSTING, AND BALANCING FOR HVAC
15956	PIPING SYSTEMS TESTING
15958	MECHANICAL EQUIPMENT TESTING

DIVISION 16 - ELECTRICAL

SECTION NO.	TITLE
16010	BASIC ELECTRICAL REQUIREMENTS
16015	ELECTRICAL SYSTEMS ANALYSIS
16050	BASIC ELECTRICAL MATERIALS AND METHODS
16110	RACEWAYS
16120	CONDUCTORS
16405	ELECTRIC MOTORS

16450	GROUNDING
16480	LOW VOLTAGE MOTOR CONTROL
16485	VARIABLE FREQUENCY DRIVES
16500	LIGHTING
16950	ELECTRICAL TESTING

DIVISION 17 - INSTRUMENTATION AND CONTROLS

SECTION NO.	TITLE
17000	INSTRUMENTATION AND CONTROLS

THIS PAGE INTENTIONALLY LEFT BLANK

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 calculated from the screw outside diameter, not trough cross-sectional area) - %	≤ 45	≤ 45	≤ 45
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:

$$\text{Deflection} = 7.29nr3P(b^2+h^2)/b^3h^3Gk$$

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

$$G = 11,000,000 \text{ psi}$$

(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 and 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 flighting 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 lighting 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) 1/2 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. 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. In sea air environment: Type 316 or 316L.
 - d. Other locations: Type 304 or 304L.
 - e. 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: As specified in Section 03600 - Grouting.

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. Flange bolts:
 - 1. As specified in Section 15052 - Common Work Results for General Piping.
- D. Mechanical assembly fasteners:
 - 1. Stainless steel:
 - a. High-temperature service or high-pressure service:
 - 1) Bolts: ASTM A193, Grade B8 (Type 304) or 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: ASTM A320, Grade B8 (Type 304) or Grade B8M (Type 316), Class 1, heavy hex.
 - 2) Nuts: ASTM A194, Grade 8 (Type 304) or Grade B8M (Type 316), heavy hex.
 - 3) Washers: Alloy group matching bolts and nuts.
 - c. General service:
 - 1) Bolts: ASTM F593, Alloy Group 1 (Type 304) or Alloy Group 2 (Type 316).
 - 2) Nuts: ASTM F594, Alloy Group 1 (Type 304) or 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.
 - 2. Drinking water service:
 - a. Asbestos free.
 - b. Material: Braided PTFE (Teflon).
 - c. Manufacturers: One of the following or equal:
 - 1) Chesterton, 1725.
 - 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 Section 17000.

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 PIPING AND VALVES

- A. Piping as specified in Section 15052 - Common Work Results for General Piping.
- B. Valves as specified in Section 15110 - Common Work Results for Valves.

2.13 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 304 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.

2.14 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.

2.15 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.

2.16 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.

2.17 SPECIAL TOOLS

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

2.18 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 Section 17000.

2.19 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

- A. Field measurements:
 - 1. Prior to shop drawings preparation, take measurements and verify dimensions indicated on the Drawings.
 - 2. Ensure equipment and ancillary appurtenances fit within available space.
- B. Sequencing and scheduling:
 - 1. Equipment anchoring: Obtain anchoring material and templates or setting drawings from equipment manufacturers in adequate time for anchors to be cast-in-place.
 - 2. Coordinate details of equipment with other related parts of the Work, including verification that structures, piping, wiring, and equipment components are compatible.
- C. Metal work embedded in concrete:
 - 1. Accurately place and hold in correct position while concrete is being placed.
 - 2. Clean surface of metal in contact with concrete immediately before concrete is placed.
- D. Concrete surfaces designated to receive non-shrink grout:
 - 1. Heavy sandblast concrete surface in contact with non-shrink grout.
 - 2. Clean concrete surfaces of sandblasting sand, grease, oil, dirt, and other foreign material that may reduce bond to non-shrink grout.
 - 3. Saturate concrete with water. Concrete shall be saturated surface damp at time non-shrink grout is placed.
- E. Install equipment in accordance with manufacturer's installation instructions and recommendations.
- F. Lubrication lines and fittings:
 - 1. Support and protect lines from source to point of use.

2. Fittings:
 - a. Bring fittings to outside of equipment in manner such that they are readily accessible from outside without necessity of removing covers, plates, housings, or guards.
 - b. Mount fittings together wherever possible using factory-mounted multiple fitting assemblies securely mounted, parallel with equipment lines, and protected from damage.
 - c. Fittings for underwater bearings: Bring fittings above water surface and mount on edge of structure above.
- G. Alignment of drivers and equipment:
1. Where drive motors or other drivers are connected to driven equipment by flexible coupling, disconnect coupling halves and align driver and equipment after complete unit has been leveled on its foundation.
 2. Comply with procedures of appropriate HI, AGMA Standards, alignment tolerances of equipment manufacturers and the following requirements to bring components into angular and parallel alignment:
 - a. Maximum total coupling offset (not the per-plane offset): Not to exceed 0.5 mils per inch of coupling length for spacer couplings based on coupling length (not dial separation).
 - b. Utilize jacking screws, wedges, or shims as recommended by the equipment manufacturer and as specified in the equipment sections.
 3. Use reverse-indicator arrangement dial-type or laser-type alignment indicators: Mount indicators on the driver/coupling flange and equipment/coupling flange. Alignment instrumentation accuracy shall be sufficient to read angular and radial misalignment at 10 percent or less of the manufacturer's recommended acceptable misalignment.
 4. Alignment and calculations shall include measurement and allowance for thermal growth, spacer coupling length, indicator separation, and axial spacing tolerances of the coupling.
 5. When alignment satisfies most stringent tolerance of system components, grout between base and foundation.
 - a. Allow minimum 48 hours for grout to harden.
 - b. After grout hardens, remove jacking screws, tighten anchor bolts and other connections, and recheck alignment.
 - c. Correct alignment as required.
 6. After functional testing is complete, dowel motor or drivers and driven equipment:
 - a. Comply with manufacturer's instructions.
- H. Grouting under equipment bases, baseplates, soleplates, and skids:
1. Unless otherwise indicated on the Drawings, grout with non-shrink grout as specified in Section 03600 - Grouting.
 - a. Non-shrink epoxy grout required only when indicated on the Drawings.
 2. Comply with equipment manufacturer's installation instructions for grouting spaces, and tolerances for level and vertical and horizontal alignment.
 3. Install grout only after:
 - a. Equipment is leveled and in proper alignment.
 - b. Piping connections are complete and in alignment with no strain transmitted to equipment.
 4. Do not use leveling nuts on equipment anchors for supporting and leveling equipment bases, baseplates, soleplates, and skids for grouting.

5. Use jack screws for supporting and leveling equipment bases, baseplates, soleplates, and skids for grouting following the procedure defined below:
 - a. Drill and tap equipment base plates, sole plates, and skids for jack screws.
 - b. Use suitable number and size of jack screws.
 - c. End of jack screws shall bear on circular steel plates epoxy bonded to equipment foundation.
 - d. Jack screw threads that will be in contact with grout: Wrap with multiple layers of tape or other material, acceptable to Engineer, to prevent grout from bonding to threads.
 - e. Place and cure grout as specified in Section 03600 - Grouting.
 - f. After grout is cured, remove jack screws and material used to prevent bonding to grout.
 - 1) Provide jack screws to Owner for future use.
 - g. Tighten equipment anchors in accordance with equipment manufacturer requirements.
 - h. Fill holes where jack screws have been removed with grout.
 - i. Cure as specified in Section 03600 - Grouting.
6. For equipment bases, baseplates, soleplates, and skids where it is not practical to use jack screws, use steel wedges and shims.
 - a. Wrap wedges and shims that contact grout with multiple layers of tape or other material, acceptable to Engineer, to prevent grout from bonding.
 - b. Place and cure grout as specified in Section 03600 - Grouting.
 - c. Remove wedges or shims.
 - d. Tighten equipment anchors to in accordance with equipment manufacturer requirements.
 - e. Fill voids where wedges and shims have been removed with grout.
 - f. Cure as specified in Section 03600 - Grouting.
7. Preparation of equipment bases, baseplates, soleplates, and skids for grouting:
 - a. Metal in contact with grout: Grit blast to white metal finish.
 - b. Clean surfaces of equipment bases, baseplates, soleplates, and skids in contact with grout of dirt, dust, oil, grease, paint, and other material that will reduce bond.
8. Preparation of concrete equipment foundation for grouting:
 - a. Rough concrete surfaces in contact with grout.
 - b. Concrete contact surface shall be free of dirt, dust, laitance, particles, loose concrete, or other material or coatings that will reduce bond.
 - c. Saturate concrete contact surface area with water for minimum of 24 hours prior to grouting.
 - d. Remove standing water just prior to grout placement, using clean rags or oil-free compressed air.
9. Forms and header boxes:
 - a. Build forms for grouting of material with adequate strength to withstand placement of grouts.
 - b. Use forms that are rigid and liquid tight. Caulk cracks and joints with an elastomeric sealant.
 - c. Line forms with polyethylene film for easy grout release. Forms carefully waxed with 2 coats of heavy-duty paste wax will also be acceptable.

10. Grout placement requirements:
 - a. Minimum ambient and substrate temperature: 45 degrees Fahrenheit and rising:
 - 1) Conform to grout manufacturer's temperature requirements.
 - b. Pour grout using header box.
 - c. Keep level of grout in header box above bottom of equipment bases, baseplates, soleplates, and skids at all times to prevent air entrapment.
 - d. Grout shall flow continuously from header box to other side of forms without trapping air or forming voids.
 - e. Vibrate, rod, or chain grout to facilitate grout flow, consolidate grout, and remove entrapped air.
 - f. After grout sets, remove forms and trim grout at 45-degree angle from bottom edge of equipment bases, baseplates, soleplates, and skids.
 - g. Cure as specified in Section 03600 - Grouting.
- I. Field welding:
 1. Use welding procedures, welders, and welding operators qualified and certified in accordance with AWS D1.1.
 2. Shielded arc welding.
- J. Field finishes:
 1. Protect motors.
 2. Clean equipment.
 3. Apply primer and coating systems as specified in Section 09960 - High-Performance Coatings requirements.
- K. Special techniques:
 1. Use applicable special tools and equipment, including precision machinist levels, dial indicators, and gauges as required in equipment installations.
- L. Tolerances:
 1. Completed equipment installations: Comply with requirements for intended use and specified vibration and noise tolerances.
- M. Warning signs:
 1. Mount securely with stainless fasteners at equipment that can be started automatically or from remote locations.

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 and 16950.
 3. Vendor control panels: As specified in Section 17000.

END OF SECTION

SECTION 15052

COMMON WORK RESULTS FOR GENERAL PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Basic piping materials and methods.
- 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 01140 - Work Restrictions.
 - b. Section 09960 - High-Performance Coatings.
 - c. Section 15061 - Pipe Supports.
 - d. Section 15211 - Ductile Iron Piping: AWWA C151
 - e. Section 15956 - Piping Systems Testing.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
 - 2. B16.47 - Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard.
- B. American Water Work Association (AWWA):
 - 1. C207 - Standard for Steel Pipe Flanges for Waterworks Services-Size 4 In. Through 144 In.
- C. ASTM International (ASTM):
 - 1. A 193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - 2. A 194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - 3. A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 4. F 37 - Standard Test Methods for Sealability of Gasket Materials.

1.03 DEFINITIONS

- A. Buried pipe: Pipe that is buried in the soil, or cast in a concrete pipe encasement that is buried in the soil.

- B. Exposed pipe: Pipe that is located above ground, or pipe that is located inside a structure, supported by a structure, or cast into a concrete structure.
- C. Underground piping: Piping actually buried in soil or cast in concrete that is buried in soil.
- D. Underwater piping: Piping below tops of walls in basins or tanks containing water.
- E. Wet wall: Wall with water on at least 1 side.

1.04 SUBMITTALS

- A. Product data:
 - 1. Escutcheons.
 - 2. Flange bolts.
 - 3. Gaskets.
 - 4. Link -type seals.
 - 5. Certifications of compliance with reference standard for lead limits.

PART 2 PRODUCTS

2.01 ESCUTCHEONS

- A. Material: Chrome-plated steel plate.
- B. Manufacturers: One of the following or equal:
 - 1. Dearborn Brass Company, Model Number 5358.
 - 2. Keeney Manufacturing Company, Model Number 102 or Number 105.

2.02 LINK TYPE SEALS

- A. Characteristics:
 - 1. Modular mechanical type, consisting of interlocking neoprene or synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening.
 - 2. Assemble links solely with stainless steel bolts and nuts to form a continuous rubber belt around the pipe.
 - 3. Provide a nylon polymer pressure plate with Type 316 stainless steel hardware. Isolate pressure plate from contact with wall sleeve.
- B. Manufacturers: One of the following or equal:
 - 1. Calpico, Incorporated.
 - 2. Pipeline Seal and Insulator, Inc., Link-Seal.

2.03 FLANGE BOLTS

- A. Ductile iron pipe:
 - 1. Bolts and nuts for ductile iron pipe flanges located indoors, outdoors above ground, or in dry vaults and structures and where pressures do not exceed 150 pounds per square inch shall be hot-dip galvanized carbon steel, ASTM A 307, Grade B.

2. Bolts and nuts for ductile iron pipe flanges located indoors, outdoors above ground, or in dry vaults and structures where the pressures exceed 150 pounds per square inch shall be alloy steel, ASTM A 193, Grade B7.
 3. Bolts and nuts for ductile iron pipe flanges submerged in water or wastewater, buried, in wet vaults or structures, adjacent to wet walls, or above open water-containing structures shall be Type 316 stainless steel in accordance with ASTM A 193, Grade B8M for bolts and in accordance with ASTM A 194, Grade 8M for nuts.
 4. Provide a washer for each nut. Washer shall be of the same material as the nut.
 5. Nuts shall be Heavy hex-head, Type 2H.
 6. Cut and finish flange bolts to project a maximum of 1/4 inch beyond outside face of nut after assembly.
 7. Tap holes for cap screws or stud bolts when used.
- B. Lubricant for stainless steel bolts and nuts:
1. Chloride-free.
 2. Manufacturers: One of the following or equal:
 - a. Huskey FG-1800.

2.04 GASKETS

- A. Gaskets for non-steam cleaned ductile iron and steel piping:
1. Suitable for pressures equal to and less than 150 pounds per square inch gauge, temperatures equal to or less than 250 degrees Fahrenheit, and raw sewage service.
 2. Gasket material:
 - a. Neoprene elastomer with minimum Shore A hardness value of 70.
 - b. Reinforcement: Inserted 13-ounce nylon fabric cloth for pipes 20 inch or larger.
 - c. Thickness: Minimum 3/32-inch thick for less than 10-inch pipe; minimum 1/8 inch thick for 10-inch and larger pipe.
 3. Manufacturers: One of the following or equal:
 - a. Pipe less than 20 inches in diameter:
 - 1) Garlock, Style 7797.
 - 2) John Crane, similar product.
 - b. Pipe 20 inches in diameter and larger:
 - 1) Garlock, Style 8798.
 - 2) John Crane, similar product.
- B. Gaskets for steam cleaned non glass-lined ductile iron and steel piping:
1. Suitable for pressures equal and less than 150 pounds per square inch gauge, temperatures equal or less than 360 degrees Fahrenheit, and raw sewage service.
 2. Material:
 - a. Neoprene elastomer, compressed, non-asbestos fiber reinforcement.
 3. Manufacturers: One of the following or equal:
 - a. Garlock, Bluegard 3300.
 - b. John Crane, similar product.

- C. Gaskets for flanged joints in polyvinyl chloride and polyethylene piping:
 - 1. Suitable for pressures equal to or less than 150 pounds per square inch gauge, with low flange bolt loadings, temperatures equal and less than 120 degrees Fahrenheit, and polymer, chlorine, caustic solutions, and other chemicals, except chemicals which liberate free fluorine including fluorochemicals and gaseous fluorine.
 - 2. Material: 0.125-inch thick Viton rubber.
 - 3. Manufacturers: One of the following or equal:
 - a. Garlock.
 - b. John Crane, similar product.
- D. Gaskets for flanged joints in low pressure air piping:
 - 1. Suitable for pressures equal to or less than 150 pounds per square inch gauge, temperatures equal to or less than 300 degrees Fahrenheit, and compressed air service.
 - 2. Material: EPDM elastomer, 1/8 inch thick, 60 Shore hardness, smooth surface.
 - 3. Manufacturers: One of the following or equal:
 - a. Garlock, Style 8314.
 - b. John Crane, similar product.
- E. Gaskets for flanged joints in ductile iron or steel water piping:
 - 1. Suitable for hot or cold water, pressures equal to or less than 150 pounds per square inch gauge, and temperatures equal to or less than 160 degrees Fahrenheit.
 - 2. Material:
 - a. Neoprene elastomer, compressed, with non-asbestos fiber reinforcement.
 - 3. Manufacturers: One of the following or equal:
 - a. Garlock, Bluegard 3300.
 - b. John Crane, similar product.
- F. Provide gaskets suitable for the specific fluids and pressure and temperature conditions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of existing conditions:
 - 1. Locate and expose existing structures, piping, conduits, and other facilities and obstructions that may affect construction of underground piping before starting excavation for new underground piping and appurtenances.
 - 2. Verify sizes, elevations, locations, and other relevant features of existing facilities and obstructions. Determine conflicts for the construction of the new underground piping and appurtenances.
 - 3. Make piping location and grade adjustments to resolve conflicts between new piping and existing facilities and obstructions.

3.02 INSTALLATION

A. General:

1. Piping drawings:
 - a. Except in details, piping is indicated diagrammatically. Not every offset and fitting, or structural difficulty that may be encountered has been indicated on the Drawings. Sizes and locations are indicated on the Drawings.
 - b. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed.
 - 1) Modifications are intended to be of minor scope, not involving a change to the design concept or a change to the Contract Price or Contract Times.
2. Piping alternatives:
 - a. Provide piping as specified in this Section, unless indicated on the Drawings or specified otherwise.
 - b. Alternative pipe ratings:
 - 1) Piping with greater pressure rating than specified may be substituted in lieu of specified piping without changes to the Contract Price.
 - 2) Piping of different material may not be substituted in lieu of specified piping.
 - c. Valves in piping sections: Capable of withstanding specified test pressures for piping sections and fabricated with ends to fit piping.
 - d. For flanged joints, where 1 of the joining flanges is raised face type, provide a matching raised face type flange for the other joining flange.
3. Unless otherwise indicated on the Drawings, piping at pipe joints, fittings, couplings, and equipment shall be installed without rotation, angular deflection, vertical offset, or horizontal offset.

B. Wall and slab penetrations:

1. Provide sleeves for piping penetrations through aboveground masonry and concrete walls, floors, ceilings, roofs, unless specified or otherwise indicated on the Drawings.
2. For piping 1 inch in nominal diameter and larger, provide sleeves with minimum inside diameters of 1 inch plus outside diameter of piping. For piping smaller than 1 inch in nominal diameter, provide sleeve of minimum twice the outside diameter of piping.
 - a. Arrange sleeves and adjacent joints so piping can be pulled out of sleeves and replaced without disturbing the structure.
 - b. Cut ends of sleeves flush with surfaces of concrete, masonry, or plaster.
 - c. Conceal ends of sleeves with escutcheons where piping runs through floors, walls, or ceilings of finished spaces within buildings.
 - d. Seal spaces between pipes and sleeves with link-type seals when not otherwise specified or indicated on the Drawings.
3. Provide flexibility in piping connecting to structures to accommodate movement due to soil settlement and earthquakes. Provide flexibility using details indicated on the Drawings.
4. Core drilled openings:
 - a. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by Engineer.

- b. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device.
 - c. Remove dust and debris from hole using compressed air.
- C. Exposed piping:
 - 1. Install exposed piping in straight runs parallel to the axes of structures, unless otherwise indicated on the Drawings:
 - a. Install piping runs plumb and level, unless otherwise indicated on the Drawings.
 - 1) Slope plumbing drain piping with a minimum of 1/4 inch per foot downward in the direction of flow.
 - 2. Install exposed piping after installing equipment and after piping and fitting locations have been determined.
 - 3. Support piping: As specified in Sections 15061:
 - a. Do not transfer pipe loads and strain to equipment.
 - 4. In addition to the joints indicated on the Drawings, provide unions, flexible couplings, flanged joints, flanged coupling adapters, and other types of joints or means which are compatible with and suitable for the piping system, and necessary to allow ready assembly and disassembly of the piping.
 - 5. Assemble piping without distortion or stresses caused by misalignment:
 - a. Match and properly orient flanges, unions, flexible couplings, and other connections.
 - b. Do not subject piping to bending or other undue stresses when fitting piping.
 - c. Do not correct defective orientation or alignment by distorting flanged joints or subjecting flange bolts to bending or other undue stresses.
 - d. Flange bolts, union halves, flexible connectors, and other connection elements shall slip freely into place.
 - e. Alter piping assembly to fit, when proper fit is not obtained.
 - f. Install eccentric reducers or increasers with the top horizontal for pump suction piping.
- D. Buried piping:
 - 1. Bury piping with minimum 3-foot cover without air traps, unless otherwise indicated on the Drawings.
 - 2. Where 2 similar services run parallel to each other, piping for such services may be laid in the same trench.
 - a. Lay piping with sufficient room for assembly and disassembly of joints, for thrust blocks, for other structures, and to meet separation requirements of public health authorities having jurisdiction.
 - 3. Laying piping:
 - a. Lay piping in finished trenches free from water or debris. Begin at the lowest point with bell ends up slope.
 - b. Place piping with top or bottom markings with markings in proper position.
 - c. Lay piping on an unyielding foundation with uniform bearing under the full length of barrels.
 - d. Where joints require external grouting, banding, or pointing, provide space under and immediately in front of the bell end of each section laid with sufficient shape and size for grouting, banding, or pointing of joints.
 - e. At the end of each day's construction, plug open ends of piping temporarily to prevent entrance of debris or animals.
 - 4. Concrete encase all buried pipe installed under concrete slabs or structures.

- E. Venting piping under pressure:
 - 1. Lay piping under pressure flat or at a continuous slope without air traps, unless otherwise indicated on the Drawings.
 - 2. Install plug valves as air bleeder cocks at high points in piping.
 - a. Provide 1-inch plug valves for water lines, and 2-inch plug valves for sewage and sludge lines, unless otherwise indicated on the Drawings.
 - 3. Provide additional pipe taps with plug cocks and riser pipes along piping as required for venting during initial filling, disinfecting, and sampling.
 - 4. Before piping is placed into service, close plug valves and install plugs. Protect plugs and plug valves from corrosion in as specified in Section 09960.
- F. Restraining piping:
 - 1. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
 - a. When piping is underground, use concrete thrust blocks, mechanical restraints, or push-on restraints.
 - b. When piping is aboveground or underwater, use mechanical or structural restraints.
 - c. Determine thrust forces by multiplying the nominal cross sectional area of the piping by design test pressure of the piping.
 - 2. Provide restraints with ample size to withstand thrust forces resulting from test pressures:
 - a. During testing, provide suitable temporary restraints where piping does not require permanent restraints.
 - 3. Place concrete thrust blocks against undisturbed soil.
 - 4. Place concrete so piping joints, fittings, and other appurtenances are accessible for assembly and disassembly.
 - 5. Provide underground mechanical restraints where specified in the Piping Schedule.
- G. Connections to existing piping:
 - 1. Expose existing piping to which connections are to be made with sufficient time to permit, where necessary, field adjustments in line, grade, or fittings:
 - a. Protect domestic water/potable water supplies from contamination:
 - 1) Make connections between domestic water supply and other water systems in accordance with requirements of public health authorities.
 - 2) Provide devices approved by Owner of domestic water supply system to prevent flow from other sources into the domestic supply system.
 - 2. Make connections to existing piping and valves after sections of new piping to be connected have been tested and found satisfactory.
 - 3. Provide sleeves, flanges, nipples, couplings, adapters, and other fittings needed to install or attach new fittings to existing piping and to make connections to existing piping.
 - 4. For flanged connections, provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.
- H. Connections to in-service piping:
 - 1. As specified in Section 01140.

- I. Connections between ferrous and nonferrous metals:
 - 1. Connect ferrous and nonferrous metal piping, tubing, and fittings with dielectric couplings especially designed for the prevention of chemical reactions between dissimilar metals.
 - 2. Nonferrous metals include aluminum, copper, and copper alloys.
- J. Flanged connections between dissimilar metals such as ductile iron pipe and steel pipe:
 - 1. Provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

3.03 CLEANING

- A. Piping cleaning:
 - 1. Upon completion of installation, clean piping interior of foreign matter and debris.
 - 2. Perform special cleaning when required by the Contract Documents.
- B. Cleaning potable water piping:
 - 1. Flush and disinfect potable water piping.
- C. Cleaning air piping:
 - 1. Perform special cleaning of filtered air piping from the intake clean air plenums to the discharge points and high-pressure air piping.
 - a. Protect surfaces from contamination.
 - 2. Special cleaning shall include wire brushing, power tool cleaning, wiping down with lint-free cloths, brooming, and vacuuming to remove rust, scale, weld spatter, dust, dirt, oil, and other matter deleterious to operation of the air system:
 - a. Do not sandblast installed piping.
 - 3. To the greatest extent possible, clean piping immediately prior to final closure of piping systems:
 - a. Enter piping, clean and wipe down surfaces, and vacuum out residue.
 - b. Clean surfaces not accessible to this cleaning operation after installation within 6 hours preceding installation.
 - 4. Subsequent to cleaning, protect surfaces from contamination by dust, dirt, construction debris, and moisture, including atmospheric moisture:
 - a. Whether or not pipe upstream has been cleaned, temporarily seal openings in partially completed work except when installation is actively in progress.
 - b. When installation is actively in progress, seal openings at the end of each day's construction or when construction is temporarily stopped.
 - 5. Suspend cleaning and seal openings when inclement weather, including dust storms, is imminent.
 - 6. Use clean, dry air for testing the piping and other elements of the system.
 - 7. Prior to introduction of air to the system, blow piping clean.
 - a. Blow with maximum discharge rate possible for minimum 4 hours, using new blowers or compressors and filters.
 - 8. Clean surfaces that become contaminated prior to acceptance.

3.04 PIPING SCHEDULE

A. Abbreviations:

1. The following abbreviations used in the column of test method refer to the respective methods as specified in Section 15956.

AM	Air method
GR	Gravity method
HH	High head method
LH	Low head method
SC	Special case

2. Abbreviations to designate piping include the following:

ASP	Asphaltic
BFPP	Belt Filter Press Feed
B&S	Special case
B&SP	Bell & Spigot
BSP	Black Steel Pipe
CI	Cast iron
CISP	Cast Iron Soil Pipe
CD	Chemical Drain
CE	Ceramic Epoxy
CND	Condensate Drain
CL	Class, followed by the designation
CM	Cement Mortar
CMP	Corrugated Metal Pipe
CPVC	Chlorinated Polyvinyl Chloride
CTP	Coal Tar Pitch
CU	Copper Tubing
DIP	Ductile iron piping
FL	Flanged
HTC	High Temperature Coating
FRP	Fiberglass Reinforced Pipe
GA	Gauge, preceded by the designation
GE	Grooved end joint
GL	Glass Lined
GSP	Galvanized Steel Pipe
HPC	High Performance Coating

HSE	High Solids Epoxy
HSEP	High Solids Epoxy and Polyurethane
MJ	Mechanical Joint
NPS	Nominal pipe size, followed by the number in inches
PE	Polyethylene
PEE	Polyethylene Encasement
PJ	Push on Joint
psi	pounds per square inch
psig	pounds per square inch gauge
PTW	Plastic Tape Wrap
PVC	Polyvinyl Chloride
Restr	Reinforced Concrete Pipe
RCP	Restrained
RDL	Roof Drain Leader
SCH	Schedule, followed by the designation
SCRD	Screwed
SDR	PVC - SDR Series Pipe
SST	Stainless steel
SW	Solvent Weld
TW	Tape Wrap
VE	Chemical Vent
VCP	Vitrified clay piping
WLD	Welded

PIPING SCHEDULE									
Process Abbrev.	Service	Nominal Diameter (inches)	Material	Pressure Class Special Thickness Class Schedule Wall Thickness	Pipe Spec. Section	Joints/ Fittings	Test Pressure/ Method	Lining	Coating
WAS	Waste Activated Sludge								
	Above Ground	4	DIP	Thickness CL 53 (min)	15211	FL	75 psig/HH	CE ⁽¹⁾	HSEP
WW or RW	Washwater								
	Below Ground	10	DIP	Thickness CL 53 (min)	15211	Restrained MJ	50 psig/HH	Cement Lined	Per manufacturer
	Above Ground	1 - 6	PVC (INSIDE BFP ROOM)	80 sch	15249	SW	50 psig/HH		
DR	Drain								
	Above Ground	1 - 10	PVC	SDR 26	15247	SW	10 psig/LH	None	None
Notes: 1. Contractor shall provide PROTECTO 401 Ceramic Epoxy or Permite Permax PCS-9043 Type II Glass Flake Epoxy lining for ductile iron pipes.									

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15061

PIPE SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Supports for pipe, fittings, valves, and appurtenances and conveyors in the belt filter press room.
- 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 05120 - Structural Steel.
 - b. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. A 380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - 2. A 967 - Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
- B. Manufacturer's Standardization Society (MSS):
 - 1. SP-58 - Pipe Hangers and Supports - Materials, Design, and Manufacture.

1.03 SUBMITTALS

- A. Shop drawings: Include schedule, indicating where supports will be installed, and drawings of pipe support system components.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General:
 - 1. 316 Stainless steel.
 - a. Fabricate as specified in Section 05120.
 - b. Finish requirements: Remove free iron, heat tint oxides, weld scale, and other impurities, and obtain a passive finished surface.

- c. At the shop, perform pickling and passivation on all surfaces inside and out in accordance with ASTM A 380 or A 967.
 - 1) Passivation treatments using citric acid are not allowed.
 - d. Field welding is prohibited unless specifically allowed by the Owner. All field welds shall be passivated.
- B. Outdoor areas and inside the belt filter press room:
 - 1. Type 316L Stainless Steel.
- C. Fasteners:
 - 1. As specified in Section 05120.

2.02 PIPE SUPPORTS

- A. Hanger rods: Sized to match suspended pipe hanger, or as indicated on the Drawings:
 - 1. Manufacturers: One of following or equal:
 - a. For stainless steel piping:
 - 1) Bergen-Power, Figure 133.
 - 2) Nibco-Tolco, Figure 103.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 140.
 - 2) Bergen-Power, Figure 133.
 - 3) Cooper B-Line Systems, Inc., Figure B3205.
- B. Hanger rods, continuously threaded: Sized to match suspended pipe hanger, or as indicated on the Drawings:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Bergen-Power, Figure 94.
 - 2) FM Stainless Fasteners.
 - b. For steel and ductile iron piping:
 - 1) Anvil International, Figure 146.
 - 2) Bergen-Power, Figure 94.
- C. Eye bolts:
 - 1. For stainless steel piping:
 - a. Type 316 stainless steel, welded and rated equal to full load capacity of rod.
 - 2. For all other piping, unless indicated on the Drawings:
 - a. Welded and rated equal to full load capacity of rod.
- D. Welded eyebolt rod:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 101.
 - 2) FM Stainless Fasteners.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 278.
 - 2) Bergen-Power, Figure 93.
 - 3) Cooper B-Line Systems, Inc., Figure B3210.

- E. Adjustable ring hangers: MSS SP-58, Type 7 or Type 9 (system dependent):
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 1C.I.
 - 2) Bergen-Power, Figure 100SS.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 97.
 - 2) Cooper B-Line Systems, Inc., Figure B3172.
- F. Adjustable clevis hangers: MSS SP-58, Type 1:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Cooper B-Line Systems, Inc, Figure B3100 or B3102.
 - 2) FM Stainless Fasteners, Figure 60.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 260 or Figure 590.
 - 2) Bergen-Power, Figure 100.
 - 3) Cooper B-Line Systems, Inc., Figure B3100 or B3102.
- G. Adjustable clevis hangers for insulated pipe: Oversize:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 1A.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 300.
 - 2) Bergen-Power, Figure 100EL.
 - 3) Cooper B-Line Systems, Inc. Figure B3108.
- H. Single rod hangers for steam pipe: MSS SP-58, Type 43; malleable iron or steel yoke and roller hangers; swivel to allow rotation of yoke on rod:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 324.
 - 2) Cooper B-Line Systems, Inc., Figure B3110.
 - 3) FM Fasteners, Figure 81.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 181.
 - 2) Cooper B-Line Systems, Inc., Figure B3110.
- I. Double rod hangers for steam pipe: MSS SP-58, Type 41:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) FM Stainless Fasteners, Figure 71.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 171.
 - 2) Cooper B-Line Systems, Inc., Figure B3114.

- J. Brackets: MSS SP-58, Type 32 with back plate; rated for 1,500 pounds:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 30M.
 - 2) Cooper B-Line Systems, Inc., Figure B3066.
 - 3) FM Stainless Fasteners, Figure 98.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 195.
 - 2) Cooper B-Line Systems, Inc., Figure B3066.
- K. Standard U-bolt: MSS SP-58, Type 24:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 110.
 - 2) Cooper B-Line Systems, Inc., Figure B3188.
 - 3) FM Stainless Fasteners, Figure 37.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 137.
 - 2) Bergen-Power, Figure 283.
 - 3) Cooper B-Line Systems, Inc., Figure B3188.
- L. Riser clamps: MSS SP-58, Type 8:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Cooper B-Line Systems, Inc., Figure B3373.
 - 2) FM Stainless Fasteners, Figure 61.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 261.
 - 2) Bergen-Power, Figure 126.
 - 3) Cooper B-Line Systems, Inc., Figure B3373.
- M. Pipe clamps: MSS SP-58, Type 4:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 4.
 - 2) Cooper B-Line Systems, Inc., Figure 3140.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 212.
 - 2) Bergen-Power, Figure 175.
 - 3) Cooper B-Line Systems, Inc., Figure B3140.
- N. Adjustable offset pipe clamp:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 4.
 - 2) Cooper B-Line Systems, Inc., Figure B3149.
 - 3) FM Stainless Fasteners, Figure 63.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 100.
 - 2) Cooper B-Line Systems, Inc., Figure B3149.

- O. Offset pipe clamp:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 8.
 - 2) Cooper B-Line Systems, Inc., Figure 3148.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 103.
 - 2) Cooper B-Line Systems, Inc., Figure B3148.
- P. Floor stand or stanchion saddles: MSS SP-58, Type 37. Provided with U-bolt hold down yokes:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 318.
 - 2) FM Stainless Fasteners, Figure 59.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 259.
 - 2) Bergen-Power, Figure 125.
 - 3) Cooper B-Line Systems, Inc., Figure B3090.
 - b. Threaded pipe stand support stanchion. Match pipe support material.
 - 1) Anvil International, Figure 63T.
 - 2) Bergen-Power, Figure 138.
 - 3) Cooper B-Line Systems Inc., Figure B3088ST.
- Q. Spring hangers:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Bergen-Power, Figure 920.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure B-268, Type G.
 - 2) Bergen-Power, Figure 920.
- R. One hole pipe clamps:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Not used.
 - b. For all other piping:
 - 1) Anvil International, Figure 126.
 - 2) Carpenter & Paterson, Figure 237S.
- S. Welded beam attachment: MSS SP-58, Type 22:
1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 304.
 - 2) Cooper B-Line Systems, Inc., Figure 3083.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 66.
 - 2) Bergen-Power, Figure 113A or 113B.
 - 3) Cooper B-Line Systems, Inc., Figure B3083.

- T. Heavy pipe clamp: MSS SP-58, Type 4:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 4H.
 - b. For all other piping, unless called out otherwise on the Drawings:
 - 1) Anvil International, Figure 216.
 - 2) Bergen-Power, Figure 298.
- U. PTFE pipe slide assembly: MSS SP-58, Type 35 with lateral and vertical restraint:
 - 1. Manufacturers: One of the following or equal:
 - a. For stainless steel piping:
 - 1) Nibco-Tolco, Figure 426.
 - b. For all other piping, unless indicated on the Drawings:
 - 1) Anvil International, Figure 257, Type 3.
 - 2) Cooper B-Line Systems, Inc., Figure B3893.
- V. Anchor bolts, concrete anchors, concrete inserts, powder-actuated fasteners, and sleeve anchors: As specified in Section 05120.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Properly support, suspend, or anchor exposed pipe, fittings, valves, and appurtenances to prevent sagging, overstressing, or movement of piping; and to prevent thrusts or loads on or against connected pumps, blowers, and other equipment.
- B. Field verify support location, orientation, and configuration to eliminate interferences prior to fabrication of supports.
- C. Carefully determine locations of inserts. Anchor to formwork prior to placing concrete.
- D. Use flush shells only where indicated on the Drawings.
- E. Do not use anchors relying on deformation of lead alloy.
- F. Do not use powder-actuated fasteners for securing metallic conduit or steel pipe larger than 1 inch to concrete, masonry, or wood.
- G. Suspend pipe hangers from hanger rods and secure with double nuts.
- H. Install continuously threaded hanger rods only where indicated on the Drawings.
- I. Use adjustable ring hangers or adjustable clevis hangers, for 4 inch and smaller diameter pipe.
- J. Use adjustable clevis hangers for pipe larger than 4 inches in diameter.

- K. Secure pipes with double nutted U-bolts or suspend pipes from hanger rods and hangers.
 - 1. For stainless steel piping, use stainless steel U-bolts.
- L. Support spacing:
 - 1. Support 2-inch and smaller piping on horizontal and vertical runs at maximum 5 feet on center, unless otherwise specified.
 - 2. Support larger than 2-inch piping on horizontal and vertical runs at maximum 10 feet on center, unless otherwise specified.
 - 3. Support exposed polyvinyl chloride and other plastic pipes at maximum 5 feet on center, regardless of size.
 - 4. Support tubing, PVC pipe 1-inch and smaller, copper pipe and tubing, fiber-reinforced plastic pipe or duct, and rubber hose and tubing at intervals close enough to prevent sagging greater than 1/4 inch between supports.
 - 5. Do not suspend or support valves, pipe and fittings from another pipe or conduit.
- M. Install supports at:
 - 1. Any change in direction.
 - 2. Both sides of flexible pipe connections.
 - 3. Base of risers.
 - 4. Floor penetrations.
 - 5. Connections to pumps, blowers, and other equipment.
 - 6. Valves and appurtenances.
- N. Securely anchor plastic pipe, valves, and headers to prevent movement during operation of valves.
- O. Anchor plastic pipe between expansion loops and direction changes to prevent axial movement through anchors.
- P. Provide elbows or tees supported from floors with base fittings where indicated on the Drawings.
- Q. Support base fittings with metal supports or when indicated on the Drawings support on concrete piers.
- R. Do not use chains, plumbers' straps, wire, or similar devices for permanently suspending, supporting, or restraining pipes.
- S. Support plumbing drainage and vents in accordance with plumbing code as specified in Section 01410.
- T. Supports, clamps, brackets, and portions of support system bearing against copper pipe: Copper plated, copper throughout, or isolated with neoprene or polyvinyl chloride tape.
- U. Where pipe is insulated, install over-sized supports and hangers.
- V. Install riser clamps at floor penetrations and where indicated on the Drawings.
- W. Coat support system components as specified in Section 09960.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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.

2.02 SPECIAL ITEMS

- A. In addition, special coating of following items will be required:

Item	Color
Valve handwheels and levers	Red
Hoist hooks and blocks	Yellow and black stripes
Steel guard posts	In accordance with standard details

- B. Paint minimum 2 inches high numbers on or adjacent to accessible valves, pumps, flowmeters, and other items of equipment which are indicated on the Drawings or in Specifications by number.

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 15076

PIPE IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Pipe identification including the following:
 - 1. Pipe identification by color and legend.
 - 2. Underground warning tape.
 - 3. Tracer wire.
 - 4. Witness markers.
 - 5. Valve identification.
- 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 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

- 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. Operation and Maintenance Data.
 - b. Warranty.

PART 2 PRODUCTS

2.01 ABOVE GROUND AND IN-CHASE PIPE IDENTIFICATION

A. Manufacturers:

1. One of the following or equal:
 - a. Seton, Opti Code Pipe Markers.
 - b. Lab Safety Supply.
 - c. Marking Services, Inc.

B. Materials:

1. Pipe markers: Self-adhesive vinyl, suitable for outdoor application from -40 degrees to 180 degrees Fahrenheit; in accordance with ASME A13.1 requirements.
 - a. Lettering:

Nominal Pipe Diameter	Lettering Size
Less than 1.5	1/2 inch
1.5 inches to 2 inches	3/4 inch
2.5 inches to 6 inches	1-1/4 inches
8 inches to 10 inches	2-1/2 inches
Over 10 inches	3-1/2 inches

b. Marker colors:

Service	Lettering	Background
Flammables, chemicals, toxics	Black	Yellow
Water, nontoxic solutions or low hazard liquids	White	Green
Nonflammable or nontoxic gases	White	Blue
Fire quenching fluids (foam, fire water, CO ₂ Halon)	White	Red

2. Coating: As specified in Section 09960.
3. Pipe identification tags: Aluminum or stainless steel with stamped-in 1/4 inch high identifying lettering.
4. Pipe identification tag chains: Aluminum or stainless steel.
5. Snap-on markers: Markers with 3/4 inch high letters for 3/4 to 4 inch pipe or covering, or 5 inch high letters for 5 inch or larger pipe or cover, as manufactured by one of following:
 - a. Brady Bradysnap-On B-915.
 - b. Seton Setmark.

2.02 BURIED PIPELINE IDENTIFICATION

A. Underground warning tape:

1. Manufacturer: One of the following or equal:
 - a. Seton Name Plate Company, Branford, CT.
 - b. T. Christy Enterprises, Inc.
2. Material:
 - a. Polyethylene tape for prolonged underground use.
 - b. Minimum tape thickness: 4 mils.

- c. Overall tape width: 6 inches.
 - d. Message: "CAUTION" with the name of the service followed by "LINE BURIED BELOW." in black lettering on colored background in accordance with approved APWA colors.
 - 1) Water: Blue.
 - 2) Sewer: Green.
 - 3) Telephone: Orange.
 - 4) Gas and other services: Yellow.
- B. Tracer wire:
- 1. Manufacturers: One of the following or equal:
 - a. Kris-Tech Wire.
 - b. Corpro.
 - 2. Materials: One of the following or equal:
 - a. Solid copper conductor with 30 mil HMWPE.
 - b. 10 gauge or thicker wire.
 - c. Match insulation color to the color of the pipe being installed.
- C. Witness markers:
- 1. Manufacturers: One of the following or equal:
 - a. Carsonite Composites, Utility Marker.
 - b. Hampton Technical Associates, Inc.
 - 2. Materials:
 - a. Glass fiber and resin reinforced thermosetting composite material.
 - b. UV resistant.
 - 3. Constructed as a single piece.
 - 4. Pointed at the bottom end.
 - 5. Information to be included on the marker:
 - a. "Caution" (type of service) "Pipeline".
 - b. Station number.
 - c. Offset:
 - 1) Only provide offset if marker is not directly over the pipe.
 - d. Name of appurtenance or fitting (e.g. 45, BO, ARV etc.)

2.03 VALVE IDENTIFICATION

- A. The Contractor shall furnish and install tags for all valves and gates required for the Work.
- 1. Tags shall be 2-in diameter round, stainless steel or brass for buried applications.
 - 2. Tags shall be furnished with a non-corrosive metal wire suitable for attaching the tag to the operator base.
 - 3. Tags shall be stamped in 1/4-inch high letter
 - a. Tags shall not be attached in such a way as to inhibit the operation of the valve or gate.
 - 4. Buried valve tags shall be secured to concrete s with the specified valve or gate number.
 - 5. Submit 2 samples of the type of tag proposed and the manufacturer's standard color chart and letter styles to the Engineer for review.
 - 6. Manufacturer: The following or equal:
 - a. Seton Name Plate Company, Branford, CT.

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.

3.03 ABOVE GROUND AND IN-CHASE PIPING IDENTIFICATION

- A. Identify exposed piping, with lettering or tags designating service of each piping system with flow directional arrows and color code.
- B. Color code:
 - 1. Paint all piping with colors as scheduled in Piping Color Code and Marker Schedule.
- C. Lettering and flow direction arrows:
 - 1. Stencil lettering on painted bands or use snap-on markers on pipe to identify pipe. When stenciling, stencil 3/4 inch high letters on 3/4 through 4-inch pipe or coverings, or 5-inch high letters on 5-inch and larger pipe or coverings.
 - 2. Provide lettering and flow direction arrows near equipment served, adjacent to valves, both sides of walls and floors where pipe passes through, at each branch or tee, and at intervals of not more than 50 feet in straight runs of pipe.
- D. Where scheduled, space 6-inch wide bands along stainless steel pipe at 10-foot intervals and other pipe at 5-foot intervals.
- E. Label chemical tank fill pipelines at locations which are visible from chemical fill stations.
- F. Metal tags:
 - 1. Where outside diameter of pipe or pipe covering is 5/8 inch or smaller, provide metal pipe identification tags instead of lettering.
 - 2. Fasten pipe identification tags to pipe with chain.
 - 3. Where tags are used, color code pipe as scheduled.

3.04 BURIED PIPING IDENTIFICATION

- A. Underground warning tape:
 - 1. Place continuous run of warning tape in pipe trench, 12 inches above the pipe.
- B. Tracer wire:
 - 1. Install on all non-metallic pipe.
 - 2. Install an electrically continuous run of tracer wire along the entire length of the pipe with wire terminations in valve boxes, vaults, or structures.

3. Install tracer wire on top of the pipe and secure to pipe with tape a minimum of every 10 feet.
 4. Where approved by the Engineer, splice sections of wire together using approved direct bury wire nuts.
 - a. Twisting the wires together is not acceptable.
- C. Witness markers:
1. Install over pipe in unpaved open-space areas at intervals not greater than 200 feet.
 2. Place markers at appurtenances located in unpaved areas.
 3. Embed markers at least 18 inches into the soil.

3.05 APPLICATION

- A. Identify piping with legend markers, directional arrow markers, and number markers; use self-adhesive arrow roll tape to secure ends of piping markers and indicate flow direction.
- B. Provide legend markers, directional arrow markers, and number markers where piping passes through walls or floors, at piping intersections and at maximum 15 foot spacing on piping runs.
- C. Provide piping marker letters and colors as scheduled.
- D. Place markers on piping so they are visible from operator's position in walkway or working platform near piping. Locate markers along horizontal centerline of pipe, unless better visibility is achieved elsewhere.

3.06 PIPING COLOR CODE AND MARKER SCHEDULE

- A. All light piping paint is also by Sher-Cryl HPA Protective & Marine Coatings. Coordinate with OWNER for their standards.

Sherwin Williams Custom Match to Pantone Purple 522-C 1 Gallon of Sher-Cryl					
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	-	-

Service Fluid	Pipe Color
Drain	Charcoal
Instrumental Air	Purple
Sample	Green
Sanitary Drain	Charcoal
Vent Pipe	Yellow

Service Fluid	Pipe Color
Wash Water (W3)	Medium Blue
Waste Activated Sludge, Thickened Sludge, Sludge Transfer	Tempest Brown
Polymer	Purple
Potable Water	Blue
Non-potable Water	Blue with black bands

Letters	Color of Bands	Color of Letters
Finished or Potable (cold)	None	Black
Nonpotable or Raw	Dark Gray	Black
Service Water (lines downstream from backflow prevention unit)	White	Red
Sample	Black	White
Polymer	Dark Green	Black
Low Pressure Air - Stainless Steel Pipe	None	Black
Compressed Air	None	Black
Waste Activated Sludge	None	White

END OF SECTION

SECTION 15110

COMMON WORK RESULTS FOR VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Basic requirements for valves.
- 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 09960 - High-Performance Coatings.
 - c. Section 17000 - Instrumentation and Controls
 - d. Section 15211 - Ductile Iron Piping: AWWA C151.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C111/A21.11 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe Fittings.
- B. ASTM International (ASTM):
 - 1. A 126 - Standard Specification for Gray Iron Casting for Valves, Flanges, and Pipe Fittings.
 - 2. A 167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 3. A 536 - Standard Specification for Ductile Iron Castings.
- C. NSF International (NSF):
 - 1. 61 - Drinking Water System Components - Health Effects.
- D. Society for Protective Coatings (SSPC):
 - 1. SP 7 - Brush-Off Blast Cleaning.
 - 2. SP 10 - Near-White Blast Cleaning.

1.03 DESIGN REQUIREMENTS

- A. Pressure rating:
 - 1. Suitable for service under minimum working pressures of 150 pounds per square inch gauge.

2. When a piping system is specified in the Piping Schedule to be tested at a pressure greater than 150 pounds per square inch gauge, provide valves for that piping system with design working pressure which is sufficient to withstand the test pressure.
- B. Valve to piping connections:
1. Valves 3 inch nominal size and larger: Flanged ends.
 2. Valves less than 3 inch nominal size: Screwed ends.
 3. Plastic valves in plastic piping:
 - a. Up to 2.5 inches: Provide solvent or heat welded unions.
 - b. 3 inches and above: Provide solvent or heat welded flanges.

1.04 SUBMITTALS

- A. Submit as specified in Section 01330.
- B. Product data:
1. Submit the following information for each valve:
 - a. Valve type, size, pressure rating, Cv factor.
 - b. Coatings.
 - c. Power valve actuators:
 - 1) Information on valve actuator including size, manufacturer, model number, limit switches, mounting; and motor enclosure, seating and unseating torque coefficient, dynamic torque, and bearing friction for calculation of maximum operating torque.
 - 2) Complete wiring diagrams and control system schematics.
 - d. Manual valve actuators:
 - 1) Information on valve actuator including size, manufacturer, model number.
 - e. Certified drawings with description of component parts, dimensions, weights, and materials of construction.
 - f. Certifications of reference standard compliance:
 - 1) Submit certification that the valves and coatings are suitable in potable water applications in accordance with NSF 61.
 - g. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.
- C. Operation and maintenance data:
1. Furnish bound sets of installation, operation, and maintenance instructions for each type of manual valve 4 inch in nominal size and larger, and all non-manual valves. Include information on valve operators in operation and maintenance instruction manual.

1.05 QUALITY ASSURANCE

- A. Manufacturer qualifications:
1. Valves manufactured by manufacturers whose valves have had successful operational experience in comparable service.

1.06 DELIVERY STORAGE AND HANDLING

- A. Protect valves and protective coatings from damage during handling and installation; repair coating where damaged.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Stainless steel: In accordance with ASTM A 167, Type 316, or Type 304, UNS Alloy S31600 or S30400.
- B. Valve and operator bolts and nuts:
 - 1. Fabricated of stainless steel for the following installation conditions:
 - a. Submerged in sewage or water.
 - b. In an enclosed space above sewage or water.
 - c. In structures containing sewage or water, below top of walls.
 - d. At openings in concrete or metal decks.
 - 2. Where dissimilar metals are being bolted, use stainless steel bolts with isolation bushings and washers.
 - 3. Underground bolts: Low-alloy steel in accordance with AWWA C111/A21.11.
- C. Bronze and brass alloys: Use bronze and brass alloys with not more than 6 percent zinc and not more than 2 percent aluminum in the manufacture of valve parts; UNS Alloy C83600 or C92200 unless specified otherwise.
- D. Valve bodies: Cast iron in accordance with ASTM A 126, Class 30 minimum or ductile iron in accordance with ASTM A 536, Grade 65-45-12 minimum unless specified otherwise.

2.02 INTERIOR PROTECTIVE LINING

- A. When specified in the particular valve specification, provide valves with type of protective lining specified in the particular valve Specification.
- B. Apply protective lining to interior, non-working surfaces, except stainless steel surfaces.
- C. Lining types:
 - 1. Fusion bonded epoxy:
 - a. Manufacturers: One of the following or equal:
 - 1) 3-M Company, ScotchKote 134; certified to NSF 61 for drinking water use.
 - b. Clean surfaces in accordance with SSPC SP 7 or SP 10, as recommended by epoxy manufacturer.
 - c. Apply in accordance with manufacturer's published instructions.
 - d. Lining thickness: 0.010 to 0.012 inches except that:
 - 1) Lining thickness in grooves for gaskets: 0.005 inches.
 - 2) Do not coat seat grooves in valves with bonded seat.
 - e. Quality control:
 - 1) Lining thickness: Measured with a non-destructive magnetic type thickness gauge.
 - 2) Verify lining integrity with a wet sponge-testing unit operating at approximately 60 volts, or as recommended by the lining manufacturer.
 - 3) Consider tests successful when lining thickness meets specified requirements and when no pinholes are found.
 - 4) Correct defective lining disclosed by unsuccessful tests, and repeat test.

- 5) Repair pinholes with liquid epoxy recommended by manufacturer of the epoxy used for lining.
2. High solids epoxy:
 - a. Product equivalent to high solids epoxy specified in Section 09960.
 - 1) Certified in accordance with NSF 61 for drinking water use.
 - 2) Interior: Coat valve interior with manufacturer's equivalent high performance high solids epoxy coating system with a certifiable performance history for the service conditions and as approved by the Engineer. Manufacturer shall provide for approval, coating information sufficient to allow Engineer to assess equivalence to the specified high solids epoxy coating specified in Section 09960.
 - b. Clean surfaces to meet SP-7 or SP-10, or as recommended by coating manufacturer.
 - c. Quality control: After coating is cured, check coated surface for porosity with a holiday detector set at 1,800 volts, or as recommended by coating manufacturer.
 - 1) Repair holidays and other irregularities and retest coating.
 - 2) Repeat procedure until holidays and other irregularities are corrected.

2.03 UNDERGROUND VALVES

- A. Provide underground valves with flanged, mechanical, or other type of joint required for the type of pipe to which the valve is to be connected.

2.04 VALVE BOXES

- A. Provide cast-iron valve boxes at each buried valve to access valve and valve operators.
- B. Do not support boxes on valve, valve operator, or pipe.
- C. Boxes:
 1. 2-piece, fabricated of cast iron; provide cover, with asphalt varnish or enamel protective coating.
 2. Adjustable to grade, install centered around the upper portions of the valve and valve operator.
- D. Manufacturers: One of the following or equal:
 1. Tyler Pipe Industries, Inc.
 2. Neenah Foundry Company.

2.05 VALVE OPERATORS

- A. Valve operator "Open" direction: Open counterclockwise.
- B. Provide valves located below operating level or deck with extensions for key operation or floor stands and handwheels.
- C. Provide manually operated valves located not more than 6 feet above the operating level with tee handles, wrenches, or handwheels.
 1. Make the valve operator more conveniently accessible by rolling valves, located more than 5 feet but less than 6 feet above the operating level, toward the operating side.

2. Secure tee handles and wrenches to the valve head or stem, except where a handle or wrench so secured constitutes a hazard to personnel; in which case, stow handle or wrench immediately adjacent to the valve on or in a suitable hanger, bracket, or receptacle.
- D. Fit valves located more than 6 feet above operating level with chain operated handles or valve wheels.
 1. Chains: Sufficient length to reach approximately 4 feet above the operating level.
 2. Where chains constitute a nuisance or hazard to operating personnel, provide holdbacks or other means for keeping the chains out of the way.
- E. Provide an operator shaft extension from valve or valve operator to finished grade or deck level when buried valves, and other valves located below the operating deck or level, are specified or indicated on the Drawings to be key operated; provide 2 inch square AWWA operating nut, and box and cover as specified, or a cover where a box is not required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Preparation prior to installation:
 1. Install valves after the required submittal on installation has been accepted.
 2. Determine after flanged valves and flanged check valves are selected, the face-to-face dimensions of flanged valves and flanged check valves.
- B. Fabricate piping to lengths taking into account the dimensions of flanged valves and flanged check valves.

3.02 INSTALLATION

- A. Provide incidental work and materials necessary for installation of valves including flange gaskets, flange bolts and nuts, valve boxes and covers, concrete bases, blocking, and protective coating.
- B. Where needed, furnish and install additional valves for proper operation and maintenance of equipment and plant facilities under the following circumstances:
 1. Where such additional valves are required for operation and maintenance of the particular equipment furnished by Contractor.
 2. Where such additional valves are required as a result of a substitution or change initiated by Contractor.
- C. Install valves with their stems in vertical position above the pipe, except as follows:
 1. Butterfly valves, gate valves aboveground, globe valves, ball valves, and angle valves may be installed with their stems in the horizontal position.
 2. Install buried plug valves with geared operators with their stems in a horizontal position.
- D. Install valves so that handles clear obstructions when the valves are operated from fully open to fully closed.

- E. Place top of valve boxes flush with finished grade or as otherwise indicated on the Drawings.
- F. Valves with threaded connections:
 - 1. Install valves by applying wrench on end of valve nearest the joint to prevent distortion of the valve body.
 - 2. Apply pipe joint compound or Teflon tape on external (male) threads to prevent forcing compound into valve seat area.
- G. Valves with flanged connections:
 - 1. Align flanges and gasket carefully before tightening flange bolts.
 - 2. When flanges are aligned, install bolts and hand tighten.
 - 3. Tighten nuts opposite each other with equal tension before moving to next pair of nuts.
- H. Valves with soldered connections:
 - 1. Do not overheat connection to prevent damage to resilient seats and metal seat rings.
 - 2. Position valves in full open position before starting soldering procedure.
 - 3. Apply heat to piping rather than to valve body.

3.03 VALVE SCHEDULE

- A. See Valve Schedule as shown on the drawings.

END OF SECTION

SECTION 15111

BALL VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Ball valves.
- B. As specified in Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Petroleum Institute (API):
 - 1. 6D - Specification for Pipeline Valves (Steel Gate, Plug, Ball, and Check Valves) - Gate Valves; Plug Valves; Ball Valves; Check Valves.
- B. American Society of Mechanical Engineers (ASME):
 - 1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
- C. American Water Works Association (AWWA):
 - 1. C507 - Standard for Ball Valves 6 Inch Through 48 Inch.
- D. ASTM International (ASTM):
 - 1. A48 - Standard Specification for Gray Iron Castings.
 - 2. A216 - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
 - 3. A351 - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.

1.03 SYSTEM DESCRIPTION

- A. General: Unless otherwise indicated on the Drawings use:
 - 1. Metal body ball valves on metallic pipelines.
 - 2. Plastic body ball valves on plastic pipelines.
- B. Do not use metal body ball valves in sodium hypochlorite or sodium bisulfite systems.

1.04 SUBMITTALS

- A. Submit as specified in Section 01330 - Submittal Procedures.
- B. Product data: As specified in Section 15110 - Common Work Results for Valves:
 - 1. Metal body ball valves: 6 inches and larger only: Submit affidavit of compliance in accordance with AWWA C507.
 - 2. Operation and maintenance manual.

- C. Commissioning submittals:
 - 1. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.05 WARRANTY

- A. Provide warranty as specified in General Conditions.

PART 2 PRODUCTS

2.01 METAL BODY BALL VALVES, 6-INCH SIZE AND LARGER

- A. Manufacturers: One of the following:
 - 1. Valmatic.
 - 2. DeZURIK.
 - 3. Approved Equal.
- B. General:
 - 1. Type: Non-lubricated, **resilient seated** and capable of sealing in either flow direction.
 - 2. In accordance with AWWA C507.
 - 3. Stem packing: Manually adjustable while valve is under pressure.
 - 4. ASME B16.1, Class 125 flanged ends.
- C. Materials:
 - 1. Body: ASTM A48 cast iron with 400 series Monel seats (metal seated valves only) and integrally cast bronze bushed trunnions.
 - 2. Ball: Type 304 or 316 stainless steel.
 - 3. Seats: 300 series stainless steel {metal seated valves}.
 - 4. Stem seals: PTFE or Viton.
- D. Valve actuator:
 - 1. Manually operated valves: Self-locking worm gear type actuator with position indicator. Permanently lubricate gearing. Provide adjustable screws to stop travel at both open and closed positions.

2.02 METAL BODY BALL VALVES, LESS THAN 6-INCH SIZE

- A. Manufacturers: One of the following, or equal:
 - 1. Conbraco Industries, Inc., Apollo Valves.
 - 2. Flow-Tek, Inc.
 - 3. Metso Automation/Jamesbury.
 - 4. NIBCO, Inc.
- B. General:
 - 1. Type: Non-lubricated, full port and capable of sealing in either direction.
 - 2. End connections:
 - a. Threaded or solder ends for sizes 3-inch and smaller.
 - b. Class 150 flanged for sizes larger than 3 inches.
 - 1) Flanges: In accordance with ASME B16.1 standards.
 - 3. Stem packing: Manually adjustable while valve is under pressure.

4. Shafts:
 - a. Rigidly connected to the ball by a positive means.
 - 1) Design connection to transmit torque equivalent to at least 75 percent of the torsional strength of the shaft.
5. Handles: Stainless steel latch lock handle with vinyl grip and stainless steel nut designed to open and close the valve under operating conditions.
6. Temperature limits: Suitable for operation between minus 20 and 350 degrees Fahrenheit.

C. Materials:

1. Valves in copper lines: Bronze body.
2. Valves in steel and ductile iron piping: Ductile iron or cast steel body.
3. Valves in stainless steel piping: Stainless steel body, material type to match piping material as specified in Section 15052 - Common Work Results for General Piping.
4. Ball: Type 304 or 316 stainless steel, Type 316 in digester gas applications.
5. Seats: PTFE.
6. Stem seals: PTFE or Viton.
7. Bearings: Self-lubricated, corrosion resistant material that will not contaminate potable water.
8. Valves for combustible fluid applications (digester gas, natural gas, fuel oil, etc.) must be of fire safe design.

2.03 PLASTIC BODY BALL VALVES

A. Manufacturers: One of the following or equal:

1. Asahi America.
2. Chemtrol Division, NIBCO, Inc.
3. Georg Fischer Piping Systems.
4. Hayward Flow Control.
5. Plast-O-Matic Valves, Inc.

B. General:

1. Type: Non-lubricated and capable of sealing in either flow direction.
2. End connections: True union; solvent or heat welded to piping.
3. Operator handle: Lever.

C. Materials:

1. Body: Polyvinyl chloride (PVC).
2. Ball: Polyvinyl chloride (PVC).
3. Seats: PTFE (Teflon).
4. O-rings: FKM (Viton) or EPDM.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Install each type of valve in accordance with manufacturers' printed instructions.

3.02 FIELD APPLIED COATING OF VALVE EXTERIOR

- A. Match color and be compatible with manufacturer's coating system and as specified in Section 09960 - High-Performance Coatings.
 - 1. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
 - 2. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

3.03 COMMISSIONING

- A. As specified in Section 01756 - Commissioning and this Section.
- B. Manufacturer services:
 - 1. Provide certificates:
 - a. Manufacturer's Certificate of Installation and Functionality Compliance.
- C. Functional testing:
 - 1. Valves:
 - a. Test witnessing: Witnessed.
 - b. Conduct pressure and leak test, as specified in Section 15110 - Common Work Results for Valves.

END OF SECTION

SECTION 15116

PLUG VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Non-lubricated plug valves.
 - 2. Lubricated plug valves.
- B. Valves have to meet AIS requirements as required by the FDEP SRF loan requirements.
- 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 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 09960 - High-Performance Coatings.
 - c. Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C606 - Grooved and Shouldered Joints.
 - 2. C517 - Resilient-Seated Cast Iron Eccentric Plug Valves.
- B. ASTM International (ASTM):
 - 1. A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. A 536 - Standard Specification for Ductile Iron Castings.

1.03 SUBMITTALS

- A. Shop drawings: Submit the following information as specified in Sections 01330 and 15110:
 - 1. Product data.
 - 2. Operation and maintenance data.

PART 2 PRODUCTS

2.01 NON-LUBRICATED PLUG VALVES

- A. Manufacturers:
 - 1. DeZurik, "PEF."
 - 2. Valmatic.
 - 3. Henry Pratt.
 - 4. No Substitutions.
- B. Design:
 - 1. Type: Rectangular or round ported Non-lubricated eccentric type, in accordance with AWWA C517.
 - 2. Plug face: Resilient material that operates satisfactorily at a temperature of 180 degrees Fahrenheit continuous and 215 degrees Fahrenheit intermittent, except for valves in compressed air or digester gas service.
 - a. Valves in compressed air service: Resilient material suitable for continuous duty at 250 degrees Fahrenheit.
 - 3. Compression washer: Provide flat compression washer made of Teflon, or of a material having equal physical characteristics on valve stem between plug and bonnet.
 - 4. Stem seals: Provide stem seals serviceable without unbolting the valve bonnet assembly. Shaft seals shall be of the multiple V-ring type with a packing gland follower. Shaft seals shall be externally adjustable and repackable under pressure without removing the actuator or bonnet from the valve. An air gap shall exist between shaft packing and bottom of actuator for visual inspection, adjustment or complete replacement of packing without disturbing any portion of the valve or actuator except the packing gland follower. Alternatively, valves shall utilize self-adjustable packing. Valves utilizing O-ring seals or non-adjustable packing shall not be acceptable.
 - 5. Grit excluders: Provide PTFE grit excluders at upper plug journals to prevent entry of foreign solids in bearing area.
 - 6. Clearly mark valves to indicate their open and closed positions.
 - 7. Provide valves with ends as required by piping details indicated on the Drawings.
 - 8. Plug design: Rectangular port is full 100 percent of standard pipe area including straight through body design with flushing port to maximize flow capacity and minimize head loss and clogging with round port, especially on the return activated sludge (RAS) and waste activated sludge (WAS) lines from the secondary clarifiers as indicated on the drawings.
- C. Materials:
 - 1. Body and plug: ASTM A 126, Class B, cast-iron body and ASTM A 536, Grade 65-45-12, ductile iron plug, with plug face Neoprene material suitable for the intended service as specified under paragraph "Design" above.
 - 2. Body seats in valves 3 inch size and larger: Provide with overlay of not less than 90-percent nickel and minimum thickness of 1/8 inch on surfaces contacting the plug face.
 - 3. Stem bearing and bottom bearing: Type 316 stainless steel.
 - 4. Internal parts, except the body and plug: Type 316 stainless steel.

5. Exposed nuts, bolts, and washers: Zinc plated. Exception: Exposed nuts, bolts, and washers for buried service: Stainless steel.
6. Grit Excluder - PTFE (Teflon).

2.02 VALVE OPERATORS

- A. Furnish valves with an operating wrench or worm gear operator:
 1. Equip valves 4 inch nominal size and smaller with a lever operator.
 2. Equip valves 6 inch nominal size and larger with a worm gear operator.

2.03 COATING

- A. Coat interior metal surfaces as specified in Section 15110.
- B. Coat exterior metal surfaces as specified in Section 09960.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install valves as specified in Section 15110 and the manufacturer's instructions.
- B. Install valves so that in the closed position the pressure in the pipeline applies a seating head on the valves.
- C. Lubrication: Lubricate plug valves and fill extended lubricant pipes with lubricant suitable for service intended.
- D. Install valves so that in the open position the plug is located in the top half of the valve body.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15120

PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Piping specialties including:
 - 1. Flexible rubber connections.
 - 2. Rubber expansion joints.
 - 3. Transition Fittings.
 - 4. Pipe saddles for ductile iron pipe.
 - 5. Tapping sleeves.
 - 6. Pressure gauges.
- B. Related Sections:
 - 1. Section 15052 - Common Work Results for General Piping.

1.02 REFERENCES

- A. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).
- B. American National Standards Institute/American Water Works Association (ANSI/AWWA):
 - 1. ANSI/AWWA C153/A21.53 - Ductile-Iron Compact Fittings.
 - 2. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
 - 3. ANSI/AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.
 - 4. ANSI/AWWA C213 - Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipelines.
 - 5. ANSI/AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.
- C. American Society for Testing and Materials (ASTM).
 - 1. ASTM A148 - Specification for Steel Castings, High-Strength, for Structural Purposes.
 - 2. ASTM A536 - Specification for Ductile Iron Castings.
- D. Society of Automotive Engineers (SAE).

1.03 SUBMITTALS

- A. Submit in accordance with Section 01330.
- B. Product Data:
 - 1. Manufacturer's certificate attesting successful performance of specified tests.
 - 2. Shop drawings detailing dimensions and materials. Provide weights for each size of ball type flexible expansion joint used on the project.
 - 3. Manufacturer's published installation instructions.
 - 4. Operation and maintenance manuals.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Bellows Type Expansion Joints and Vibration Control Joints:
 - 1. Protect joints against damage during packing, shipping, installation, and also during pressure test.
 - 2. Lock expansion joints against movement until pressure tests are completed.
 - 3. Replace damaged expansion joints with new and undamaged expansion joints.
- B. Ball-Type Flexible Expansion Joints:
 - 1. Protect sliding and rotating surfaces against damage during packing, shipping, and installation.
 - 2. Lock expansion joints against movement until pressure tests are completed.

PART 2 PRODUCTS

2.01 FLEXIBLE RUBBER CONNECTIONS

- A. Manufacturers: One of the following or equal:
 - 1. Mercer Rubber Company, Type 150 Vibraflex.
 - 2. Red Valve Company, Inc., Part Number P-5.
- B. Provide flexible rubber connections with 3/8 inch thick neoprene rubber tube with full faced flanged ends suitable to withstand a pressure of 150 pounds per square inch gauge.
- C. Provide complete flexible rubber connections, including galvanized retaining rings and control rods.

2.02 RUBBER EXPANSION JOINTS

- A. Manufacturers: One of the following or equal:
 - 1. Mercer Rubber Company, Style 500 or 700.
 - 2. Red Valve Company, Inc., Type J-1.
- B. Provide rubber expansion joints complete with control units and split retaining rings.
- C. Design:
 - 1. Material: Neoprene rubber, reinforced with embedded steel rings, and a strong synthetic fabric.
 - 2. Expansion Rings, Suitable for Pressures of at Least 125 Pounds per Square Inch Gauge, Except as Follows:
 - a. Expansion joints in pump suction piping and where indicated on the Drawings suitable for minimum 90 pounds per square inch gauge, pressure and minimum 30 inches mercury vacuum.
 - b. Split retaining rings, galvanized.
 - c. Ends of expansion joints, 150 pound ANSI flanges with drilling to match that of the piping.

- D. Rubber Expansion Joints for Blowers: Butyl type rubber formulated for service application and for maximum temperature of 250 degrees Fahrenheit, suitable for minimum 40 pounds per square inch gauge pressure, and minimum 15 inches mercury vacuum.

2.03 TRANSITION FITTINGS

- A. Manufacturers: One of the following or equal:
 - 1. Spears.
- B. Materials:
 - 1. Slip Socket: Schedule 80 PVC.
 - 2. Collar: 316 Stainless Steel.
 - 3. Threaded Insert: 316 Stainless Steel.

2.04 PIPE SADDLES FOR DUCTILE IRON PIPE

- A. Manufacturers: One of the following or equal:
 - 1. BTR Inc./Smith-Blair, Inc., Style 317.
 - 2. Romac Industries, Inc., Style 202S.
- B. Materials:
 - 1. Pipe Saddles: Ductile iron.
 - 2. Straps, Bolts, and Nuts: Type 304 stainless steel with Teflon coating on nuts.
 - 3. Gaskets: Rubber.

2.05 TAPPING SLEEVES

- A. Manufacturers: One of the following or equal:
 - 1. BTR, Inc./Smith-Blair, Inc., Style 622.
 - 2. Romac Industries, Inc., Style FTS 420.
- B. Materials:
 - 1. Tapping Sleeves: Steel construction.
 - 2. Bolts and Nuts: Type 304 stainless steel.
 - 3. Nuts: Teflon coated.
 - 4. Gaskets: Rubber.
 - 5. Size of Tapped Boss: As indicated on the Drawings.

2.06 PRESSURE GAUGES

- A. Design:
 - 1. Provide dual-range, liquid filled gauges with ranges as indicated on the Drawings.
 - 2. Size: As follows, unless otherwise indicated on the Drawings or specified:
 - a. For 1-Inch Pipe and Larger: 4-1/2 inch diameter.
 - b. For Smaller than 1-Inch Pipe: 2-1/2 inch diameter.
 - 3. Provide gauges with Type 316 stainless steel, wetted parts, phenolic cases with threaded ring, except for panel mounting, in which case provide gauge with front flanged aluminum case with threaded ring. Apply black epoxy coating to cases.
 - 4. Provide case fitted with a rupture disc, which shall relieve out the back of the case.

5. Window: Shatterproof glass or high temperature acrylic.
6. Provide gauges with Type 316 stainless steel socket and bellows or bourdon tube, depending on pressure range.
 - a. Where the maximum pressure is less than or equal to 15 pounds per square inch, the gauge shall use bellows as the measuring element.
 - b. Where the maximum pressure is greater than 15 pounds per square inch, the measuring element shall be a bourdon tube.
7. Socket Tips:
 - a. Socket Tips for Bellows and Bourdon Tube: Type 316 Stainless steel.
 - b. Size: 1/2 inch for 4-1/2 inch diameter gauges, 1/4 inch for 2-1/2 inch diameter gauges.
8. Mount gauges on diaphragm seals where indicated on the Drawings.
 - a. Provide diaphragm seals with Type 316 stainless steel top housing, bottom housing and bolt assemblies, except as follows:
 - 1) Sodium hypochlorite and ferric chloride service: Provide Titanium diaphragm seal bottom housing.
 - 2) Sodium hydroxide service: Provide Monel diaphragm seal bottom housing.
 - 3) Hydrochloric acid: Provide Hastelloy C diaphragm seal bottom housing.
 - b. Fit bottom housing with a 1/4 inch flushing connection with Type 316 stainless steel nipple and shutoff cock.
 - 1) Sodium hypochlorite and ferric chloride service: Provide PVC shutoff cock.
 - c. Diaphragm Seal: Removable.
 - 1) For pressure less than or equal to 15 pounds per square inch, provide viton diaphragm seal.
 - 2) For pressures greater than 15 pounds per square inch, provide Type 316 stainless steel diaphragm seal.
 - 3) For sodium hypochlorite, ferric chloride, and hydrochloric acid applications, provide Tantalum diaphragm seals.
 - 4) For sodium hydroxide application, provide Monel diaphragm seals.
 - d. Fit diaphragm seal gauge assembly with a snubber.
 - 1) Snubber shall have porous metal disc sized to dampen pressure fluctuations in the filled system.
 - 2) Snubber: Stainless steel.
 - 3) Snubber filter disc shall be sized to prevent the gauge from pulsating.
 - 4) Provide diaphragm seal gauge assemblies filled with silicon, except as follows:
 - a) For sodium hypochlorite, ferric chloride, sodium hydroxide, and hydrochloric acid, provide diaphragm seal gauge assemblies filled with halocarbon.
9. Pressure gauges, except gauges with diaphragm seals, shall have pulsation dampeners installed between the gauge and the shut-off valve.
 - a. Pulsation Dampeners: Stainless steel.

B. Manufacturers:

1. Pressure Gauges: One of the following or equal:
 - a. U.S. Gauge Division of Ametek, Inc., Solfrunt Gauges, Figure Number 1931T.
 - b. Dresser Industries, Inc., Ashcroft Figure Number 1379.

2. Pressure Gauges for Digester Gas Systems: One of the following or equal:
 - a. Dresser Industries, Inc.
 - b. Ashcroft, Figure 1179 compound gauge.
3. Diaphragm Seal: One of the following or equal:
 - a. For pressure less than or equal to 15 pounds per square inch:
 - 1) Ashcroft, Type 301.
 - 2) Mansfield and Green, Type LG.
 - b. For pressures greater than 15 pounds per square inch:
 - 1) Ashcroft, Type 101.
 - 2) Mansfield and Green, Type RG.
4. Snubber: One of the following or equal:
 - a. Ashcroft.
 - b. Chemiquip.
5. Pulsation Dampeners: One of the following or equal:
 - a. Dresser Industries, Inc., Ashcroft Figure Number 1106S.
 - b. Operation and Maintenance Specialties, Charlotte, N.C., Ray Pressure Snubbers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Expansion Joints for Steam Cleaned Piping:
 1. Install no less than one expansion joint in a run of steam cleaned piping which exceeds 20 feet in length. Do not exceed 200 feet in spacing of expansion joints.
 2. Install expansion joints in steam cleaned piping between anchors.
- B. Vibration Control Joints:
 1. Install vibration control joints at piping connections to or from mechanical equipment to prevent transmitting equipment vibration through the piping system.
- C. Transition Couplings
 1. Application:
 - a. Use transition couplings with function and design similar to flexible couplings and flanged coupling adapters for connecting piping having different outside diameters.
 2. Install transition-coupling products specifically designed and manufactured for that application.
- D. Pipe Saddles:
 1. Coat threads on bolts with anti-gall coating prior to installation.
- E. Tapping Sleeves:
 1. Coat threads on bolts with anti-gall coating prior to installation.
- F. Pressure Gauges:
 1. Install pressure and compound gauges as indicated on the Drawings, in the Pressure Gauge Schedule, and as specified.
 2. Install gauges as specified, and as recommended by the manufacturer in published instructions.

3.02 FIELD QUALITY CONTROL

- A. Testing: Field test gauges with a calibrated test gauge, in the presence of Engineer.

END OF SECTION

SECTION 15121

PIPE COUPLINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Flexible couplings, flanged coupling adapters.
- B. Related Sections:
 - 1. Section 15052 - Common Work Results for General Piping.

1.02 REFERENCES

- A. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).
- B. American Society for Testing and Materials (ASTM):
 - 1. A 36 - Specification for Structural Steel.
 - 2. A 53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. A 325 - Specification for High-Strength Bolts for Structural Steel Joints.
- C. Society of Automotive Engineers (SAE).

1.03 SUBMITTALS

- A. Submit in accordance with Section 01330.
- B. Shop drawings detailing dimensions and materials.
- C. Piping Layout Drawings: Coordinate preparation of required piping layout drawings such that coupling center sleeve sizes are clearly identified on drawings.
- D. Manufacturer's published installation instructions.

PART 2 PRODUCTS

2.01 PIPE COUPLINGS IN DUCTILE IRON PIPING

- A. Flexible Couplings:
 - 1. Manufacturers: One of the following or equal:
 - a. Dresser Industries, Style 153.
 - b. Romac Industries, Inc., Style 501.
 - c. Smith-Blair, Inc., Series 441.
 - 2. Materials:
 - a. Center Sleeve: Ductile iron, ASTM A536.
 - b. Follower Flanges: Ductile iron, ASTM A536.

- c. Bolts and Hex Nuts:
 - 1) Aboveground: High strength, low alloy steel.
 - 2) Buried and Underwater: Type 316 stainless steel.
- 3. Coating and Lining: Provide product with shop-applied primer which is compatible with finish coating to be applied in the field.
- 4. Center Sleeve Dimensions: Provide center sleeves with lengths in accordance with following table:

Nominal Pipe Size, Inches	Buried Condition	Aboveground Condition
3 inch and smaller	Manufacturers standard	Manufacturers standard
4 inch to 8 inch, inclusive	7 inches	5 inches
10 inch to 14 inch, inclusive	12 inches	6 inches
Greater than 16 inch	Use steel flexible coupling per Paragraph 2.02	Use steel flexible coupling per Paragraph 2.02

- B. Flanged Coupling Adapters, 12-inch size and smaller:
 - 1. Manufacturers: One of the following or equal:
 - a. Dresser Industries, Style 127.
 - b. Romac Industries, Inc., Style FCA501.
 - c. Smith-Blair, Inc., Series 912.
 - 2. Materials:
 - a. Flanged Body: Ductile iron, ASTM A126 or ASTM A536.
 - b. Follower Ring: Ductile iron, ASTM A536.
 - c. Bolts and Hex Nuts:
 - 1) Aboveground: High strength, low alloy steel.
 - 2) Buried and Underwater: Type 316 stainless steel bolts.
 - 3. Flange Design: In accordance with AWWA Class D with ANSI 150 pound drilling.
 - 4. Coating and Lining: Provide product with shop-applied primer which is compatible with finish coating to be applied in the field.
- C. Flanged Coupling Adapters, greater than 12-inch size:
 - 1. Manufacturers: One of the following or equal:
 - a. Dresser Industries, Style 128-W.
 - b. Romac Industries, Inc., Style FC400.
 - c. Smith-Blair, Inc., Series 913.
 - 2. Materials:
 - a. Flange and Flanged Body: Steel, ASTM A53 or ASTM A512.
 - b. Follower Ring: Rolled steel.
 - c. Bolts and Hex Nuts:
 - 1) Aboveground: High strength, low alloy steel.
 - 2) Buried and Underwater: Type 316 stainless steel bolts.
 - 3. Flange Design: In accordance with AWWA Class D with ANSI 150 pound drilling.
 - 4. Coating and Lining: Provide product with shop-applied primer that is compatible with finish coating to be applied in the field.
- D. Restrained Flanged Coupling Adaptor:
 - 1. Manufacturers: One of the following or equal:
 - a. Romac Industries, Inc., Style DJ400.
 - b. Smith-Blair, Inc., Series 975.

2. Materials:
 - a. Flanged Spool: AWWA Class D steel ring flange, compatible with ANSI Class 125 and 150 bolt circles. Pipe shall be Schedule 40 ASTM A53 for sizes 3 inches to 12 inches. Pipe shall be ASTM A36 for sizes 14 inches to 72 inches.
 - b. End Ring and Body: For sizes 3 inches to 12 inches, ASTM A536 ductile iron. For sizes 14 inches to 72 inches, Steel ASTM A36.
 - c. Bolts and Hex Nuts: High strength, low alloy steel.
 - d. Tie Rods: High tensile steel per ASTM A193 grade B7.
3. Coating and Lining: Fusion bonded epoxy, NSF 61 certified.

2.02 SPLIT-SLEEVE TYPE COUPLING

- A. General: As an alternate for flexible couplings or where shown on the Drawings, provide split-sleeve type couplings. Where thrust restraint is required or where shown on the Drawings, provide end rings for attachment to the pipe.
- B. Construction: Couplings selected shall be designed for the type, size and working pressure of the pipe with which they are to be used.
 1. Couplings are bolted, split-sleeve type and consist of these basic components:
 - a. One or two-piece housing.
 - b. Gasket assembly
 - c. Bolts, nuts, and end rings required for pipe restraint.
 2. Coupling shall be manufactured from ASTM A 36 Carbon Steel. The coupling shall be of a double arch cross section, which closes around pipe ends (with steel end rings for thrust restraint as required). As the coupling closes, it confines the elastomeric gasket beneath the arches of the sleeve to create the radial seal. The axial seal is affected at the closure plates as the bolts pull the coupling snug around the pipe. The coupling shall permit a degree of angular pipe deflection, flexibility, contraction, and expansion (limited by the thrust rings when required). Couplings shall be epoxy-coated on the inner diameter and outer diameter prior to delivery. Buried couplings shall receive additional protection against corrosion that matches the pipe as given in Section 09960. Bolts and nuts shall conform to the requirements of Section 05500.
- C. Pipe Preparation: Pipe ends shall be smooth for expansion or contraction requirements. Where thrust restraint is required or shown on the Drawings, pipe ends shall include end rings affixed for pipe end restraint requirements. The coupling manufacturer will provide end rings that are to be welded to the pipe per the manufacturer's requirements in lieu of other types of M-11 restraint systems. Follow coupling manufacturer's recommendation for size and amount of welding required to attach the end rings to the pipe.
- D. Gaskets: The sealing members are comprised of two (2) "O" ring gaskets and an elastomeric sealing pad bonded to the integral sealing plate. Internal pressure is not required to affect the seal. For water service, the gasket supplied may be Isoprene or Buna-N conforming to ASTM D-2000 for the design pressure within the temperature range of minus 20 to 180 degrees Fahrenheit. Elastomers shall have properties as designated by ASTM D-2000.

- E. Restrained Joint: When required for thrust restraint or as shown on the Drawings, end rings shall be furnished with the couplings and shall be of the same material as the coupling housings. The coupling shall provide a fully restrained pipe joint. One end ring is welded to each of the pipe ends (as required). The ring fits beneath the coupling and is protected by the coupling. All pipe restraint shall be within the coupling house, requiring no external thrust restraint components.
- F. Manufacturer: The following or equal:
1. Victaulic Company of America, DEPEND-O-LOK.

2.03 FLEXIBLE COUPLINGS FOR STAINLESS STEEL PIPING

- A. Manufacturers:
1. Dresser Industries, Style 38, or approved equal.

2.04 GASKETS FOR FLEXIBLE COUPLINGS AND FLANGED COUPLING ADAPTERS

- A. Provide gasket materials for process piping applications as follows:
1. Low Pressure and High Pressure Air, Steam, Hot Water: EPDM.
 2. All Other Process Piping Applications: Neoprene rubber or Buna-N.

2.05 EXTERIOR COATINGS - UNDERGROUND AND SUBMERSED APPLICATIONS

- A. Manufacturers: One of the following or equal:
1. Tapecoat Company, Inc., T.C. Mastic.
 2. Kop-Coat Company, Inc., Bitumastic Number 50.
 3. Thickness: Minimum 0.040 inch.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In underground and underwater installations, coat the coupling exterior after installation with a protective coating.
- B. Install pipe couplings with gap between pipe ends in accordance with the following table. Install flexible coupling with pipe gap located in middle of center sleeve. Install flanged coupling adapter with end of plain end pipe in middle of flanged coupling body. Maximum gap tolerance shall be plus or minus 1/8-inch.

Center Ring Length	Gap Dimension and Tolerance
4 inch through 6 inch	3/8-inch plus or minus 1/8-inch
7 inch	5/8-inch plus or minus 1/8-inch
10 inch and greater	7/8-inch plus or minus 1/4-inch.

- C. Provide joint harnesses for flexible couplings unless otherwise indicated on the Drawings with a written note.

END OF SECTION

SECTION 15211

DUCTILE IRON PIPE: AWWA C151

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Ductile iron pipe, joints, fittings, gaskets, and pipe linings and coatings.
- 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 CMAR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CMAR'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 CMAR to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 01330 - Submittal Procedures.
 - b. Section 01756 - Testing, Training and Facility Start-Up.
 - c. Section 02318 - Trenching.
 - d. Section 09960 - High-Performance Coatings.
 - e. Section 15052 - Common Work Results for General Process Piping.

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- B. American Water Works Association (AWWA):
 - 1. C104 - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - 2. C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
 - 4. C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 5. C115 - Flanged Ductile Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - 6. C150 - Standard for Thickness Design of Ductile-Iron Pipe.
 - 7. C151 - Standard for Ductile-Iron Pipe, Centrifugally Cast.
 - 8. C600 - Installation of Ductile Iron Water Mains and Their Appurtenances.
 - 9. C606 - Standard for Grooved and Shouldered Joints.
- C. American Welding Society (AWS):
 - 1. D11.2 - Guide for Welding Iron Castings.

- D. ASTM International (ASTM):
 - 1. A 47 - Standard Specifications for Ferritic Malleable Iron Castings.
 - 2. A 183 - Standard Specifications for Carbon Steel Track Bolts and Nuts.
 - 3. A 536 - Standard Specifications for Ductile Iron Castings.
 - 4. C 283 - Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
 - 5. D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
- E. Ductile Iron Pipe Research Association (DIPRA):
 - 1. Thrust Restraint Design Manual.
- F. NACE International (NACE):
 - 1. SP0188 - Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
- G. National Association of Pipe Fabricators, Inc. (NAPF):
 - 1. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings.
- H. Society for Protective Coatings (SSPC):
 - 1. PA-2 - Measurement of Dry Coating Thickness With Magnetic Gages.

1.03 SYSTEM DESCRIPTION

- A. Thrust restraint system design:
 - 1. Design restrained joint thrust restraint system.
 - 2. Determine the length of pipe that must be restrained on each side of the focus of a thrust load in accordance with the procedures and criteria established by the DIPRA Thrust Restraint Design Manual as specified in Piping Schedule in Section 15052 and the following additional criteria:
 - a. Design pressure: Test pressure.
 - b. Laying condition: Type 5 in accordance with AWWA C150.
 - c. Soil designation: Silt 1 as defined by DIPRA.
 - d. Unit friction resistance: Based upon polyethylene encasement of pipe.
 - e. Safety factor: 1.5 (for thrust restraint calculations only).

1.04 SUBMITTALS

- A. Submit as specified in Section 01330.
- B. Shop Drawings:
 - 1. Detailed layout drawings showing alignment of pipes, location of valves, fittings, and appurtenances, types of joints, connections to structures, and thrust restraint system layouts.
 - 2. Thrust restraint systems: Calculations and layout for restrained joint thrust restraint systems.
 - 3. Photographs, drawings, and descriptions of fittings, gaskets, couplings, grooving of pipe and fittings, pipe linings, and coatings.

- C. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756.
 - 1. Manufacturer's test reports for polyurethane lining certifying successful performance of holiday detection tests.
 - a. This documentation shall identify each piece by mark designation, and show the actual test results during the final inspection by the manufacturer prior to shipment.
 - b. Acceptance criteria for glass lining shall be as specified under Field Quality Control.
 - 2. Manufacturer's test results for glass lined pipe-certifying compliance with specified material requirements for glass lining.
 - 3. Include Coating Manufacturer's Technical Representative's reports.
- D. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Lining manufacturers: For piping specified to receive glass or epoxy lining, use only a lining manufacturer having a minimum of 5 years' experience supplying this type of product to the wastewater and water industry.
 - 2. Welded on outlets: The pipe manufacturer shall have a minimum of 5 years' experience in the fabrication and testing of outlets of similar size and configuration similar to those used on the Project.
- B. Pre-installation meeting:
 - 1. Arrange for Coating Manufacturer's Technical Representative to attend preconstruction conferences, and to make periodic visits to factory or shop to inspect surface preparation of pipe, fittings, and accessories; and to inspect application of linings to interior and coatings to exterior of pipe, fittings, and accessories.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Block piping and associated fittings for shipment to prevent damage to coatings and linings.
- B. Carefully handle piping and associated fittings during loading, unloading, and installation.
 - 1. Do not drop piping material from cars or trucks.
 - 2. Lower piping by mechanical means.
 - 3. Do not drop or pound pipe to fit grade.
- C. Cement Mortar lined pipe and fittings must be handled only from the outside.
 - 1. No forks, chains, straps, hooks, or other lifting device shall be placed inside the pipe or fittings for lifting, positioning, or laying.
- D. Protect gaskets and polyethylene encasement from long-term exposure to sunlight.
- E. Store piping, fittings, and other accessories such that they do not accumulate and hold rainwater, dirt, and debris.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Ductile iron piping:
 - 1. Typical type:
 - a. In accordance with AWWA C150 and AWWA C151.
 - b. Pressure class or special thickness class as indicated in the Piping Schedule provided in Section 15052.
 - 2. Type with screw-on flanges:
 - a. In accordance with AWWA C115 with minimum special thickness Class 53 wall thickness as required for screw-on flanges.
 - b. Special thickness class as indicated in the Piping Schedule as specified in Section 15052.
 - 3. Type with grooved couplings:
 - a. Special thickness class as indicated in the Piping Schedule as specified in Section 15052.
- B. Joints:
 - 1. Flanged joints:
 - a. Screw-on flanges: Comply with the diameter, thickness, drilling, and other characteristics in accordance with ASME B16.1. In addition, comply with the following requirements:
 - 1) Ductile iron.
 - 2) Long hub, threaded, and specially designed for ductile iron pipe.
 - 3) After attaching to pipe, machine flange face to make pipe end and flange even and perpendicular to the axis of the pipe.
 - b. Bolt holes on flanges: 2-holed and aligned at both ends of pipe.
 - c. Cap screw or stud bolt holes: Tapped.
 - d. Bolts and nuts: As specified in Section 15052.
 - e. Gaskets: Standard styrene butadiene copolymer (SBR) unless specified otherwise in Section 15052.
 - 2. Grooved joints: In accordance with AWWA C606, as complemented and modified below, radius-cut type, with following components:
 - a. Couplings: Rigid type, cast from ductile iron in accordance with ASTM A 536, Grade 65-45-12, or malleable iron in accordance with ASTM A 47, Grade 32510.
 - b. Bolts and nuts: In accordance with ASTM A 183, Grade 2.
 - c. Gaskets: Capable of being applied on surface of piping with cavities to provide for an improved seal with the internal piping pressure. Material to be used for following services:
 - 1) For liquid service: NBR For air service: Fluoroelastomer.
 - 2) For hot water service: EPDM.
 - d. Fittings: In accordance with AWWA C606, rigid radius-cut groove:
 - 1) Center-to-center dimensions: In accordance with AWWA C110.
 - 2) Wall thickness and other characteristics: In accordance with AWWA C606.
 - e. Flanged unit connections: Flanged to grooved joint adapters or a long enough spool with one end flanged and the other end grooved to prevent interference with the operation of adjacent valves, pumps, or other items.
 - 3. Mechanical joints: In accordance with AWWA C111.
 - 4. Push-on rubber gasket joints: In accordance with AWWA C111.

5. Integrally restrained mechanical joints:
 - a. Application:
 - 1) Where designation Mech Rest.
 - 2) MJ is specified in the Piping Schedule provided in Section 15052 supply a restrained mechanical joint piping system, which includes restrained mechanical joints where necessary based upon thrust calculations.
 - 3) Standard mechanical joints as specified above can be used where thrust calculations demonstrate restraint is not required.
 - b. Design:
 - 1) Integral retainer weldment type or lugged type joint with Type 304 stainless steel rods and nuts.
 - 2) Restrained mechanical joints of the configuration which utilizes a gripping or friction force for restraint will not be acceptable.
 - c. Manufacturers: Where restrained mechanical joints are required, use one of the following or equal:
 - 1) American Cast Iron Pipe Company, MJ Coupled Joint.
 - 2) Pacific States Cast Iron Pipe Company, Lock Mechanical Joint.
 - 3) Griffin Pipe Products Co., Bolt-Lok.
 - 4) Griffin Pipe Products Co., Mech-Lok.
6. Integrally restrained push-on joints:
 - a. Application:
 - 1) Where designation restrained push-on is specified in the Piping Schedule provided in Section 15052 supply a restrained push-on joint piping system, which includes restrained push-on joints where necessary based upon thrust calculations.
 - 2) Standard push-on rubber gasket joints as specified above can be used where thrust calculations demonstrate restraint is not required.
 - b. Design:
 - 1) Restrained push-on joints of the configuration which utilizes a gripping or friction force for restraint will not be acceptable.
 - 2) Suitable for the following working pressures:
 - a) For 4- through 24-inch pipe: 350 pounds per square inch gauge.
 - b) For 30- through 54-inch pipe: 250 pounds per square inch gauge.
 - c. Manufacturers: One of the following or equal:
 - 1) United States Pipe and Foundry Company, TR Flex.
 - 2) Pacific States Cast Iron Pipe Company, Thrust Lock.
 - 3) American Cast Iron Pipe Company, Flex Ring or Lok-Ring.
 - 4) Griffin Pipe Products Co., Snap-Lok.
 - d. Limit buried joints to half the manufacturer's published allowable angular joint deflection for purposes of pipeline alignment and elimination of fittings.

C. Fittings:

1. Ductile iron in accordance with AWWA C110
2. Joint type: Same as that of the associated piping as specified in Section 15052.
3. Plain end-to-flanged joint connectors using setscrews are not acceptable.

- D. Pipe linings:
 - 1. Cement-mortar lining:
 - a. In accordance with AWWA C104, apply cement-mortar on clean bare metal surfaces. Extend to faces of flanges, ends of spigots, and shoulders of hubs.
 - b. Minimum lining thickness: Standard in accordance with AWWA C104.
 - c. Type of cement: Type II.
 - 2. Asphaltic seal coat:
 - a. Apply over cement mortar linings and to outside surface of pipes that will not receive another coating. Apply in accordance with AWWA C151.
- E. Coatings:
 - 1. Asphalt varnish: Factory applied.
 - 2. Primer:
 - a. Factory applied for field coating.
 - b. Compatible with materials as specified in Section 09960.

2.02 CERAMIC EPOXY LINING

- A. The interior of all sludge pipe and fittings (BFP Sludge feed) as specified or indicated on the drawings shall be Protecto 401™ ceramic epoxy lining, 40 mils nominal dry film thickness or Permite Permax PCS-9043 Type II glass flake epoxy 50 mils nominal dry film thickness.
- B. The lining shall be applied by a certified firm with a successful history of applying above linings.
- C. The pipe and fittings manufacturer shall provide a certificate attesting that the applicator met the requirements of this specification and the material used as specified.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Install ductile iron piping in accordance with AWWA C600, modified as specified in Section 15052.
 - 2. For underground piping, the trenching, backfill, and compaction: As specified in Section 02318.
- B. Polyethylene encasement:
 - 1. Wrap all buried ductile iron pipe and fittings in 2 layers of loose polyethylene wrap in accordance with AWWA C105.
 - 2. Polyethylene encasement shall be continuous and terminated neatly at connections to below grade equipment or structures.
 - 3. At wall penetrations, extend encasement to the wall and neatly terminate.
 - 4. At slab penetrations, extend encasement to 2 inches below the top of slab and neatly terminate.
 - 5. When rising vertically in unimproved areas, extend encasement 6 inches above existing grade and neatly terminate.

6. Repair tears and make joints with 2 layers of plastic tape.
7. All work shall be inspected prior to backfilling of pipe and associated items.

C. Joints:

1. Install types of joints as specified in the piping schedule provided in Section 15052.
2. Mechanical joints are not acceptable in above ground applications.
3. Field closure for restrained push-on pipe:
 - a. Locate field closures in areas where thrust calculations demonstrate restraint is not required.
4. Grooved joints:
 - a. Install piping with grooved joints where specified in the piping schedule as specified in Section 15052 or indicated on the Drawings.
 - b. Assemble grooved joints in accordance with manufacturer's published instructions.
 - c. Support grooved-end pipe in accordance with manufacturer's published instructions.
 - 1) Install at least 1 support between consecutive couplings.

D. Tapping ductile iron pipe:

1. Direct tapping of ductile iron pipe may be performed but is limited to the following conditions:
 - a. Maximum allowable tap diameter by pipe diameter and pressure class:

Pipe Size (inches)	Pressure Class				
	150	200	250	300	350
	Maximum Allowable Direct Tap Size (inches)				
3	-	-	-	-	3/4
4	-	-	-	-	3/4
6	-	-	-	-	1
8	-	-	-	-	1
10	-	-	-	-	1
12	-	-	-	-	1-1/4
14	-	-	1-1/4	1-1/2	1-1/2
16	-	-	1-1/2	2	2
18	-	-	2	2	2
20	-	-	2	2	2
24	-	2	2	2	2

- b. The maximum allowable tap diameter for pipelines greater than 24 inches is 2 inches.
- c. Two layers of 3-mil thread sealant are required to minimize the torque required to effect a watertight connection.

3.02 FIELD QUALITY CONTROL

- A. Testing ductile iron piping:
 - 1. Test as specified in Section 15052.
 - 2. Do not test sections longer than 1/2 mile in total pipe length.
- B. Repair damaged cement mortar lining to match quality, thickness, and bonding of original lining in accordance with AWWA C104.
 - 1. When lining cannot be repaired or repairs are defective, replace defective piping with undamaged piping.

3.03 COMMISSIONING AND PROCESS START-UP REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services:
 - 1. Provide Manufacturer's Certificate of Source Testing.
 - 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.

			Manufacturer Rep Onsite					
Source Testing (Witnessed or Non-witnessed)	Training Requirements		Installation Testing		Functional Testing		Process Operational Period	
	Maintenance (hrs per session)	Operation (hrs per session)	Trips	Days (each trip)	Trips	Days (each trip)	Trips	Days (each trip)
Non-witnessed	Not required		Not required		Not required		Not required	

END OF SECTION

SECTION 15247

POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Gravity sewer pipe and fittings in accordance with ASTM D 3034 and ASTM F 679 standards.
- 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 15052 - Common Work Results for General Piping.
 - b. Section 15956 - Piping Systems Testing.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. C 923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
 - 2. D 1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 3. D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 4. D 3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 5. D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - 6. F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - 7. F 679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

1.03 ABBREVIATIONS

- A. PVC: Polyvinyl chloride.
- B. SDR: Standard dimension ratio; the outside diameter divided by the pipe wall thickness.

1.04 SUBMITTALS

- A. Product data: Describe materials, pipe, fittings, and gaskets.
- B. Manufacturer's Published Installation Instructions.
- C. Certificates:
 - 1. Submit manufacturer's certificate attesting that pipe and fittings meet specified requirements in accordance with ASTM D 3034 and ASTM F 679, as applicable.
 - 2. Manufacturer's certification of date of manufacture of pipe for each lot delivered.

1.05 QUALITY ASSURANCE

- A. Mark plastic pipe with nominal size, type, class, schedule, or pressure rating, manufacturer and all markings required in accordance with ASTM standards.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect from sunlight, scoring, and distortion.
- B. Do not allow surface temperatures to exceed 120 degrees Fahrenheit.
- C. Store and handle as recommended by manufacturer in published instructions.

PART 2 PRODUCTS

2.01 PIPE

- A. Extruding and molding material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.
- B. PVC compound: Cell classification 12454-C in accordance with ASTM D 1784.
- C. Stabilizers, antioxidants, lubricants, colorants, and other additives and fillers not to exceed 10 parts by weight per 100 of PVC resin in the compound.
- D. Pipe less than or equal to 15-inch diameter:
 - 1. In accordance with ASTM D 3034.
 - 2. Wall thickness SDR 26.
 - 3. Joints: Push-on in accordance with ASTM D 3212.
 - a. Integral bell.
 - b. Factory installed gaskets meeting the requirements in accordance with ASTM F 477.

2.02 FITTINGS

- A. Same material as the pipe.
- B. Minimum wall thickness: Same as the minimum wall thickness of the equivalent size pipe as specified in Table 1 of ASTM F 679.

- C. Supplied by the pipe manufacturer.
- D. Factory molded with joints and gaskets equal to those of the pipe.
- E. Gasket:
 - 1. In accordance with ASTM F 477.
 - 2. Manhole adapter gasket: Stainless steel clamp with gasket or similar device to seal the penetration.
- F. Flexible gaskets for precast bases with a flexible pipe connection:
 - a. In accordance with ASTM C 923.
 - b. Manufacturer: The following or approved equal:
 - 1) Press-Seal Gasket Corporation: PSX.
 - 2) A-Lok Premium.
- G. Waterstop grouting rings:
 - 1. Manufacturer: The following or approved equal:
 - a. NPC.
 - b. Press-Seal Gasket Corporation.

2.03 SOURCE QUALITY CONTROL

- A. Mark pipe and fittings in accordance with ASTM D 3034 and ASTM F 679 as appropriate.
- B. Mark the production control code on pipe and fittings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Install piping in accordance with ASTM D 2321 and manufacturer's published installation instructions.
 - 2. Provide plugs or caps for stubs and branch pipes left unconnected to laterals.
 - 3. Lubricate and assemble joints in accordance with the pipe manufacturer's published instructions.
- B. Connections to manholes:
 - 1. Make connections to manholes with a manhole gasket that prevents infiltration and exfiltration through the penetrations using 1 of the following methods:
 - a. Precast bases with a flexible pipe connection:
 - 1) Pipe connectors shall be cast into the base.
 - a) Pipe openings shall contain flexible gaskets.
 - 2) Follow manufacturer's recommendation for lubrication to prevent damage to the gasket during pipe insertion.
 - 3) When PSX gaskets are used, the take-up screws for the gasket clamps shall be positioned a minimum of 90 degrees apart.
 - 4) Install and grout in place per manufacturers instructions.

- b. Cast in place or precast bases using grouting rings:
 - 1) Provide opening for connection large enough to allow subsequent grouting around the grouting ring.
 - 2) Grout around the pipe penetration manhole gasket and seal the opening.

3.02 FIELD QUALITY CONTROL

- A. Test pipe as specified in Section 15052 and Section 15956.

END OF SECTION

SECTION 15249

POLYVINYL CHLORIDE (PVC) PIPE: SCHEDULE TYPE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Schedule type PVC pipe and fittings.
- 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 01756 - Testing, Training and Facility Start-Up.
 - c. Section 15052 - Common Work Results for General Process Piping.
 - d. Section 15956 - Piping Systems Testing.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. D 1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 2. D 1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - 3. D 2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 4. D 2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 5. D 2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
 - 6. D 2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride)(PVC) Pipe and Fittings.
 - 7. F 645 - Standard Guide for Selection, Design and Installation of Thermoplastic Water-Pressure Piping Systems.
- B. NSF International (NSF):
 - 1. 61 - Drinking Water System Components – Health Effects.

1.03 SUBMITTALS

- A. Submit as specified in Section 01330.
- B. Shop Drawings:
 - 1. Describe materials, pipe, fittings, gaskets, and solvent cement.
 - 2. Installation instructions.
- C. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756. Include as applicable:
 - 1. Date of manufacture of tubing for each lot delivered.
 - 2. Solvent cement manufacturer's report and certification.
- D. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756.

1.04 QUALITY ASSURANCE

- A. Pipe in potable water applications: Provide pipe bearing NSF 61 seal.
- B. Mark pipe and fittings in accordance with ASTM D 1785.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect from sunlight, scoring, and distortion.
- B. Do not allow surface temperatures to exceed 120 degrees Fahrenheit.
- C. Store and handle as recommended by manufacturer in published instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Extruding and molding material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.
 - 1. Pipe: Designation PVC 1120 in accordance with ASTM D 1785 and appendices:
 - a. Extruded from Type I, Grade 1, Class 12454-B material in accordance with ASTM D 1784.
 - b. Schedule 80 unless otherwise indicated on the Drawings or specified in the Piping Schedule in Section 15052.
 - 2. Fittings: In accordance with ASTM D 2467.
 - a. Same material as the pipe and of equal or greater pressure rating.
 - b. Supplied by pipe manufacturer.
 - c. Unions 2-1/2 inches and smaller:
 - 1) Use socket end screwed unions.
 - d. Unions 3 inches and larger:
 - 1) Use socket flanges with 1/8-inch full-face soft EPDM gasket.

3. Solvent cement:
 - a. In accordance with ASTM D 2564.
 - b. Manufacturers: The following or equal:
 - 1) IPS Corporation.
 - c. Certified by the manufacturer for the service of the pipe.
 - d. In potable water applications: Provide solvent cement listed by NSF for potable water applications.
 - e. Primer: As recommended by the solvent cement manufacturer.

2.02 SOURCE QUALITY CONTROL

- A. Meets or exceeds all quality assurance test requirements stated in ASTM D 1785.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install piping in accordance with ASTM F 645, or manufacturer's published instructions for installation of piping, as applicable.
- B. Provide molded transition fittings for transitions from plastic to metal pipe.
 1. Do not thread pipe.
- C. Locate unions where indicated on the Drawings, and elsewhere where required for adequate access and assembly of the piping system.
- D. Provide serrated nipples for transition from pipe to rubber hose.
- E. Solvent weld joints in accordance with ASTM D 2855.

3.02 FIELD QUALITY CONTROL

- A. Test pipe as specified in Section 15052 and Section 15956.

3.03 COMMISSIONING AND PROCESS START-UP REQUIREMENTS

- A. As specified in Section 01756 and this Section.
- B. Manufacturer services:
 1. Provide Manufacturer's Certificate of Source Testing.
 2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15740

HEAT PUMPS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Heat pump units

1.02 REFERENCES

- A. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
 - 1. 210-240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - 2. 270 - Sound Rating of Outdoor Unitary Equipment.
 - 3. 340/360 - Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
- B. Air Movement and Control Association International, Inc. (AMCA):
 - 1. 210 - Laboratory Methods for Testing Fans for Certified Aerodynamic Performance Rating.
- C. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - 1. Standard 15 - Safety Standard for Refrigeration Systems.
 - 2. Standard 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - 3. Standard 62.1 - Ventilation for Acceptable Indoor Air Quality.
- D. American National Standards Institute (ANSI):
 - 1. Z21.47 - Gas Fired Central Furnaces (except Direct Vent Central Furnaces) with Addenda.
- E. Federal Specification (FS):
 - 1. Standard 141 - Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing.
- F. National Electrical Code (NEC).
- G. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
- H. National Fire Protection Association (NFPA):
 - 1. 54 - National Fuel Gas Code.
 - 2. 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
- I. National Roofing Contractors Association (NRCA).
- J. Underwriters' Laboratories, Inc. (UL).
 - 1. 900 - Standard for Air Filter Units.

1.03 DEFINITIONS

- A. NEMA: Type 3R enclosure in accordance with NEMA 250.

1.04 SUBMITTALS

- A. Submit as specified in Section 01330 - Submittal Procedures.
- B. Shop drawings:
 - 1. System layout, mechanical, electrical power, and control diagrams.
 - 2. Nameplate information.
 - 3. Materials.
 - 4. Supports, vibration isolators, and seismic bracing calculations and details.
 - 5. Primary and ancillary equipment.
 - 6. Proposed cutting and patching, when required.
 - 7. Maximum recommended equipment vibration levels and field-testing method.
 - 8. Sound power level in each of 8 octave bands and overall Sones.
 - 9. Bearing life.
 - 10. Fan performance curves showing specified operating condition.
 - 11. Copy of factory test results.
- C. Operation and maintenance data as specified in Section 01782 - Operation and Maintenance Data.
- D. Warranties.
- E. Provide required commissioning submittals as specified in Section 01756 - Commissioning.

1.05 QUALITY ASSURANCE

- A. Assemble panels, enclosures, and rack systems along with all internal and external devices, wiring, equipment, and materials in a facility that is recognized by UL to assemble and certify UL-labeled control panels.
- B. Qualification of manufacturer: Manufacturer with experienced personnel, physical facilities, and management capacity sufficient to produce products of quality specified with a minimum 5 years satisfactory performance record.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver units in 1 piece (or modular, if required), factory assembled, piped, internally wired, and factory tested.
- B. Protect equipment from dust and atmospheric exposure as recommended by the unit manufacturer.
 - 1. Provide temporary closures for equipment openings designed for airflow.

1.07 WARRANTY

- A. Provide warranty as specified in the General Conditions.

- B. Special warranties:
 - 1. Refrigerant compressors and closed or sealed refrigerant systems warranty duration: Provide 5-year warranty.
 - 2. Electric heaters (if supplied) warranty duration: Provide 5-year warranty.
 - 3. Evaporator and condensing coils warranty duration: Provide 5-year warranty.

1.08 MAINTENANCE

- A. Extra materials: Provide 2 extra (3 total) sets of filters per unit installed.
- B. Provide 1 set of sheaves and belts for change-out, if required, for final balance per unit installed.
- C. After final balance, provide 1 extra set of belts for each unit installed.
- D. Special tools: Deliver 1 set of special tools needed to assemble and disassemble the components of the unit requiring regular maintenance.

PART 2 PRODUCTS

2.01 GENERAL

- A. As specified in Section 01600 - Product Requirements and 15050 - Common Work Results for Mechanical Equipment.
- B. 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.
- C. All supplied components of the unit shall be furnished and fully integrated by the unit system supplier, having unit responsibility:
 - 1. Furnish and install all piping, valves, dampers, sensors and wiring within the unit package.
 - 2. Provide a unit mounted control panel prewired on the unit to all dampers and sensors within the unit.
- D. Motors:
 - 1. Totally enclosed.
 - 2. Voltage and number of phases as scheduled.
 - 3. Compressor motors:
 - a. Cooled by refrigerant gas passing through windings.
 - b. Provided with line break thermal and current overload protection.
 - 4. Fan and blower motors:
 - a. Permanently lubricated ball bearings.
 - b. Integral automatic reset thermal overload protection.
 - 5. Other requirements as specified.
- E. Electrical:
 - 1. Provide a single conduit connection in the unit for both power and control wiring.

2.02 SYSTEM DESCRIPTION

A. Design requirements:

1. Provide fans that have sharply rising pressure characteristics which extend throughout the operating range and continue to rise beyond the efficiency peak.
2. Provide fans that peak as close as possible to the maximum efficiency and whose operating range is within the normal fan selection range.
3. When scheduled, provide guided vibration isolator for fans, so that not more than 10 percent of the vibration amplitude of the fan and motor is transmitted to the supporting structure.
4. Design fan inner scroll and air stream surfaces to maintain smoothness for entire fan service life.
5. Seismic and Wind supports: Design supports to comply with the criteria specified in Section 01410 - Regulatory Requirements.
6. Electrical components: UL listed and meeting the design and installation requirements of the NEC.
7. Roof curbs: Designed in accordance with NRCA Standards.
8. Gas, water piping, drains, and venting: In accordance with building code, mechanical code, and plumbing code as specified in Section 01410 - Regulatory Requirements and in accordance with applicable codes.
9. Fans supplied with heat pump units: Rated in accordance with AMCA 210.
10. Unit heat pumps: Rated in accordance with AHRI Standards 210-240 or 340/360 and AHRI 270. Conform to the latest version of ASHRAE 15.
11. Unit heat pumps with auxiliary heating options: Certified in accordance with ANSI Z21.47.
12. Insulation and adhesives: In accordance with NFPA 90A requirements for flame spread and smoke generation.
13. Refrigerant: HCFC R-410A.
14. Finishes: When not specified with fan type, coat ferrous metals as specified in Section 09960 - High-Performance Coatings.

B. Performance requirements:

1. Performance requirements as specified and as scheduled on the Heat Pump Schedule indicated on the Drawings.
2. Outdoor noise levels: Outdoor noise levels in the 8 octave band ranges, as measured in accordance with AHRI Standard 270 for unit heat pumps and split system heat pumps shall not exceed the following:

OCTAVE BANDS								
Unit Nominal Capacity (Tons)	63	125	250	500	1,000	2,000	4,000	8,000
0 to 5	64	70	71	74	74	71	67	67
6	79	85	78	74	71	73	66	59
7-1/2 to 10	64	70	73	79	82	78	74	67
12 and larger	84	88	84	83	84	78	72	68

3. Units shall be capable of starting and running from 45 to 125 degrees Fahrenheit ambient outdoor air temperature and exceeding the maximum load criteria of AHRI Standard 210-240 or 340/360.

4. Capable of starting and providing heating at or above 0 degrees Fahrenheit outdoor ambient air temperature.
5. Minimum cooling and heating capacities, energy efficiency ratios (EER), and coefficient of performance (COP), as rated in accordance with AHRI 210-240 or 340/360 and 270, unless scheduled otherwise:

				Heating High Temperature ⁽¹⁾		Heating Low Temperature ⁽²⁾	
Nominal Capacity (Tons)	Standard cfm	Cooling Capacity (Btuh)	EER ⁽³⁾	Capacity (Btuh)	COP	Capacity (Btuh)	COP
3	1,200	36,400	11.0	35,200	3.0	18,400	2.0
4	1,750	47,000	11.0	47,000	3.0	26,400	2.0
5	2,000	59,000	11.0	59,000	3.0	26,400	2.1
6	2,400	72,800	11.0	70,400	3.0	36,800	2.0
7-1/2	3,000	87,000	11.0	89,000	3.0	49,000	2.0
10	4,000	113,000	11.0	116,000	3.0	65,000	2.0

Notes:

(1) High temperature heating standard:

- a. 70 degrees Fahrenheit dB indoor entering air temperature.
- b. 47 degrees Fahrenheit dB, 43 degrees Fahrenheit wet bulb outdoor entering air temperature.

(2) Low temperature heating standard:

- a. 70 degrees Fahrenheit dB indoor entering air temperature.
- b. 17 degrees Fahrenheit dB, 15 degrees Fahrenheit wet bulb outdoor entering air temperature.

(3) EER value:

- a. Deduct 0.2 from the required EER's for units with a heating section other than electric resistance heat.
- b. EER value based on CCR Title 24 requirements.

1. Units with heating capabilities: Meet or exceed the following efficiencies:

- a. Annual fuel utilization efficiency: 80 percent.
- b. Steady state efficiency: 80 percent.

2. Unit air flows for cooling: A minimum of 300 cubic feet per minute per ton but not exceeding 500 cubic feet per minute per ton of cooling unless scheduled otherwise.

3. Filter:

- a. Media: UL 900 listed, Class I or Class II, approved by local authorities.
- b. Efficiency: 45 to 50 percent dust spot efficiency when rated per ASHRAE Test Standard 52.2.
- c. Face velocity: Per manufacturer recommendation.

2.03 MINI-SPLIT SYSTEM HEAT PUMPS

- A. Manufacturers: One of the following or equal:
 - 1. Mitsubishi, Series PUZ; when indoor air handling unit scheduled, Series PKA (wall mounted).
 - 2. Samsung, similar series.
 - 3. Daikin, similar series.
 - 4. Trane, similar series.
- B. Compressors:
 - 1. Fully hermetically-sealed, high-efficiency, reciprocating or rotary or scroll-type, with rubber grommet vibration isolation.
- C. Fans:
 - 1. Indoor air fan:
 - a. Direct driven with capacitor start motor; double inlet, forward curve sirocco fan, steel with corrosion resistant finish, statically and dynamically balanced.
 - b. Bearings: permanently sealed ball bearing type and permanently lubricated.
 - 2. Outdoor condenser fan:
 - a. Propeller type, direct drive, aluminum blades, dynamically balanced.
 - b. Bearings: Permanently sealed ball bearing type and permanently lubricated.
- D. Coils:
 - 1. Evaporator and condenser coils: seamless copper tubes with mechanically bonded aluminum plate fins.
 - 2. Provide corrosion resistant finish, suitable for marine environment.
- E. Refrigerant components: Refrigerant circuit including:
 - 1. Accumulator and filter/drier.
 - 2. Expansion device.
 - 3. Reversing valve.
 - 4. Flow control valves.
 - 5. Service and gauge connections on compressor suction and discharge, and liquid lines to charge, evacuate, and contain refrigerant.
- F. Controls and equipment safety features:
 - 1. Provide system controls for a complete functioning system:
 - a. High and low evaporator fan speed control for cooling and heating modes.
 - b. Fan only operation.
 - c. Ventilation control; closed.
 - d. Space temperature condition setting.
 - e. Vapor bellows thermostat to cycle unit to maintain space condition.
 - 2. Equipment safety features:
 - a. Thermostatic base pan drain to prevent freeze up of the fan in collected condensate.
 - 3. Provide with a low ambient cooling option.

- G. Unit casing:
 - 1. Slide-out design unit casing manufactured of high strength molded plastic with smooth finish and outdoor casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, polyester powder coating for corrosion protection.
 - 2. Weatherproof design, reinforced and braced for maximum rigidity.
 - 3. Provided with:
 - a. Filter rack for filters accessible through the front or top of the unit.
 - b. Non-corrosive drain pan in accordance with ASHRAE Standard 62.1.
 - c. Horizontal drain connection.
 - d. Provide mini condensate pump suitable to be powered from indoor/outdoor unit.
 - e. Knockouts for power connections.
 - f. Provide wall sleeve of galvanized steel coated similar to unit casing.

2.04 ACCESSORIES

- A. Sensors: Provided by manufacture.
- B. Provide hail guard to protect against damage from hail and other flying debris.
- C. Provide coil guard grill to protect condenser coil from penetration by large objects.
- D. Provide condensate drain per mechanical code as specified in Section 01410 - Regulatory Requirements.

PART 3 EXECUTION

3.01 GENERAL

- A. Inspect all components for shipping damage, conformance to specifications, and proper torques and tightness of fasteners, as specified in Section 15050 - Common Work Results for Mechanical Equipment.
- B. Prior to installation, protect equipment from dust and atmospheric exposure as recommended by the unit manufacturer.
 - 1. Provide temporary closures for equipment openings designed for airflow.
- C. During installation and until equipment is operated, protect equipment and ducts from dust and debris by covering openings with tape or plastic.
- D. Examine and verify details and sections indicated on the Drawings, ascertain adequacy, and determine conflicts in dimensions and clearances.
 - 1. Take measurements and verify dimensions to ascertain fit of installation.
 - 2. Ascertain structural sufficiency to support installation.
 - 3. Ascertain that supports and openings are correctly located; otherwise cut new openings where required.
 - a. Submit details of proposed cutting and patching.
 - 4. Confirm specified thermostat or other controls are compatible with specified equipment.

3.02 INSTALLATION

- A. As specified in Section 15050 - Common Work Results for Mechanical Equipment:
 - 1. Before installation, remove dust and debris from equipment and ducts.
- B. Anchoring and support:
 - 1. Provide anchoring and support designed in accordance with current engineering practice for equipment and appurtenances by attaching or connecting to supporting members or by providing other supports.
 - 2. Provide anchoring and support per section 01410 - Regulatory Requirements.
- C. Adjust alignment of ducts and equipment where necessary to resolve conflicts with architectural features or to resolve conflicts with the work of other trades.
- D. Install and wire unit air conditioners, controls, and thermostats in accordance with manufacturer's recommendations.
 - 1. Provide local disconnect switches.
- E. Upon completion of installation, clean duct, and debris from ductwork, and equipment.

3.03 COMMISSIONING

- A. As specified in Section 01756 - Commissioning and this Section.
- B. Manufacturer services:
 - 1. Provide certificates:
 - a. Manufacturer's Certificate of Source Testing.
 - b. Manufacturer's Certificate of Installation and Functionality Compliance.
 - 2. Manufacturer's Representative onsite requirements:
 - a. Installation: 1 trip, 1 day minimum.
 - b. Functional Testing: 1 trips, 1 day minimum each.
 - 3. Training:
 - a. Maintenance: 2 hours per session, 2 sessions.
 - b. Operation: 1 hours per session, 2 sessions.
 - 4. Process operational period:
 - a. As required by Owner or Contractor.
- C. Source testing:
 - 1. Test as specified in Section 15958 - Mechanical Equipment Testing.
 - 2. Equipment:
 - a. Test witnessing: Not witnessed.
 - b. Conduct Level 1 General Equipment Performance Test.
 - c. Conduct Level 1 Vibration Test.
 - d. Conduct Level 1 Noise Test.
 - e. Factory test in cooling and heating modes including economizer operation. Evacuate coils and refrigerant system for 30 minutes prior to final charging of unit before shipment.
 - 3. Electrical Instrumentation and Controls:
 - a. Test witnessing: Not witnessed.

- D. Functional testing:
 - 1. Equipment:
 - a. Test witnessing: Witnessed.
 - b. Conduct Level 1 General Equipment Performance Test.
 - c. Conduct Level 1 Vibration Test.
 - d. Conduct Level 1 Noise Test.
 - e. Test equipment and installation to verify tightness, operation, and unit heat pump vibration is within manufacturer's submitted maximum.
 - f. Test equipment performance and balance equipment as specified in Section 15954 - Testing, Adjusting, and Balancing for HVAC.
 - g. Test for outdoor sound power at levels.
 - 2. Electrical Instrumentation and Controls:
 - a. Test witnessing: Witnessed.

3.04 SCHEDULES

- A. As indicated on the Drawings.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15954

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Heating, ventilation, and air conditioning systems testing, adjusting, and balancing.

1.02 REFERENCES

- A. Associated Air Balance Council (AABC):
 - 1. National Standards for Field Measurements and Instrumentation, Total System Balance, Air Distribution-Hydronic Systems.
- B. National Environmental Balancing Bureau (NEBB):
 - 1. Procedural Standards for Testing, Adjusting, and Balancing Environmental Systems.
- C. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - 1. Heating, Ventilating, and Air Conditioning Systems - Testing, Adjusting, and Balancing.
- D. Testing, Adjusting, and Balancing Bureau (TABB):
 - 1. International Standards for Environmental Systems Balance.

1.03 TESTING, ADJUSTING, AND BALANCING WORK REQUIREMENTS

- A. Procure the services of an independent air balance and testing agency belonging to and in good standing with the AABC, NEBB, or the TABB to perform air balancing, testing, and adjustment of building and process air conditioning, heating, and ventilating air systems.
- B. The Work includes: Balancing new air systems installed as part of this contract and existing air systems affected by the installation of new equipment.
- C. Perform testing of heating, ventilating, and air conditioning equipment, balancing of distribution systems, and adjusting of air terminal units and ductwork accessories to ensure compliance with Specifications and Drawings. Perform tests for following:
 - 1. Split System Heat Pumps
- D. Test each mode of operation of thermostats, electronic controllers, and pneumatic, electric or electronic heating, ventilating, and air conditioning instruments to ensure operation as specified.
- E. Test and adjust room distribution patterns at air outlets.

- F. Provide instruments required for testing, adjusting, and balancing operations; retain possession of instruments; remove instruments from site at completion of services.
- G. Make instruments available to the Engineer to facilitate spot checks during testing.
- H. Provide test holes for pressure and pitot flow measurements; provide plugs for all test holes after testing.

1.04 QUALITY ASSURANCE

- A. Test, balance, and adjust environmental systems in accordance with either:
 - 1. AABC: National Standards for Field Measurements and Instrumentation, Total Systems Balance, Air Distribution-Hydronic System.
 - 2. NEBB: Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
 - 3. TABB: International Standards for Environmental Systems Balance.
- B. Perform services under direction of AABC, NEBB, or TABB certified supervisor.
- C. Calibrate and maintain instruments in accordance with requirements of standards. Make calibration histories of instruments available for examination.
- D. Make measurements in accordance with accuracy requirements of standards.
- E. Testing, adjusting, and balancing performance requirements:
 - 1. Comply with procedural standards of certifying association.
 - 2. Execute each step of prescribed testing, balancing, and adjusting procedures without omission.
 - 3. Accurately record required data.
 - 4. Make measurements in accordance with recognized procedures and practices of certifying association.
 - 5. Measure air volume discharged at each outlet and adjust air outlets to design air volumes within 5 percent over.

1.05 SUBMITTALS

- A. Resumes of proposed supervisor and personnel showing training and qualifications.
- B. Interim reports: At least 30 days prior to starting field work, submit the following:
 - 1. Set of report forms filled out as to design flow values and installed equipment pressure drops, and required cubic feet per minute for air terminals.
 - 2. Develop heating, ventilating, and air conditioning system schematic similar to Figure 6-1 in SMACNA Testing, Adjusting, and Balancing.
 - 3. Complete list of instruments proposed to be used, organized in appropriate categories, with data sheets for each showing:
 - a. Manufacturer and model number.
 - b. Description and use when needed to further identify instrument.
 - c. Size or capacity range.
 - d. Latest calibration date.
- C. Final report: At least 15 days prior to Contractor's request for final inspection, submit 3 copies of final reports, on applicable reporting forms. Include:
 - 1. Identify instruments which were used and last date of calibration of each.

2. Procedures followed to perform testing, adjusting, and balancing.
 3. Identification and succinct description of systems included in report.
 4. Initial balance test results made with all dampers and air control devices in full open positions.
 5. Description of final locations and sizes, including opening area and dimensioned configuration of orifices and other restrictions used to achieve final balanced flows.
 6. Description of final location and opening positions of dampers, registers, louvers, and valves.
 7. Schematics of systems included in report; use schematics as part of testing, adjusting, and balancing report to summarize design and final balanced flows.
 8. Testing, adjusting, and balancing report forms.
 9. Final field results established for system balancing including airflow, fan speeds, and fan static pressures at the fan inlet and outlet.
 10. Appendices.
 11. Include appendices for:
 - a. Raw field data taken during testing.
 - b. Sample calculation sheet for each type of calculation made to convert raw field data to final results.
 - c. Initial air balance results with dampers and registers in full open position; include airflow at all inlets and outlet, initial fan speed and fan suction and discharge pressures.
- D. Proposed schedule for testing and balancing.
- E. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.06 SITE CONDITIONS

- A. Prior to start of testing, adjusting, and balancing, verify that:
1. Systems installation is complete and in full operation.
 2. Outside conditions are within reasonable range relative to design conditions.
 3. Lighting fixtures are energized.
 4. Special equipment such as computers, laboratory equipment, and electronic equipment are in full operation.
 5. Requirements for preparation for testing and balancing have been met for elements of each system which require testing.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Perform Functional Tests as specified in Section 01756 - Commissioning.

- B. Testing, adjusting, and balancing acceptance criteria: Consider testing, adjusting, and balancing procedures successful and complete when heating, ventilating, and air conditioning systems and components are functioning properly and system air and water flows are within specified tolerances of design flows.

3.02 TESTING, ADJUSTING, AND BALANCING

- A. Test, adjust, and balance separate complete heating, ventilating, and air conditioning systems.
- B. Include in testing, adjusting, and balancing related existing heating, ventilating, and air conditioning components.
- C. Perform testing, adjusting, and balancing cycles until airflows meet acceptance criteria.
 - 1. Ascertain airflow balance between overall requirements and flow in individual supply and exhaust grilles.
- D. Initial testing, adjusting, and balancing: Perform first test on each system with dampers, grilles, orifices, and other variable airflow devices in their full open position; measure and report initial airflows, fan speed, and fan static pressures at fan inlet and outlet.
 - 1. Adjust total system flow downward or upward by adjusting fan speed until 1 inlet or outlet is at indicated flow and all other flows exceed indicated flows.
 - 2. Adjust fan speed by changing fan drives or sheaves as necessary.
- E. Subsequent testing, adjusting, and balancing: Perform adjustments in subsequent testing, adjusting, and balancing by adjusting dampers, louvers, or size of orifices or plates.
 - 1. Measure and record air volume discharged at each inlet and outlet and adjust air inlets and outlets to design air volumes within 0 to 5 percent over design rates.
 - 2. Adjust fan speeds and motor drives within drive limitations, for required air volume.
 - 3. Measure cubic feet per minute and static pressures and adjust air supply and exhaust fan units to deliver at least 100 to 105 percent of the design air volume.
 - 4. Measure and record static air pressure conditions on fans, including filter and coil pressure drops, and total pressure across the fan.
 - 5. Evaluate building and room pressure conditions to determine adequate supply and return air conditions.
 - 6. Evaluate space and zone temperature of conditions to determine adequate performance of the systems to maintain temperatures without draft.
 - 7. Permanently mark final balance positions of balancing dampers.
- F. Develop heating, ventilating, and air conditioning system schematics similar to Figure 6-1 in SMACNA Testing, Adjusting, and Balancing.
- G. Accurately record the required data on AABC, NEBB, or TABB test and balance report forms.
- H. Measure amperage draw of fan and pump motors for final balance.

- I. Test primary source equipment in accordance with AABC, NEBB, or TABB procedures.
 1. Primary source equipment includes items listed in this Section not previously tested as part of this testing, adjusting, and balancing work.
 2. Complete appropriate AABC, NEBB, or TABB equipment test forms for each piece of equipment.
 3. Calculate cooling and heating capacities to show conformance with specified capacities.
 4. Adjust equipment as needed to deliver specified cooling and heating loads.
 5. Record final equipment performing characteristics and adjustment settings in the final design report.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 15956

PIPING SYSTEMS TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Test requirements for piping systems.
- B. Related Sections:
 - 1. Section 15052 - Basic Piping Materials and Methods.

1.02 REFERENCES

- A. Uniform Plumbing Code (UPC).
- B. National Fuel Gas Code: ANSI Z 223.1 or NFPA 54.
- C. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
 - 1. B31.8 - Gas Transmission and Distribution Piping Systems.
 - 2. B31.1 - Power Piping.
 - 3. B31.3 - Process Piping.
- D. Uniform Mechanical Code (UMC).

1.03 TESTING REQUIREMENTS

- A. General Requirements:
 - 1. Testing requirements are stipulated in Laws and Regulations; are included in the Piping Schedule in Section 15052; are specified in the specifications covering the various types of piping; and are specified herein.
 - 2. Requirements in Laws and Regulations supersede other requirements of Contract Documents, except where requirements of Contract Documents are more stringent, including higher test pressures, longer test times, and lower leakage allowances.
 - 3. Test plumbing piping in accordance with Laws and Regulations, the Uniform Plumbing Code, and UL requirements.
 - 4. When testing with water, the specified test pressure is considered to be the pressure at the highest point of the piping section under test. Lower test pressure as necessary to prevent testing the lowest point above a safe test pressure.
- B. Furnish necessary personnel, materials, and equipment, including bulkheads, restraints, anchors, temporary connections, pumps, water, pressure gauges, and other means and facilities required to perform tests.

- C. Pipes to be Tested: Test only those portions of pipes that have been installed as part of this Contract. Test new pipe sections prior to making final connections to existing piping. Furnish and install test plugs, bulkheads, and restraints required to isolate new pipe sections. Do not use existing valves as test plug or bulkhead.
- D. Unsuccessful Tests:
 - 1. Where tests are not successful, correct defects or remove defective piping and appurtenances and install piping and appurtenances that comply with the specified requirements.
 - 2. Repeat testing until tests are successful.
- E. Test Completion: Drain and leave piping clean after successful testing.
- F. Test Water Disposal: Dispose of testing water at site storm water retention pond in accordance with requirements of federal, state, county, and city regulations governing disposal of wastes in the location of the Project and disposal site.

1.04 SUBMITTALS

- A. Schedule and Notification of Tests:
 - 1. Submit a list of scheduled piping tests by noon of the working day preceding the date of the scheduled tests.
 - 2. Notification of Readiness to Test: Immediately before testing, notify ENGINEER in writing of readiness, not just intention, to test piping. Have personnel, materials, and equipment specified in place before submitting notification of readiness.

1.05 SEQUENCE

- A. Clean piping before pressure or leak tests.
- B. Test gravity piping underground, including sanitary sewers, for visible leaks before backfilling and compacting.
- C. Underground pressure piping may be tested before or after backfilling when not indicated or specified otherwise.
- D. Backfill and compact trench, or provide blocking that prevents pipe movement before testing underground piping with a maximum leakage allowance.
- E. Test underground piping before encasing piping in concrete or covering piping with slab, structure, or permanent improvement.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 TESTING ALIGNMENT, GRADE, AND DEFLECTION

- A. Alignment and Grade:
 - 1. Visually inspect the interior of gravity piping with artificial light, reflected light, or laser beam.
 - 2. Consider inspection complete when no broken or collapsed piping, no open or poorly made joints, no grade changes that affect the piping capacity, or no other defects are observed.
- B. Deflection Test:
 - 1. Pull a mandrel through the clean piping section under test.
 - 2. Perform the test not sooner than 30 days after installation and not later than 60 days after installation.
 - 3. Use a 9 rod mandrel with a contact length of not less than the nominal diameter of the pipe within one percent plus or minus.
 - 4. Consider test complete when the mandrel can be pulled through the piping with reasonable effort by 1 person, without the aid of mechanical equipment.

3.02 AIR TESTING METHOD FOR PRESSURE PIPING

- A. Air test piping, indicated with "AM" in the Piping Schedule, with air or another nonflammable or inert gas.
- B. Test air piping by the air test method.
- C. Test at pressure as specified in Piping Schedule in Section 15052.
 - 1. Provide temporary pressure relief valve for piping under test. Set at the lesser of 110 percent of the test pressure or 50 pounds per square inch gauge over the test pressure.
 - 2. Air method test pressures shall not exceed 110 percent of the piping maximum allowable working pressure calculated in accordance with the most stringent of ANSI/ASME B31.1, ANSI/ASME B31.3, ANSI/ASE B31.8, or the pipe manufacturer's stated maximum working pressure.
 - 3. Gradually increase test pressure to an initial test pressure equal to the lesser of one-half the test pressure or 25 pounds per square inch gauge.
 - 4. Perform initial check of joints and fittings for leakage.
 - 5. Gradually increase test pressure in steps no larger than the initial pressure. Check for leakage at each step increase until test pressure reached.
 - 6. At each step in the pressure, examine and test piping being air tested for leaks with soap solution.
 - 7. Consider examination complete when piping section under test holds the test pressure for 15 minutes without losses.

3.03 TESTING GRAVITY FLOW PIPING

- A. Test Gravity Flow Piping Indicated with "GR" in the Piping Schedule, as Follows:
 - 1. Unless Specified Otherwise, Subject Gravity Flow Piping to the Following Tests:
 - a. Alignment and grade.
 - b. For plastic piping test for deflection.

- c. Visible leaks and pressure with maximum leakage allowance, except for storm drains and culverts.
- 2. Inspect piping for visible leaks before backfilling. Provide temporary restraints when needed to prevent movement of piping. Pressure test piping with maximum leakage allowance after backfilling.
- 3. With the lower end plugged, fill piping slowly with water while allowing air to escape from high points. Keep piping full under a slight head for the water at least 24 hours.
 - a. Examine piping for visible leaks. Consider examination complete when no visible leaks are observed.
 - b. Maintain piping with water, or allow a new water absorption period of 24 hours for the performance of the pressure test with maximum leakage allowance.
 - c. After successful completion of the test for visible leaks and after the piping has been restrained and backfilled, subject piping to the test pressure for minimum of four hours while accurately measuring the volume of water added to maintain the test pressure.
 - 1) Consider the test complete when leakage is equal to or less than the following maximum leakage allowances:
 - a) For Concrete Piping with Rubber Gasket Joints: 80 gallons per day per inch of diameter per mile of piping under test.
 - (1) Advise manufacturer of concrete piping with rubber gasket joints of more stringent than normal maximum leakage allowance.
 - b) For Vitrified Clay and Other Piping: 500 gallons per day per inch of diameter per mile of piping under test.

3.04 TESTING HIGH-HEAD PRESSURE PIPING

- A. Test piping for which the specified test pressure in the Piping Schedule is 20 pounds per square inch gauge or greater, by the high head pressure test method, indicated "HH" in the Piping schedule.
- B. General:
 - 1. Test connections, hydrants, valves, blowoffs, and closure pieces with the piping.
 - 2. Do not use installed valves for shutoff when the specified test pressure exceeds the valve's maximum allowable seat differential pressure. Provide blinds or other means to isolate test sections.
 - 3. Do not include valves, equipment or piping specialties in test sections if test pressure exceeds the valve, equipment or piping specialty safe test pressure allowed by the item's manufacturer.
 - 4. During the performance of the tests, test pressure shall not vary more than plus or minus 5 pounds per square inch gauge with respect to the specified test pressure.
 - 5. Select the limits of testing to sections of piping. Select sections that have the same piping material and test pressure.
 - 6. When Test Results Indicate Failure of Selected Sections, Limit Tests to Piping:
 - a. Between valves.
 - b. Between a valve and the end of the piping.
 - c. Less than 500 feet long.

7. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test with maximum leakage allowance.

C. Testing Procedures:

1. Fill piping section under test slowly with water while venting air. Use potable water for all potable waterlines and where noted on the Piping Schedule
2. Before pressurizing for the tests, retain water in piping under slight pressure for a water absorption period of minimum 24 hours.
3. Raise pressure to the specified test pressure and inspect piping visually for leaks. Consider visible leakage testing complete when no visible leaks are observed.

D. Pressure Test with Maximum Leakage Allowance:

1. Leakage allowance is zero for piping systems using flanged, National Pipe Thread threaded and welded joints.
2. Pressure test piping after completion of visible leaks test.
3. For piping systems using joint designs other than flanged threaded or welded joints, accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period.
 - a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage and no damage to piping and appurtenances has occurred.
 - b. Successful completion of the pressure test with maximum leakage allowance shall have been achieved when the observed leakage during the test period is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.
 - c. When leakage is allowed, calculate the allowable leakage by the following formula:

$$L = S \times D \times P^{1/2} \times 133,200^{-1}$$

wherein the terms shall mean:

L = Allowable leakage in gallons per hour.

S = Length of the test section in feet.

D = Nominal diameter of the piping in inches.

P = Average observed test pressure in pounds per square inches, gauge, at the lowest point of the test section, corrected for elevation of the pressure gauge.

x = The multiplication symbol.

3.05 TESTING LOW-HEAD PRESSURE PIPING

- A. Test piping for which the specified test pressure is less than 20 pounds per square inch gauge, by the low head pressure test method, indicated "LH" in the Piping Schedule.

- B. General:
1. Test pressures shall be as scheduled in Section 15052.
 2. During the performance of the tests, test pressure shall not vary more than plus or minus 2 pounds per square inch gauge with respect to the specified test pressure.
 3. Test connections, blowoffs, vents, closure pieces, and joints into structures, including existing bell rings and other appurtenances, with the piping.
 4. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test with maximum leakage allowance.
- C. Visible Leaks Test:
1. Subject piping under test to the specified pressure measured at the lowest end.
 2. Fill piping section under test slowly with potable water while venting air.
 3. Before pressurizing for the tests, retain water in piping under slight pressure for the water absorption period of minimum 24 hours.
 4. Raise pressure to the specified test pressure and inspect piping visually for leaks. Consider testing complete when no visible leaks are observed.
- D. Pressure Test with Maximum Leakage Allowance:
1. Pressure test piping after completion of visible leaks test.
 2. Accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period.
 - a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage of 80 gallons per inch of nominal diameter, per mile of piping section under test after 24 hours and no damage to piping and appurtenances has occurred.
 - b. Successful completion of the leakage test shall have been achieved when the observed leakage is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.
- E. Optional Joint Test:
1. When joint testing is allowed by note in the piping schedule, the procedure shall be as follows:
 - a. Joint testing will be allowed only for low head pressure piping.
 2. Joint testing may be performed with water or air.
 3. Joint test piping after completion of backfill and compaction to the top of the trench.
 4. Joint Testing with Water:
 - a. Measure test pressure at the invert of the pipe. Apply pressure of 4 feet plus the inside diameter of the pipe in water column within 0.20 feet in water column.
 - b. Maintain test pressure for one minute.
 - c. Base the allowable leakage per joint on 80 gallons per inch nominal diameter, per mile of piping, per 24 hours equally distributed to the actual number of joints per mile for the type of piping.
 - d. Consider the pressure test to be complete when makeup water added is less than the allowable leakage.
 - e. Successful completion of the joint test with water shall have been achieved when the observed leakage is equal or less than the allowable leakage.

5. Joint Testing with Air:
 - a. Apply test pressure of 3 pounds per square inch gauge with a maximum variation of plus 0.20 and minus 0.00 pounds per square inch.
 - b. Maintain test pressure for 2 minutes.
 - c. Consider the pressure test to be complete when the test pressure does not drop below 2.7 pounds per square inch for the duration of the test.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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. Section 15956 - Piping Systems Testing.
 - 3. Section 16050 - Electrical General Provisions.
 - 4. Division 17 - Instrumentation and Control System.

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 Section 16405 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 Section 16405. 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 Section 16405. 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. Test and prepare piping as specified in Section 15956.
 3. 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.
 4. 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 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. Requirements specified within this section apply to all sections in Division 16, ELECTRICAL. Work specified herein shall be performed as if specified in the individual sections.

1.02 ELECTRICAL SUBCONTRACTOR QUALIFICATIONS

- A. The electrical subcontractor shall meet or exceed the criteria described below:
 - 1. The electrical subcontractor shall be licensed in the State of Florida.
 - 2. The electrical subcontractor shall have successfully completed electrical construction on three water or wastewater treatment plant related projects within the past six years.
 - 3. The electrical subcontractor shall have, in their employ, the following full-time employees that will be assigned to perform the electrical work of this contract:
 - a. A minimum of (1) Licensed Master Electrician who is overall responsible for the supervision of personnel performing the construction, installation startup and testing of all electrical related facilities and systems.
 - b. A minimum of (1) Licensed Journeyman Electrician responsible for the daily construction activities and guidance of the electrical contractor's on-site employees. The Licensed Journeyman's primary assignment will be the construction of the electrical facilities of this project until project completion. The Licensed Journeyman shall be certified in Volusia County or shall meet the reciprocity standards of Florida State Statute 489 Part II.
 - 4. The electrical subcontractor shall not be involved in any current or pending litigation which may have a material negative impact on the ability to complete the project. The electrical subcontractor shall provide a statement advising all current or pending litigations.

1.03 DESIGN REQUIREMENTS

- A. All electronic boards as part of electrical equipment shall meet the atmospheric conditions of the space the equipment is installed in. All electronic boards, which are not installed in a conditioned environment, shall be fungus-resistant.
- B. All electrical equipment shall be rated for the conditions the equipment is installed in.

1.04 STANDARDS, CODES, PERMITS, AND REGULATIONS

- A. Perform all work; furnish and install all materials and equipment in full accordance with the latest applicable rules, regulations, requirements, and specifications of the following:
 - 1. Local Laws and Ordinances.

2. State and Federal Laws.
 3. National Electrical Code (NEC).
 4. State Fire Marshal.
 5. Underwriters' Laboratories (UL).
 6. National Electrical Safety Code (NESC).
 7. American National Standards Institute (ANSI).
 8. National Electrical Manufacturer's Association (NEMA).
 9. National Electrical Contractor'S Association (NECA) Standard of Installation.
 10. Institute of Electrical and Electronics Engineers (IEEE).
 11. Insulated Cable Engineers Association (ICEA).
 12. Occupational Safety and Health Act (OSHA).
 13. National Electrical Testing Association (NETA).
 14. American Society for Testing and Materials (ASTM).
 15. Florida Building Code, including Local County/City amendments.
- B. Conflicts, if any, which may exist between the above items, will be resolved at the discretion of the Engineer.
- C. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern. Code compliance is mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with these codes.
- D. Obtain all permits and pay all fees required by any governmental agency having jurisdiction over the work. Arrange all inspections required by these agencies. On completion of the work, furnish satisfactory evidence to the Engineer that the work is acceptable to the regulatory authorities having jurisdiction.

1.05 ELECTRICAL COORDINATION

- A. Work Provided Under this Contract:
1. Perform electrical demolition works as shown on drawings and as per specifications. Provide temporary power as shown on drawings and as per section 1.05.B of this specification.
 2. Provide and install the complete electrical power distribution system shown on the drawings including equipment space and supporting raceway for future equipment.
 3. Existing MCC-3 at the existing Dewatering Building shall be removed and provide and install new MCC-3 as shown on drawings and as per specifications. Make all necessary modifications, terminations, connections, etc. for a complete and working switchboard system in place.
 4. Provide and install all electrical equipment indicated on the drawings and described in the specifications including motor control centers, variable frequency drives, disconnects, local starters, wire, raceway etc. complete in place.
 5. Provide and install new lighting system as indicated on the drawings, complete in place.
 6. Provide and install all conduit and wire required for power, instrumentation, and control systems complete in place.
 7. Provide and install all electrical required to support HVAC systems as shown on the drawings complete in place.

8. Provide all miscellaneous electrical including disconnect switches, terminations, fittings, junction boxes, terminal junction boxes, mounting supports, etc. not specified but obviously necessary for complete working systems in place.
9. Provide coordination study as per specification 16015.
10. Provide rubber mats in front of new MCC's as per this specification.

B. Temporary Power:

1. Provide temporary power for all office trailers and for all construction areas. Coordinate with local power and telephone utility for temporary construction power and telephone service during construction.
2. Provide all material and labor for the installation and maintenance of temporary construction power requirements for the project.
3. Provide temporary power for 2nd floor belt filter press units to keep them in operation during construction of 1st floor belt filter press units and conveyors and demolition of exposed conduits mounted on the ceiling of 1st floor. All costs associated with the temporary power, temporary cables, labor, supports, etc. for the period of temporary power usage shall be included as part of Contractor's Bid price.

C. Construction Constraints:

1. New MCC-3 shall be in place and ready for connection before demolition of existing MCC-3 begins, unless otherwise noted.
2. Coordinate with Owner on the timing of demolition works. The existing belt filter press (BFP) units on the 2nd floor will need to be in operation as long as possible and to minimize the rental time of mobile sludge dewatering unit. New belt filter press (BFP) units and conveyors at the 1st floor shall be ready for operations before demolition of belt filter press units on the 2nd floor, unless otherwise noted.

1.06 SUBMITTALS

A. Quality Control Submittals:

1. Factory test certification and reports for all major electrical equipment.
2. As part of the electrical submittal, the contractor shall provide a minimum of 1/2"=1'-0" scaled layout of the electrical equipment in the existing electrical room, new electrical room, or major electrical equipment in a mechanical room showing sizes of all equipment and their spatial relationship. Non-electrical equipment shall be approved before finalizing the electrical layout in mechanical rooms. Adjust electrical room layout based on the actual equipment dimension from the approved shop drawings.
3. Submit exposed conduit layout plan of dewatering building – 1ST floor for approval.

B. The following information shall be provided for electrical equipment furnished under specifications 16050 Basic Electrical Materials and Methods; 16480 MCC, 16485 Variable Frequency Drives:

1. A copy of each specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check-marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from

the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined shall signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation.

2. Electrical equipment submittals shall be made by specification section. Submit one package per specification section and do not group multiple specification sections under one submittal package.
3. Provide complete underground and exposed conduit layout and equipment layouts: a scaled plan layout of the new and existing electrical room(s) showing spatial relationships of all equipment as well as the overall size of the room as stated in section 1.06.A.2.
4. Provide a conduit plan for major power, instrumentation and control conduits, both interior and exterior, showing routing, size and stub up locations for buried or in slab conduits.

1.07 ENVIRONMENTAL CONDITIONS

- A. All chemical rooms and areas shall be designated as corrosive.
- B. All indoor chemical and process equipment areas shall be considered wet locations.
- C. Electrical equipment in rooms designated as Classified by NFPA 70 (national electrical code) as Division 1 or Division 2 shall meet all requirements set forth for that classification as described in NEC article 500.

1.08 INSPECTION OF THE SITE AND EXISTING CONDITIONS

- A. The Electrical Drawings were developed from past record drawings and information supplied by the Owner. Verify all scaled dimensions prior to submitting bids.
- B. No subsequent increase in Contract cost will be allowed for additional work required because of the Contractor's failure to visit the site and determine conditions at the site before submitting their bid.
- C. Carry out any work involving the shutdown of the existing services to any piece of equipment now functioning in existing areas at such time as to provide the least amount of inconvenience to the Owner. Do such work when directed by the Engineer.
- D. After award of Contract, locate all existing underground utilities at each area of construction activity. Protect all existing underground utilities during construction. Pay for all required repairs without increase in Contract cost, should damage to underground utilities occur during construction.

1.09 RESPONSIBILITY

- A. The Contractor shall be responsible for:
 1. Complete systems in accordance with the intent of these Contract Documents.
 2. Coordinating the details of facility equipment and construction for all Specification Divisions, which affect the work, covered under Division 16, ELECTRICAL.

3. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.

1.10 INTENT OF DRAWINGS

- A. Electrical plan Drawings show only general location of equipment, devices, and raceway, unless specifically dimensioned. The Contractor shall be responsible for the proper routing of raceway, subject to the approval of the Engineer.
- B. All electrical equipment sizes and characteristics have been based on manufacturer GE, Square D and Eaton (Cutler-Hammer) except otherwise noted on drawings or in other specifications. If the Contractor chooses to and is allowed to substitute, the Contractor shall be responsible for fitting all the equipment in the available space as shown on the Drawings.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide materials and equipment listed by UL wherever standards have been established by that agency. All panels shall have appropriate UL label.
- B. Equipment Finish:
 1. Provide manufacturers' standard finish and color, except where specific color is indicated.
 2. If manufacturer has no standard color, provide equipment with ANSI No. 61, light gray color.

PART 3 EXECUTION

3.01 GENERAL

- A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- B. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

3.02 LOAD BALANCE

- A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.
- B. Balance electrical load between phases as nearly as possible on switchboards, panel boards, motor control centers, and other equipment where balancing is required.
- C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.03 CHECKOUT AND STARTUP

- A. Equipment Line Current Tests:
 - 1. Check line current in each phase for each piece of equipment.
 - 2. If any phase current for any piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.
- B. Startup:
 - 1. Demonstrate satisfactory operation of all 480-volt electrical equipment. Participate with other trades in all startup activities.
 - 2. Assist the Instrumentation and Control (I&C) Contractor in verifying signal integrity of all control and instrumentation signals.

3.04 RUBBER MATS

- A. A three foot wide rubber mat shall be furnished and installed on the floor and in front of each MCC, existing VFD assembly, and PLC control panel. The mat shall be long enough to cover the full length of each line-up. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mat shall be guaranteed extra quality, free from cracks, blow holes, or other defects detrimental to their mechanical or electrical strength. The mat shall meet OSHA requirements and the requirements of ANSI/ASTM D-178 J6-7 for Type 2, Class 2 insulating matting.

END OF SECTION

SECTION 16015

ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The requirements of this specification shall apply to the new electrical distribution system or modification of the existing electrical distribution system at City of Daytona Beach – Westside Regional Water Reclamation Facility added or modified under this contract (Dewatering Building) as shown on one line diagrams and as describes in this specification. The end result shall be a fully protected, and properly coordinated, system with proper arc flash safety labels and personal protective equipment recommendations.
- B. Contractor shall furnish short-circuit and protective device coordination studies as described herein. The coordination study shall begin with the new MCC-3 include all of the new electrical protective devices down to, and including, the main breaker and feeder circuit in each 208 Volt panelboard. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with emergency and standby generators associated paralleling equipment and distribution switchgear, if applicable. Contractor shall obtain the previous coordination study (on-going CMAR project) from the Owner and use the data at the two existing MCC-A and MCC-B to perform the coordination and arc flash study associated with this project. Coordinate with Owner to obtain a copy of the existing study data after the project is awarded.
- C. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex.
- D. The new arc flash label shall match the style and format with the existing labels where possible. If existing arc flash labels are generic type, provide custom arc flash labels as required by NFPA 70E.

1.02 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - b. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - c. IEEE 242: Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - d. IEEE 399: Recommended Practice for Industrial and Commercial Power System Analysis.
 - e. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
 - f. IEEE 1584-2002: Guide for Performing Arc Flash Hazard Calculations.

2. American National Standards Institute (ANSI):
 - a. C57.12.00, Standard General Requirements for Liquid-immersed Distribution, Power, and Regulating Transformers.
 - b. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - c. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - d. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
 - e. eANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents
3. National Fire Protection Association:
 - a. NFPA 70E: National Electrical Safety Code Chapter 1.
 - b. NFPA 70: National Electrical Code.
4. Occupational Safety & Health Administration (OSHA):
 - a. 29-CFR, Part 1910, sub part S.

1.03 SUBMITTALS

- A. Shop drawings: the results of the short-circuit; protective device coordination and arc flash hazard analysis studies shall be summarized in a preliminary and final summary report. Submit five (5) three-ring binder bound copies of the complete preliminary and final study reports. The preliminary short circuit and device coordination study report shall be submitted within 30 days of notice to proceed and shall be a basis for approval of all other electrical equipment in the power distribution system. The contractor is expected to review the results of the preliminary short circuit and device coordination study report against all other applicable shop drawings, including industrial control panels, prior to shop drawing submittal to coordinate appropriate fault duty ratings of all electrical equipment. The final short circuit and device coordination study report shall incorporate all comments from shop drawing submittals and include the arc-flash hazard analysis. The contractor shall ensure proper arc-flash warning labels are applied to all appropriate electrical equipment installed under this contract when the final study has been approved.

1.04 QUALITY ASSURANCE

- A. Short circuit, protective device coordination, and arc flash studies shall be prepared by the manufacturer furnishing the electrical power distribution equipment or a professional electrical engineer registered in the State of Florida, hired by the manufacturer, in accordance with IEEE 242 and IEEE 399.
- B. Manufacturer shall have unit responsibility for the equipment and protective device coordination.

1.05 SEQUENCING AND SCHEDULING

- A. An initial, complete short circuit and arc flash study must be submitted and reviewed before Engineer will approve Shop Drawings for switchgear, unit sub stations, breakers, MCC'S, switchboard, VFD'S, manufactured industrial control panels and circuit breaker panelboard equipment. Failure to do so will delay the approval of major equipment submittals.
- B. The short circuit, protective device coordination and arc flash studies shall be updated prior to Project Substantial Completion. Utilize characteristics of as-installed equipment actual wire run lengths and materials.

PART 2 PRODUCTS

2.01 GENERAL

- A. Contractor shall furnish all field data as required for the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing. As-built drawings for existing electrical equipment are available if requested to the Owner.
- B. Source combination may include present and future utility supplies, motors, and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.
- D. Equipment and component titles used in the studies shall be identical to the equipment and component titles shown on the Drawings.
- E. Perform studies using digital computer with a software package such as SKM Power*Tools for Windows™ DAPPER™, CAPTOR™ and ARC FLASH™, or approved equal.
- F. Perform complete fault calculations for all busses on utility and generator power sources. Perform load flow and voltage drop studies for major feeders and loads with long feeder runs. Analysis shall include expected fault currents at industrial control panels manufactured in accordance with UL 508A and NEC article 409.
- G. Fault source combinations shall include large motors, large transformers, utility and generator.
- H. Utilize proposed and existing load data for the study obtained from Contract Documents and field survey. Coordinate with local power utility for available fault currents from utility services, as needed.

- I. Existing Equipment:
 - 1. Include fault contribution of existing motors, services, generators and equipment, as appropriate, in the study.
 - 2. Obtain required existing equipment data from the field and FPL.
- J. Provide a comprehensive report document containing the short circuit, device coordination and arc flash studies. As a minimum the report structure shall contain the following:
 - 1. Executive Summary.
 - 2. Methodology.
 - 3. One Line Diagram(s).
 - 4. Short Circuit Analysis.
 - 5. Short Circuit Analysis Results/Conclusions/Recommendations.
 - 6. Device Coordination Analysis.
 - 7. Recommended protective devices settings.
 - 8. Arc Flash Analysis.
 - 9. Arc Flash PPE recommendations.

2.02 SHORT CIRCUIT STUDY

- A. General:
 - 1. Use cable impedances based on copper conductors. Use actual conductor impedances if know. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.
 - 2. Use bus impedances based on copper bus bars.
 - 3. Use cable and bus resistances calculated at 25 degrees C.
 - 4. Use 600-volt cable reactances based on use of typical data of conductors to be used in this project.
 - 5. Use transformer impedances 92.5 percent of "nominal" impedance based on tolerances specified in ANSI C57.12.00.
- B. Provide:
 - 1. Calculation methods and assumptions.
 - 2. Selected base per unit quantities.
 - 3. One-line diagrams annotated with results of short circuit analysis including:
 - a. Three phase, line-to-line and single line to ground faults.
 - b. Equipment Short Circuit Rating.
 - 4. Source impedance data, including electric utility system and motor fault contribution characteristics.
 - 5. DAPPER™ Short circuit report, demand load report, load flow report and input data reports.
 - 6. Results, conclusions, and recommendations.
- C. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed symmetrical three-phase bolted fault, bolted line-to-ground fault, and bolted line-to-line fault at each:
 - 1. Electric utility's supply termination point.
 - 2. Main breakers, generator breakers and feeder breakers.
 - 3. Low voltage switchgear, switchboard and/or distribution panelboard.
 - 4. Unit substations.
 - 5. Motor control centers.
 - 6. Standby generator.

7. Automatic Transfer Switch (if applicable).
8. All branch circuit panelboards.
9. Variable Frequency Drives.
10. Industrial control panels manufactured in accordance with UL 508A and NEC article 409.
11. Other significant locations throughout the system.
12. Future load contributions as shown on one-line diagram.

D. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings. Verify all equipment, main breakers, ATS, and protective devices are applied within their ratings.
2. Adequacy of switchgear, switchboards, motor control centers, unit substations and panelboard bus bar bracing to withstand short-circuit stresses
3. Adequacy of transformer windings to withstand short-circuit stresses
4. Cable and busway sizes for ability to withstand short-circuit heating besides normal load currents.
5. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current

E. Through the General Contractor, furnish expected fault currents for industrial control panels, constructed and installed under other divisions and specifications of this contract, to the panel builder for his coordination with meeting the requirements of UL 508A and NEC article 409.

2.03 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves for distribution system, graphically displayed on log-log scale paper. Time Current Curve plots from SKM CAPTOR™ program are acceptable.
- B. Each curve sheet to have title and one-line diagram with legend identifying the specific portion of system associated with time-current curves on that sheet.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Perform device coordination on time-current curves for low voltage distribution system(s).
- F. Provide Individual protective device time-current characteristics on log-log paper or software generated graphs.
- G. Plot Characteristics on Curve Sheets:
 1. Electric utility's relays or protective device (if applicable).
 2. Electric utility's fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands (if applicable).
 3. Medium voltage equipment relays (if applicable).
 4. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

5. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
 6. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters.
 7. Transformer damage curves.
 8. Conductor damage curves.
 9. ANSI transformer with stand parameters.
 10. Significant symmetrical and asymmetrical fault currents.
 11. Ground fault protective devices and settings (if applicable).
 12. Pertinent motor starting characteristics and motor damage points.
 13. Pertinent generator short circuit decrement curve and generator damage point.
 14. Circuit breaker panelboard main breakers, where appropriate.
 15. Motor circuit protectors for major motors
- H. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- I. Primary Protective Device Settings for Delta-Wye Connected Transformer:
1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within the transformer's characteristics curve, including a point equal to 58 percent of ANSI C57.12.00 withstand point.
 2. Secondary Line-To-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.
- J. Separate medium voltage relay characteristics curves from curves for other devices by at least 0.4-second time margin.

2.04 ARC FLASH ANALYSIS

- A. Perform incident energy calculations in accordance with IEEE 1584-2002 Guide for Performing Arc Flash Hazard Calculations for all equipment analyzed in the short circuit study. Tabular results and recommended labels from SKM ARC FLASH™ are acceptable.
- B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model.
- C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and unit substations, variable frequency drives, industrial control panels) where work could be performed on energized parts.
- D. The Arc-Flash Hazard Analysis shall include all medium voltage, low voltage and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.
- E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².

- F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- G. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
- H. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.
- I. Furnish recommendations for Personal Protective Equipment, in accordance with OSHA standards, and proper labels to be located on the electrical equipment in accordance with NEC Article 110.16.
- J. Use manufacturer data for: enclosure type; gap between exposed conductors or buss way; grounding type; number of phases and connection; and working distance.

2.05 TABULATIONS

- A. Input Data:
 - 1. Utility three-phase and line-to-ground available contribution with associated X/R ratios.
 - 2. Short circuit reactances of rotating machines and associated X/R ratios.
 - 3. Cable type, construction, size, quantity per phase, length, impedance and conduit type.
 - 4. Bus data, including impedance.
 - 5. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio.
- B. Short Circuit Data:
 - 1. Source fault impedance and generator contributions.
 - 2. X to R ratios.
 - 3. Asymmetry factors.
 - 4. Motor contributions.
 - 5. Short circuit kVA.
 - 6. Symmetrical and asymmetrical fault currents.
- C. Recommended Protective Device Settings:
 - 1. Phase and ground relays:
 - a. Relay name.
 - b. Device number.
 - c. Description.
 - d. TCC catalog number.
 - e. Short circuit ratings.
 - f. Current transformer ratio.
 - g. Current tap.
 - h. Time dial setting (as applicable).
 - i. Instantaneous pickup setting (as applicable).
 - j. Ground fault setting (as applicable).

- k. Specialty, non-overcurrent device settings.
 - l. Recommendations on improved relaying systems, if applicable
- 2. Circuit Breakers:
 - a. Breaker name.
 - b. Breaker Description.
 - c. Model number.
 - d. TCC catalog number.
 - e. Short circuit rating.
 - f. Frame/Sensor rating.
 - g. Adjustable pickups and time delays (long time, short time, ground).
 - h. Adjustable time-current characteristic.
 - i. Adjustable instantaneous pickup.
 - j. Recommendations on improved trip systems, if applicable
- 3. Motor Circuit Protectors (MCP):
 - a. MCP name.
 - b. MCP Description.
 - c. Model number.
 - d. TCC catalog number.
 - e. Short circuit rating.
 - f. Frame/Sensor rating.
 - g. Instantaneous settings.
- 4. Fuses:
 - a. Fuse name.
 - b. Fuse Description.
 - c. Model number.
 - d. TCC catalog number.
 - e. Short circuit rating.
 - f. Fuse rating.
- D. Incident energy and flash protection boundary calculations.
 - 1. Arcing fault magnitude
 - 2. Device clearing time
 - 3. Duration of arc
 - 4. Arc flash boundary
 - 5. Working distance
 - 6. Incident energy
 - 7. Hazard Risk Category
 - 8. Recommendations for arc flash energy reduction

2.06 STUDY ANALYSES

- A. Written Summary:
 - 1. Scope of studies performed.
 - 2. Explanation of bus and branch numbering system.
 - 3. Prevailing conditions.
 - 4. Selected equipment deficiencies.
 - 5. Results of short circuit and coordination studies.
 - 6. Comments or suggestions.
- B. Suggest changes and additions to equipment rating and/or characteristics.

- C. Notify Engineer in writing of existing circuit protective devices improperly rated for new fault conditions.

PART 3 EXECUTION

3.01 GENERAL

- A. Adjust relay and protective device settings according to values established by coordination study.
- B. Make minor modifications to equipment as required to accomplish conformance with the short circuit and protective device coordination studies.
- C. Provide arc flash labels on all electrical equipment.
- D. Notify Engineer in writing of any required major equipment modifications.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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.
 - d. Or approved equal.

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.
 - f. Or approved equal.
- 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.
 - g. Or approved equal.
- 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.

f. Or approved equal.

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.
 - 9) Or approved equal.

- 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 (Cutler-Hammer);
 3. GE,
 4. 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:
 - a. General Electric; Type CR 104P.
 - b. Square D; Type T.
 - c. Cutler-Hammer; Type 10250T.
 2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
 - a. Square D; Type SK.
 - b. General Electric; Type CR 104P.
 - c. Cutler-Hammer; Type E34.
 - d. 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.
 - 4. Or approved equal.

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.
 - 4. Or approved equal.

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 ;
 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.
 - 3. Or approved equal.

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:

<u>Voltage</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
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. Siemans
 4. Square D Company
 5. Current Technology
 6. No approved or 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. K-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. Eaton (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. Mounting Hardware:
 - 1. Noncorrosive Interior Areas: Galvanized.
 - 2. All Other Areas: Stainless steel.
- 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 MOTOR SURGE PROTECTION

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

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16110

RACEWAYS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Association of State Highway and Transportation Officials (AASHTO): Division I, Standard Specifications for Highway Bridges, Fourteenth Edition.
 2. American National Standards Institute (ANSI):
 - a. C80.1, Rigid Steel Conduit-Zinc Coated.
 - b. C80.3, Electrical Metallic Tubing-Zinc Coated.
 - c. CS0.5, Rigid Aluminum Conduit.
 - d. C80.6, Intermediate Metal Conduit (IMC)-Zinc Coated.
 3. American Society for Testing and Materials (ASTM):
 - a. A123 EI, Standard Specification for Zinc-Coated (Galvanized) Coatings on Iron and Steel Products.
 - b. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 4. National Electrical Contractor's Association, Inc. (NECA): 5055, Standard of Installation.
 5. National Electrical Manufacturers Association (NEMA):
 - a. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - b. TC 2, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
 - c. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - d. TC 6, PVC and ABS Plastic Utilities Duct for Underground Installation.
 - e. VE 1, Metallic Cable Tray Systems.
 6. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC)
 7. Underwriters Laboratories, Inc. (UL):
 - a. 1, Standard for Safety Flexible Metal Conduit.
 - b. 6, Standard for Safety Rigid Metal Conduit.
 - c. 360, Standard for Safety Liquid-Tight Flexible Steel Conduit.
 - d. 514B, Standard for Safety Fittings for Conduit and Outlet Boxes.
 - e. 514C, Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
 - f. 651, Standard for Safety Schedule 40 and 80 PVC Conduit.
 - g. 651A, Standard for Safety Type EB and Rigid PVC Conduit and HDPF Conduit.
 - h. 797, Standard for Safety Electrical Metallic Tubing.
 - i. 870, Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings.
 - j. 1242, Standard for Safety Intermediate Metal Conduit.
 - k. 1660, Standard for Safety Liquid-Tight Flexible Nonmetallic Conduit.

1.02 SUBMITTALS

- A. Shop Drawings:
 - 1. Manufacturer's Literature:
 - a. Electric metallic tubing.
 - b. Rigid aluminum conduit.
 - c. PVC Schedule 40 conduit.
 - d. PVC Schedule 80 conduit.
 - e. Flexible metal, liquid-tight conduit.
 - f. Flexible, nonmetallic, liquid-tight conduit.
 - g. Conduit fittings.
 - h. Wireways.
 - 2. Precast Manholes and Handholes:
 - a. Dimensional drawings and descriptive literature.
 - b. Traffic loading calculations.
 - c. Accessory information.
 - 3. Cable Tray Systems:
 - a. Dimensional drawings, calculations, and descriptive information.
 - b. NEMA load/span designation and how it was selected.
 - c. Support span length and pounds-per-foot actual and future cable loading at locations, with safety factor used.
 - d. Location and magnitude of maximum simple beam deflection of tray for loading specified.
 - e. Layout drawings and list of accessories being provided.
 - 4. Conduit Layout:
 - a. Plan and section type, showing arrangement and location of conduit and duct bank required for:
 - 1) Low and medium voltage feeder and branch circuits.
 - 2) Instrumentation and control systems.
 - 3) Communications systems.
 - 4) Empty conduit for future use.

1.03 UL COMPLIANCE

- A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 PRODUCTS

2.01 CONDUIT AND TUBING

- A. Electric Metallic Tubing (EMT), not used:
 - 1. Meet requirements of ANSI C80.3 and UL 797.
 - 2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.
- B. Rigid Aluminum Conduit:
 - 1. Meet requirements of ANSI C80.5 and UL 6.
 - 2. Material: Type 6063, copper-free aluminum alloy.
- C. PVC Schedule 40/80 Conduit:
 - 1. Meet requirements of NEMA TC 2 and UL 651.

2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
- D. PVC-Coated Rigid Galvanized Steel Conduit:
1. Meet requirements of NEMA RN 1.
 2. Material:
 - a. Conduit: Meet requirements of ANSI C80.1 and UL 6
 - b. PVC Coating: 40 mils nominal thickness, bonded to metal.
- E. Flexible Metal, Liquid-Tight Conduit:
1. UL 360 listed for 105 degrees C insulated conductors.
 2. Material: Galvanized steel, with an extruded PVC jacket.
- F. Flexible, Nonmetallic, Liquid-Tight Conduit:
1. Material: PVC core with fused flexible PVC jacket.
 2. UL 1660 listed for:
 - a. Dry Conditions: 80 degrees C insulated conductors.
 - b. Wet Conditions: 60 degrees C insulated conductors.
 3. Manufacturers:
 - a. Carlon; Carflex or X-Flex.
 - b. T & B; Xtraflex LTC or EFC.
 - c. Or approved equal.

2.02 FITTINGS

- A. Electric Metallic Tubing:
1. Meet requirements of UL 514B.
 2. Type: Steel body and locknuts with steel or malleable iron compression nuts. Set screw and drive-on fittings not permitted.
 3. Compression Ring: Stainless steel.
 4. Coupling Manufacturers:
 - a. Appleton; Type 95T.
 - b. Crouse-Hinds; Type CPR.
 - c. Or approved equal.
 5. Connector Manufacturers:
 - a. Appleton; Type 86T.
 - b. Crouse-Hinds; Type CPR.
 - c. Or approved equal.
- B. Rigid Aluminum Conduit:
1. General:
 - a. Meet requirements of UL 514B.
 - b. Type: Threaded, copper-free. Set screw fittings not permitted.
 2. Insulated Bushing:
 - a. Material: Cast aluminum, with integral insulated throat, and rated for 150 degrees C.
 - b. Manufacturer: O.Z. Gedney; Type AB or approved equal.
 3. Grounding Bushing:
 - a. Material: Cast aluminum with integral insulated throat, rated for 150 degrees, with solderless lugs.
 - b. Manufacturer: O.Z. Gedney; Type ABLG or approved equal.

4. Conduit Hub:
 - a. Material: Cast aluminum, with insulated throat.
 - b. Manufacturers:
 - 1) O.Z. Gedney; Type CHA.
 - 2) T & B; Series 370AL.
 - 3) Or approved equal.
5. Conduit Bodies:
 - a. Manufacturers (For Normal Conditions):
 - 1) Appleton; Form 85 threaded Unilets.
 - 2) Crouse-Hinds; Mark 9 or Form 7-SA threaded condulets.
 - 3) Killark; Series O Electrolets.
 - b. Manufacturers (For Hazardous Locations):
 - 1) Appleton.
 - 2) Crouse-Hinds.
 - 3) Killark.
6. Couplings: As supplied by conduit manufacturer.
7. Conduit Sealing Fitting Manufacturers:
 - a. Appleton; Type EYF-AL or EYM-AL.
 - b. Crouse-Hinds; Type EYS-SA or EZS-SA.
 - c. Killark; Type EY or EYS.
8. Drain Seal Manufacturers:
 - a. Appleton; Type EYDM-A.
 - b. Crouse-Hinds; Type EYD-SA or EZD-SA.
 - c. Or approved equal.
9. Drain/Breather Fitting Manufacturers:
 - a. Appleton; Type ECDB.
 - b. Crouse-Hinds; ECD.
 - c. Or approved equal.
10. Expansion Fitting Manufacturers:
 - a. Deflection/Expansion Movement: Steel City; Type DF-A.
 - b. Expansion Movement Only: Steel City; Type AF-A.
 - c. Or approved equal.
11. Cable Sealing Fittings: To form watertight nonslip cord or cable connection to conduit.
 - a. Bushing: Neoprene at connector entry.
 - b. Manufacturer: Appleton CG-S.
 - c. Or approved equal.

C. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC-3.
2. Type: PVC, slip-on.

D. Flexible Metal, Liquid-Tight Conduit:

1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
2. Insulated throat and sealing O-rings.
3. Long design type extending outside of box or other device at least 2 inches.
4. Manufacturer: T & B; Series 5300 or approved equal.

E. Flexible, Nonmetallic, Liquid-Tight Conduit: Meet requirements of UL 514B.

1. Type: One-piece fitting body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.

- 2. Manufacturers:
 - a. Carlon; Type LT.
 - b. Kellems; Polytuff.
 - c. T & B; LT Series.
 - d. Or approved equal.
- F. Watertight Entrance Seal Device:
 - 1. New Construction:
 - a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
 - b. Manufacturer: O.Z./Gedney; Type FSK or WSK, as required or approved equal.
 - 2. Gored-Hole Application:
 - a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
 - b. Manufacturer: O.Z./Gedney; Series CSM or approved equal.
- G. Hazardous Locations: Approved for use in the atmosphere involved.
 - 1. Manufacturer: Crouse-Hinds; Type ECGJH or approved equal.

2.03 WIREWAYS

- A. Meet requirements of UL 870.
- B. Type: Steel-enclosed, with removable, hinged cover.
- C. Rating: Outdoor raintight if outdoor, and indoor if indoor.
- D. Finish: Gray, baked enamel for indoor, 316 stainless steel for outdoor.
- E. Manufacturers:
 - 1. Square D.
 - 2. B-Line Systems, Inc.
 - 3. Or approved equal.

2.04 CABLE TRAYS

- A. Not used.

2.05 ABOVE GROUND PULLBOX

- A. See Electrical Drawings.

2.06 ACCESSORIES

- A. Duct Bank Spacers:
 - 1. Type: Nonmetallic, interlocking, for multiple conduit sizes.
 - 2. Suitable for all types of conduit.
 - 3. Manufacturer: Underground Device, Inc.; Type WUNPEECE or approved equal.
- B. Identification Devices:
 - 1. Raceway Tags:
 - a. Material: Permanent, nylon.

- b. Shape: Round.
- c. Raceway Designation: Pressure stamped, embossed, or engraved.
- d. Tags relying on adhesives or taped-on markers not permitted.
- 2. Warning Tape:
 - a. Material: Polyethylene, 4-mil gauge.
 - b. Color: Red.
 - c. Width: Minimum 6-inch.
 - d. Designation: Warning on tape that electric circuit is located below tape.
 - e. Manufacturers:
 - 1) Blackburn, Type RT.
 - 2) Griffolyn Co.
 - 3) Or approved equal
- 3. Buried Raceway Marker:
 - a. Material: Sheet bronze, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
 - b. Designation: Incise to depth of 3/32 inch, ELECTRIC CABLES, in letters 1/4-inch high.
 - c. Minimum Dimension: 1/4-inch thick, 10 inches long, and 3/4-inch wide.
- C. Raceway Coating:
 - 1. Material: Heat shrink tubing.
 - 2. Manufacturers:
 - a. Raychem; Type BSTS/BSTS-FR.
 - b. Or approved equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Conduit and Tubing sizes shown are based on the use of copper conductors. Reference Section 16120, CONDUCTORS, concerning conduit sizing for aluminum conductors.
- B. All installed Work shall comply with NECA 5055.
- C. Crushed or deformed raceways not permitted.
- D. Maintain raceway entirely free of obstructions and moisture.
- E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- F. Aluminum Conduit: Do not install in direct contact with concrete or earth. Provide and install unistrut between concrete and Aluminum or install heat shrink tubing to the conduit. For conduit transition from underground (PVC) to aboveground application (Rigid Aluminum), install heat shrink tubing on conduit. Heat shrink shall cover the underground conduit adapter and extend at least 6 inches above ground.
- G. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
- H. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

- I. Group raceways installed in same area.
- J. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.
- K. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- L. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
- M. Block Walls: Do not install raceways in same horizontal course with reinforcing steel.
- N. Install watertight fittings in outdoor, underground, or wet locations.
- O. All metal conduit to be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- P. Do not install raceways in concrete equipment pads, foundations, or beams.
- Q. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
- R. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

3.02 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

- A. Minimum cover 1-1/2 inches, unless otherwise noted.
- B. Provide support during placement of concrete to ensure raceways remain in position.
- C. Floor Slabs:
 - 1. Conduit installed 18 inches below slab, encased in concrete.
 - 2. Conduits installed less than 18 below slab, concrete incased and have hooks to tie the duct bank to the slab.
 - 3. Outside diameter of conduit not to exceed one-third of the slab thickness.
 - 4. Separate conduit by minimum six times conduit outside diameter, except at crossings.

3.03 CONDUIT APPLICATION

- A. Diameter: Minimum 3/4 inch.
- B. Exterior, Exposed:
 - 1. Rigid Aluminum.
- C. Interior, Exposed:
 - 1. Rigid Aluminum.
- D. Interior, Concealed (Not Embedded in Concrete):

1. Rigid Aluminum.

- E. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors: PVC Schedule 40.
- F. Concrete Slab on Top or concrete encased: PVC Schedule 40.
- G. Under Slabs-On-Grade: PVC Schedule 40.
- H. Corrosive Areas: PVC Schedule 80.
- I. Lightning Protection: PVC Schedule 40.

3.04 CONNECTIONS

- A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:
 - 1. Conduit Size 4 Inches or Less: Flexible metal, liquid-tight conduit.
 - 2. Conduit Size Over 4 Inches: Nonflexible.
 - 3. Corrosive Areas: Flexible, nonmetallic, liquid-tight.
 - 4. Length: 18-inch minimum, 60-inch maximum, of sufficient length to allow movement or adjustment of equipment.
- B. Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.
- C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.
- D. Transition From Underground or Concrete Embedded to Exposed: Heat shrink coated Rigid Aluminum conduit or PVC coated Aluminum.
- E. Under floor mounted electrical equipment: PVC schedule 40 with end bell.
- F. Exterior Light Pole Foundations: PVC schedule 40.

3.05 PENETRATIONS

- A. Make at right angles, unless otherwise shown.
- B. Notching or penetration of structural members, including footings and beams, not permitted.
- C. Fire-Rated Walls, Floors, or Ceilings: Fire-stop openings around penetrations to maintain fire-resistance rating.
- D. Apply heat shrink tubing to all metallic conduit in contact with concrete floor slabs to a point 6 inches above concrete surface.
- E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.

F. Entering Structures:

1. Membrane Waterproofed Wall or Floor:
 - a. Provide a watertight seal.
 - b. Without Concrete Encasement: Install watertight entrance seal device on each side.
 - c. With Concrete Encasement: Install watertight entrance seal device on the accessible side.
 - d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
 - e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
 - f. Conduit penetration of roof is not allowed.
2. Heating, Ventilating, and Air Conditioning Equipment:
 - a. Penetrate equipment in area established by manufacturer.
 - b. Terminate conduit with flexible metal conduit at junction box or conduit attached to exterior surface of equipment prior to penetrating equipment.
3. Corrosive-Sensitive Areas:
 - a. Seal all conduit passing through chlorine and ammonia room walls.
 - b. Seal all conduit entering equipment panel boards and field panels containing electronic equipment.
 - c. Seal penetration with silicone type sealant as specified in Section FIRE STOPPING.
4. Existing or Precast Wall (Underground): Core drill wall and install a watertight entrance seal device.
5. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
 - a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
 - b. Fill space between raceway and sleeve with an expandable plastic compound on each side.
6. Manholes and Handholes:
 - a. Metallic Raceways: Provide insulated grounding bushings.
 - b. Nonmetallic Raceways: Provide bell ends flush with wall.
 - c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.06 SUPPORT

- A. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 10 feet. Do not support from piping, pipe supports, or other raceways.
- B. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 40 percent extra space for future conduit.
- C. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
 1. Wood: Wood stainless steel screws.
 2. Hollow Masonry Units: Toggle stainless steel bolts.
 3. Concrete or Brick: Expansion shields, or stainless steel tapcon.
 4. Steelwork: Machine stainless steel screws.
- D. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.07 BENDS

- A. Install concealed raceways with a minimum of bends in the shortest practical distance.
- B. Make bends and offsets of longest practical radius.
- C. Install with symmetrical bends or cast metal fittings.
- D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
- E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
- F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.
- G. PVC Conduit:
 - 1. Bends 30-Degree and Larger: Provide factory-made elbows.
 - 2. 90-Degree Bends: Provide pvc coated rigid steel elbows.
 - 3. Use manufacturer's recommended method for forming smaller bends.
- H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.08 EXPANSION/DEFLECTION FITTINGS

- A. Provide on all raceways at all structural expansion joints, and in long tangential runs.
- B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.
- C. Install in accordance with manufacturer's instructions.

3.09 PVC CONDUIT

- A. Solvent Welding:
 - 1. Provide manufacturer recommended solvent; apply to all joints.
 - 2. Install such that joint is watertight.
- B. Adapters:
 - 1. PVC to Metallic Fittings: PVC terminal type.
 - 2. PVC to Rigid Aluminum Conduit: PVC female adapter.
- C. Beveled-End Conduit: Bevel the unbelled end of the joint prior to joining.

3.10 WIREWAYS

- A. Install in accordance with manufacturer's instructions.
- B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.

3.11 CABLE TRAYS

- A. Install in accordance with Application Information Section of NEMA VE 1.
- B. Provide accessories as necessary for a complete system.
- C. Install such that joints are not made at support brackets.
- D. Install horizontal section support brackets between support point and quarter point of tray span.
- E. Provide ceiling trapeze for all horizontal cable tray.
- F. Install support within 2 feet on each side of expansion joints and within 2 feet of fitting extremity.
- G. Provide expansion joints in accordance with NEMA VE 1 for 50 degrees F maximum temperature variation.
- H. Install horizontal tray level, plumb, straight, and true to line or grade within a tolerance of 1/8 inch in 10 feet and within a cumulative maximum of 1/2 inch.
- I. Install vertical tray plumb within a tolerance of 1/8 inch in 10 feet.
- J. Install without exposed raw edges.
- K. Maintain 9-inch vertical separation between multi-tiered trays having a common support, and at all crossover locations.
- L. Provide bonding jumper at each expansion joint and adjustable connection.
- M. Ground Conductor: Provide properly sized clamps for each section, elbow, tee, cross, and reducer.

3.12 TERMINATION AT ENCLOSURES

- A. Cast Metal Enclosure: Provide manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.
- B. Sheet Metal Boxes, Cabinets, and Enclosures:
 - 1. Rigid Aluminum Conduit:
 - a. Provide one lock nut each on inside and outside of enclosure.
 - b. Install grounding bushing.
 - c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad; if neither ground bus nor pad exists, connect jumper to lag bolt attached to metal enclosure.
 - d. Install insulated bushing on ends of conduit where grounding is not required.
 - e. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
 - 2. Electric Metallic Tubing: Provide gland compression, insulated connectors.
 - 3. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.

4. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.
5. PVC Schedule 40/80 Conduit: Provide PVC terminal adapter with lock nut.

3.13 UNDERGROUND RACEWAYS

- A. Cover: Maintain minimum 2-foot cover above conduit and concrete encasement, unless otherwise shown.
- B. Make routing changes as necessary to avoid obstructions or conflicts.
- C. Couplings: In multiple conduit runs, stagger so that couplings in adjacent runs are not in same transverse line.
- D. Union type fittings not permitted.
- E. Spacers:
 1. Provide preformed, nonmetallic spacers, designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
 2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.
- F. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.
- G. Installation with Other Piping Systems:
 1. Crossings: Maintain minimum 12-inch vertical separation.
 2. Parallel Runs: Maintain minimum 12-inch separation.
 3. Installation over valves or couplings not permitted.
- H. Concrete Encasement: As specified in Section CAST-IN-PLACE CONCRETE.
 1. Concrete Color: Gray, dust top of concrete ductbank with powdered red concrete dye before concrete sets and trowel dry onto top of ductbank.
- I. Backfill:
 1. As specified in Section EARTHWORK.
 2. Do not backfill until inspected by ENGINEER.

3.14 ABOVE GROUND PULLBOX

- B. A. Install above ground pullbox on concrete slab as per details.
- C. B. Grounding: As specified in Section 16450, GROUNDING.
- D. C. Identification: Provide equipment tag as per Section, 16050.

3.15 EMPTY RACEWAYS

- A. Provide permanent, removable cap over each end.
- B. Provide PVC plug with pull tab for underground raceways with end bells for PVC conduits, matching metallic cap for metallic conduits.

- C. Provide nylon pull cord.
- D. Identify, as specified in Paragraph IDENTIFICATION DEVICES, with waterproof tags attached to pull cord at each end, and at intermediate pull point.

3.16 IDENTIFICATION DEVICES

- A. RacewayTags:
 - 1. Identify origin and destination.
 - 2. Install at each terminus, near midpoint, and at minimum intervals of every 50 feet of exposed Raceway, whether in ceiling space or surface mounted.
 - 3. Provide nylon strap for attachment.
- B. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of runs.
- C. Buried Raceway Markers:
 - 1. Install at grade to indicate direction of underground raceways.
 - 2. Install at all bends and at intervals not exceeding 100 feet in straight runs.
 - 3. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.

3.17 PROTECTION OF INSTALLED WORK

- A. Protect products from effects of moisture, corrosion, and physical damage during construction.
- B. Provide and maintain manufactured watertight and dust-tight seals over all conduit openings during construction.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16120

CONDUCTORS

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): 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 2. American Society for Testing and Materials (ASTM):
 - a. A167, Standard Specification for Stainless and Heat Resisting Chromium-Nickel-Plated Steel Plate, Sheet, and Strip.
 - b. B3, Standard Specification for Soft or Annealed Copper Wire.
 - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B263, Standard Test Method for Determination of Cross-Sectional Area of Stranded Conductors.
 3. Association of Edison Illuminating Companies (AEIC):
 - a. AEIC CS8 Specification for Extruded Dielectric Shield Power Cables rated 5 through 46 kV
 4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 48, Standard Test Procedures and Requirements for High-Voltage Alternating Current Cable Terminations.
 - b. 404, Standard for Cable Joints for Use with Extruded Dielectric Cable Rated 5,000V through 46,000V and Cable Joints for Use with Laminated Dielectric Cable Rated 2,500V through 500,000V.
 - c. 1202, Flame-Propagation Testing of Wire and Cables.
 5. National Electrical Contractors Association, Inc. (NECA): 5055, Standard of Installation.
 6. National Electrical Manufacturers' Association (NEMA):
 - a. CC 1, Electric Power Connectors for Substations.
 - b. WC 70, Power Cables rated 2000V or less for Distribution of Electrical Energy
 - c. WC 74, 5-46kV Shielded Power Cable for Use in Distribution of Electrical Energy.
 - d. WC 57, Standard for Control, Instrumentation, and Thermocouple Cable.
 7. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 8. Underwriters Laboratories, Inc. (UL):
 - a. 13, Standard for Safety Power-Limited Circuit Cables.
 - b. 44, Standard for Safety Rubber-Insulated Wires and Cables.
 - c. 62, Standard for Safety Flexible Cord and Fixture Wire.
 - d. 486A, Standard for Safety Wire Connector and Soldering Lugs for Use with Copper Conductors.
 - e. 486B, Standard for Safety Wire Connectors and Soldering Lugs for Use with Aluminum Conductors.
 - f. 510, Standard for Safety Insulating Tape.
 - g. 854, Standard for Safety Service-Entrance Cables.

- h. 910, Standard for Safety Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air Handling Spaces.
- i. 1072, Standard for Safety Medium-Voltage Power Cables.
- j. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
- k. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

- A. Shop Drawings:
 - 1. Wire and cable descriptive product information.
 - 2. Wire and cable accessories descriptive product information.
 - 3. Cable fault detection system descriptive product information.
 - 4. Manufactured wiring systems descriptive product information.
 - 5. Manufactured wire systems rating information.
 - 6. Manufactured wire systems dimensional drawings.
 - 7. Manufactured wire systems special fittings.
 - 8. Busway descriptive product information.
 - 9. Busway rating information.
 - 10. Busway dimensional drawings.
 - 11. Busway special fitting information.
 - 12. Busway-equipment interface information for equipment to be connected to busways.
- B. Quality Control Submittals:
 - 1. Certified Factory Test Report for conductors 600 volts and below.
 - 2. Certified Factory Test Report per AEIC CS6, including AEIC qualification report for conductors above 600 volts.

1.03 UL COMPLIANCE

- A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

- A. Conform to applicable requirements of NEMA WC 70.
- B. Conductor Type:
 - 1. 120- and 277-Volt Lighting, No. 10 AWG and Smaller: Stranded copper.
 - 2. 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Stranded copper.
 - 3. All Other Circuits: Stranded copper.
- C. Insulation: Type THHN/THWN, except for sizes No. 6 and larger, with XHHW insulation.
- D. Direct Burial and Aerial Conductors and Cables:
 - 1. Type USE/RHH/RHW insulation, UL t (54 listed, Type RHW-2/USE-2.

2. Conform to physical and minimum thickness requirements of NEMA WC 70.
- E. Flexible Cords and Cables:
1. Type SOW with ethylene propylene rubber insulation in accordance with UL 62.
 2. Conform to physical and minimum thickness requirements of NEMA WC 70.
- F. Cable Tray Conductors and Cables: Type TC.

2.02 600-VOLT RATED CABLE

- A. General:
1. Type: TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 20,000 Btu/hr, and NFPA 70, Article 340, or UL 13 Listed Power Limited Circuit Cable meeting requirements of NFPA 70, Article 725.
 2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
 3. Suitable for installation in open air, in cable trays, or conduit.
 4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
 5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.
- B. Wire and Connectors:
1. Cable shall be rated for 600 volts and shall meet the requirements below:
 2. Conductors shall be stranded
 3. All wire shall be brought to the job in unbroken packages and shall bear the data of manufacturing; not older than 12 months.
 4. Type of wire shall be XHHW or THHN, rated 75 degrees C suitable for wet locations except where required otherwise by the drawings.
 5. No wire smaller than No. 12 gauge shall be used unless specifically indicated.
 6. Conductor metal shall be copper.
 7. All conductors shall be megger tested after installation and insulation must be in compliance with the Insulated Power Cable Engineers Association Minimum Values of Insulation Resistance.
- C. Type I-Multiconductor Control Cable:
1. Conductors:
 - a. No. 14 AWG, seven-strand copper.
 - b. Insulation: 15-mil PVC with 4-mil nylon.
 - c. UL 1581 listed as Type THHN/THWN rated VW-I.
 - d. Conductor group bound with spiral wrap of barrier tape.
 - e. Color Code: In accordance with NEMA WC 5, Method 1, and Sequence K-2.
 2. Cable: Passes the ICEA T-29-520 210,000 Btu/hr Vertical Tray Flame Test.
 3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (inches)	Jacket Thickness (mils)
3	0.41	45
5	0.48	45
7	0.52	45

No. of Conductors	Max. Outside Diameter (inches)	Jacket Thickness (mils)
12	0.72	60
19	00.83	60
25	1.00	60
37	1.15	80

4. Manufacturers:
 - a. Okonite Co.
 - b. Rome Cable.
 - c. General Cable.
 - d. Or approved equal.

D. Type 2-Multiconductor Power Cable:

1. Conductors:
 - a. Class B stranded, coated copper.
 - b. Insulation: Chemically crosslinked ethylene-propylene with Hypalon jacket.
 - c. UL 1581 listed as Type EPR, rated VW-1.
 - d. Color Code: Conductors, size No. 8 AWG and smaller, colored conductors, NEMA WC5 Method 1, color 5 per Article POWER CONDUCTOR COLOR CODING. Conductors, size No. 6 AWG and larger, NEMA WC5, Method 4.
2. Cable pass the ICEA T-29-520 210,000 Btu/hr Vertical Tray Flame Test.
3. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. of Conductors	Max.Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2	0.42	45
		3	0.45	45
		4	0.49	45
10	10	2	0.54	60
		3	0.58	60
		4	0.63	60
8	10	3	0.66	60
		4	0.72	
6	8	3	0.74	60
		4	0.81	
4	6	3	0.88	60
		4	0.97	80
2	6	3	1.01	80
		4	1.11	
1/0	6	3	1.22	80
		4	1.35	
2/0	4	3	1.32	80
		4	1.46	
4/0	4	3	1.56	80
		4	1.78	

4. Manufacturers:
 - a. Okonite Co.
 - b. Pome Cable.
 - c. Or approved equal.
- E. Type B-No. 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.
 1. Outer Jacket: 45-mil nominal thickness.
 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
 3. Dimension: 0.31-inch nominal OD.
 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nominal nylon.
 - e. Color Code: Pair conductors black and red.
 5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Or approved equal.
 6. The following test shall be performed on instrumentation and control system cables. All tests shall be end-to-end test of installed cables with the ends supported in free air, not adjacent to any ground object. All test data shall be recorded on forms acceptable to the Engineer. Complete records of all tests shall be made and delivered to the Engineer.
 - a. Continuity tests shall be performed by measuring wire/shield loop resistances of signal cable as the wires, taken one at a time, are shorted to the channel shield. No loop resistance measurement shall carry by more than ± 2 ohms from the calculated average loop resistance value.
 - b. Insulation resistance tests shall be performed by using a 500 volt megohmmeter to measure the insulation resistance between each channel wire and channel shield, between individual channel shields in a multi-channel cable, between each individual channel and the overall cable shield in multi-channel cable, between each wire and ground, and between each shield and ground. Values of resistance less than 10 megohms shall be unacceptable.
- F. Type B1-No. 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.
 1. Outer Jacket: 45-mil nominal.
 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 3. Dimension: 0.32-inch nominal OD.
 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand, tinned copper drain wire.

- c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nylon.
 - e. Color Code: Triad conductors black, red, and white.
 - 5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Or approved equal.
- G. Type B2-No. 18 AWG, Multi-Twisted, Shielded Pairs with a Common, Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 55 requirements.
- 1. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8
 - b. Tinned copper drain wires.
 - c. Pair drain wire size AWG 20, group drain wire size AWG 18.
 - d. Insulation: 15-mil PVC.
 - e. Jacket: 4-mil nylon.
 - f. Color Code: Pair conductors black and red with red conductor numerically printed for group identification.
 - g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.
 - 2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.
 - 3. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (inches)	Nominal Jacket Thickness (mils)
4	0.50	45
8	0.68	60
12	0.82	60
16	0.95	80
24	1.16	80
36	1.33	80
50	1.56	80

- 4. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Or approved equal.
- H. Type B3-No. 18 AWG, Multi-twisted Pairs with a Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 55.
- 1. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
 - b. Tinned copper drain wire size 18 AWG
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nylon.

- e. Color Code: Pair conductors black and red, with red conductor numerically printed for group identification.
2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.
3. Cable Sizes:

Number Of Pairs	Maximum Outside Diameter (inches)	Nominal Jacket Thickness (mils)
4	0.46	45
8	0.63	60
12	0.75	60
16	0.83	60
24	1.06	80
36	1.21	80
50	1.42	80

4. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Or approved equal.
- I. Ethernet Cat. 6e UTP Cable (Copper):
 1. Section applies to all Ethernet Cable (Copper) except for Fiber Optic cable.
 2. Conductor Physical Characteristics: 4 twisted pairs (8 conductors), 23 AWG solid bare Copper with Polyolefin Insulation. Overall Nominal Diameter: 0.235 inch. Operating Temperature Range: -20°C to +75°C. Model Number – 7881A, Belden Inc. For underground application, cable shall be wet location rated.
 3. NEC/UL specification CMR, UL444, UL verified category 6.
 4. Manufacturer:
 - a. Belden Inc.
 - b. Or approved equal.

2.03 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE for No.6 and larger, other use THHN/THWN, insulation.
- B. Direct Buried: 4/0 Bare tinned stranded copper, unless otherwise noted on drawings.

2.04 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

- A. Tape:
 1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.
 2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
 3. Arcs and Fireproofing:
 - a. 30-mil, elastomer
 - b. Manufacturers and Products:
 - 1) Scotch; Brand 77, with Scotch Brand 69 glass cloth tape binder.

- 2) Plymount; Plyarc 30, with Plymount Plyglas glass cloth tape binder.
 - 3) Or approved equal.
- B. Identification Devices:
1. Sleeve: Permanent, PVC, yellow or white, with legible machine-printed black markings.
 2. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
 3. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.
- C. Connectors and Terminations:
1. Nylon, Self-Insulated Crimp Connectors:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO.
 2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO.
- D. Cable Lugs:
1. In accordance with NEMA CC I.
 2. Rated 600 volts of same material as conductor metal.
 3. Insulated, Locking-Fork, Compression Lugs:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) ILSCO; ILSCONS.
 - 3) Or approved equal.
 4. Un-insulated Crimp Connectors and Terminators:
 - a. Manufacturers and Products:
 - 1) Square D; Versitide.
 - 2) Thomas & Betts; Color-Keyed.
 - 3) ILSCO.
 5. Un-insulated, Bolted, Two-Way Connectors and Terminators:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Locktite.
 - 2) Burndy; Quiklug.
 - 3) ILSCO.
- E. Cable Ties: Nylon, adjustable, self-locking, and reusable.
1. Manufacturers and Product: Thomas & Betts; TY-RAP or approved equal.
- F. Heat Shrinkable Insulation: Thermally stabilized, crosslinked polyofin.
1. Manufacturers and Product: Thomas & Betts; SHRINK-KON or approved equal.

2.05 PULLING COMPOUND

- A. Nontoxic, non-corrosive, noncombustible, nonflammable, wax-based lubricant; UL listed.
- B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
- C. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.
- D. Manufacturers and Products:
 - 1. Ideal Co.; Yellow 77.
 - 2. Polywater, Inc.
 - 3. Cable Grip Co.

2.06 WARNING TAPE

- A. As specified in Section 16110, RACEWAYS.

2.07 SOURCE QUALITY CONTROL

- A. Conductors 600-Volts and Below: Test in accordance with UL 44 and 854 Standards.

PART 3 EXECUTION

3.01 GENERAL

- A. Conductor installation to be in accordance with NECA 5055.
- B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
- C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- D. Tighten screws and terminal bolts in accordance with UL 486A for copper conductors.
- E. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.
- F. Bundling: Where single conductors and cables in manholes, hand holes, vaults, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 18 inches on center.
- G. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

- H. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4-inch smaller than raceway inside diameter.
- I. Cable Tray Installation:
1. Install wire and cable parallel and straight in tray.
 2. Bundle, in groups, all wire and cable of same voltage having a common routing and destination; use cable ties, at maximum intervals of 8 feet.
 3. Clamp cable bundles prior to making end termination connections.
 4. Separate cables of different voltage rating in same cable tray with barriers.
 5. Fasten wires, cables, and bundles to tray with nylon cable straps at the following maximum intervals:
 - a. Horizontal Runs: 20 feet.
 - b. Vertical Runs: 5 feet.

3.02 POWER CONDUCTOR COLOR CODING

- A. Conductors 600 Volts and Below:
1. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 to 2 inches wide.
 2. No. 8 AWG and Smaller: Provide colored conductors.
 3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts Three-Phase, Four-Wire Delta, Center Tap Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	Gray Brown Orange Yellow
NOTE: Phase A, B, C implies direction of positive phase rotation. Coordinate with AHJ and local codes and adjust the color accordingly.		

4. Tracer: Outer covering of white with an identifiable colored strip other than green in accordance with NFPA 70.

- B. Conductors Above 600 Volts: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 to 2 inches wide.
 - 1. Colors:
 - a. Grounded Neutral: White.
 - b. Phase A: Brown.
 - c. Phase B: Orange.
 - d. Phase C: Yellow.

3.03 CIRCUIT IDENTIFICATION

- A. Circuits Appearing in Circuit Schedules: identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, hand holes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
- B. Circuits Not Appearing in Circuit Schedules:
 - 1. Assign circuit name based on device or equipment at load end of circuit.
 - 2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.
- C. Method:
 - 1. Conductors No. 3 AWG and Smaller: Identify with sleeves.
 - 2. Cables, and Conductors No. 2 AWG and Larger:
 - a. Identify with marker plates.
 - b. Attach marker plates with nylon tie cord.
 - 3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

- A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.
- B. Do not splice unless specifically indicated or approved by ENGINEER and Owner/Plant Superintendent.
- C. Connections and Terminations:
 - 1. Install wire nuts only on solid or stranded conductors.
 - 2. Install nylon self-insulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 6 AWG and smaller.
 - 3. Install un-insulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 4 AWG through No. 2/0 AWG.
 - 4. Install un-insulated, bolted, two-way connectors and terminators for power circuit conductors No. 4/0 AWG and larger.
 - 5. Install un-insulated bolted, two-way connectors for motor circuit conductors No. 12 and larger.
 - 6. Tape insulates all un-insulated connections.
 - 7. Place no more than one conductor in any single-barrel pressure connection.
 - 8. Install crimp connectors with tools approved by connector manufacturer.
 - 9. Install terminals and connectors acceptable for type of material used.

- 10. Compression Lugs
 - a. Attach with a tool specifically designed for purpose.
 - b. Tool shall provide complete controlled crimp and shall not release until crimp is complete.
 - c. Do not use plier type crimpers.
- D. Do not use soldered mechanical joints.
- E. Terminations:
 - 1. Indoors: Use general purpose, flame retardant tape.
 - 2. Outdoors: Use flame retardant, cold- and weather-resistant tape.
- F. Cap spare conductors and conductors with UL listed end caps.
- G. Cabinets, Panels, and Motor Control Centers:
 - 1. Remove surplus wire, bridle and secure.
 - 2. Where conductors pass through openings or over edges in sheet metal, remove bums, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.
- H. Control and Instrumentation Wiring:
 - 1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
 - 2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
 - 3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
 - 4. Where connections of cables installed under this section are to be made under Section 17000, INSTRUMENTATION AND CONTROL, leave pigtails of adequate length for bundled connections.
 - 5. Cable Protection:
 - a. Under Infinite Access Floors: May be installed without bundling.
 - b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under the floor or grouped into bundles at least 1/2-inch in diameter.
 - c. Maintain integrity of shielding of instrumentation cables.
 - d. Ensure grounds do not occur because of damage to jacket over the shield.
- I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.05 UNDERGROUND DIRECT BURIAL CABLE

- A. Install in trench as required.
- B. Warning Tape: Install approximately 12 inches above cable, aligned parallel to, and within 12 inches of centerline of the run.

3.06 FIELD QUALTTY CONTROL

A. In accordance Section 16950, ELECTRICAL TESTING.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

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 09910, 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 WPIL 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).
 - c. 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									
		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp	Nom.Speed rpm	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.
	3600	82.0	84.0			Mfr.'s Std.	Mfr.'s Std.		
2	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.
	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.
3	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.
	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.
5	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.
	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.
7.5	900	87.5	86.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	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.
10	900	89.3	88.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.

TABLE 1									
MOTOR PERFORMANCE REQUIREMENTS									
		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp	Nom.Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
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.
	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									
		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp	Nom.Speed rpm	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
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		

TABLE 1									
MOTOR PERFORMANCE REQUIREMENTS									
		% Guar. Min. Full Load Efficiency				%Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp	Nom.Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
400	3600	94.3				88.4			
	1800	94.37				86.8			
450	3600	94.7				89.1			
500	3600	94.7				88.3			

SECTION 16450

GROUNDING

PART 1 GENERAL

1.01 SCOPE

- A. Provide and install grounding system as shown on drawings and as specifies herein complete in place.

1.02 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. American National Standards Institute (ANSI): C2, National Electrical Safety Code (NESC).
 - 2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
- B. Submittals
 - 1. Shop Drawings:
 - a. Product Data:
 - 1) Exothermic weld connectors.
 - 2) Mechanical connectors.
 - 3) Compression connectors.
 - 4) Ground rods.
 - 5) Ground conductors (if not submitted with 16120),
 - 6) Grounding wells, etc. as needed for grounding system.
- C. UL Compliance
 - 1. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

PART 2 PRODUCTS

2.01 GROUND ROD

- A. Material: Copper clad.
- B. Diameter: Minimum 5/8 inch.
- C. Length: 20 feet.

2.02 GROUND CONDUCTORS

- A. As specified in Section 16120, CONDUCTORS.

2.03 CONNECTORS

- A. Exothermic Weld Type:
 - 1. Outdoor Weld: Suitable for exposure to elements or direct burial.
 - 2. Indoor Weld: Use low-smoke, low-emission process.

3. Manufacturers:
 - a. Erico Products, Inc.; Cadweld and Cadweld Exolon.
 - b. Thermoweld.
 - c. Or approved equal.
- B. Compression Type:
 1. Compress deforming type; wrought copper extrusion material.
 2. Single indentation for conductors 6 AWG and smaller.
 3. Double indentation with extended barrel for conductors 4 AWG and larger.
 4. Barrels pre-filled with oxide inhibiting and anti-seizing compound and sealed.
 5. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.
 - c. Ilso Corp.
- C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.
 1. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.
 - c. Ilso Corp.

2.04 GROUNDING WELLS

- A. Ground rod box complete with cast iron riser ring and traffic cover marked GROUND ROD.
- B. Manufacturers:
 1. Christy Co.; No. G5.
 2. Lightning and Grounding Systems, Inc.; I-R Series.
 3. Or approved equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Grounding shall comply with NFPA 70 and ANSI C2.
- B. Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.
- C. Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.
- D. Bond together system neutrals, service equipment enclosures, exposed non-current-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- E. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.

- F. Shielded Control Cables:
 - 1. Ground shield to ground bus at power supply for analog signal.
 - 2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
 - 3. Do not ground control cable shield at more than one point.

3.02 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.
- B. Nonmetallic Raceways and Flexible Tubing: Install an equipment-grounding conductor connected at both ends to non-current carrying grounding bus.
- C. Connect ground conductors to raceway grounding bushings.
- D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.
- E. Connect enclosure of equipment containing ground bus to that bus.
- F. Bolt connections to equipment ground bus.
- G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.
- H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

3.03 MOTOR GROUNDING

- A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.
- B. Nonmetallic Raceways and Flexible Tubing: Install an equipment-grounding conductor connected at both ends to non-current carrying grounding bus.
- C. Motors Less Than 10 hp: Furnish compression, spade-type terminal connected to conduit box mounting screw.
- D. Motors 10 hp and above: Tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.
- E. Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 GROUND RODS

- A. Install full length with conductor connection at upper end.
- B. Install with connection point below finished grade, unless otherwise shown.

3.05 GROUNDING WELLS

- A. Install inside buildings, asphalt, and paved areas.
- B. Install riser ring and cover flush with surface.
- C. Place 9 inches crushed rock in bottom of each well.

3.06 CONNECTIONS

- A. General:
 - 1. Above grade Connections: Use exothermic weld, mechanical, or compression-type connectors. Material as listed in part 2.
 - 2. Below grade Connections: Install exothermic weld type connectors.
 - 3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
 - 4. Notify Engineer before backfilling ground connections.
- B. Exothermic Weld Type:
 - 1. Wire brush or file contact point to bare metal surface.
 - 2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
 - 3. Avoid using badly worn molds.
 - 4. Mold to be completely filled with metal when making welds.
 - 5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.
- C. Compression Type:
 - 1. Install in accordance with connector manufacturer's recommendations.
 - 2. Install connectors of proper size for grounding conductors and ground rods specified.
 - 3. Install using connector manufacturer's compression tool having proper sized dies and proof of calibration within the last 12 months.
- D. Mechanical Type:
 - 1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
 - 2. Install in accordance with connector manufacturer's recommendations.
 - 3. Do not conceal mechanical connections.

3.07 METAL STRUCTURE GROUNDING

- A. Ground metal sheathing and exposed metal vertical structural elements to grounding system.
- B. Bond electrical equipment supported by metal platforms to the platforms.
- C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.08 MANHOLE AND HANDHOLE GROUNDING

- A. Install one ground rod inside each.
- B. Ground Rod Floor Protrusion: 4 to 6 inches above floor.
- C. Make connections of grounding conductors fully visible and accessible.
- D. Connect all non current-carrying metal parts, and any metallic raceway grounding bushings to ground rod with No. 6 AWG copper conductor.

3.09 TRANSFORMER GROUNDING

- A. Bond neutrals of transformers within buildings to system ground network, and to any additional indicated grounding electrodes.
- B. Bond neutrals of substation transformers to substation grounding grid and system grounding network.
- C. Bond neutrals of pad-mounted transformers to four locally driven ground rods and buried ground wire encircling transformer and system ground network.

3.10 SURGE PROTECTION EQUIPMENT GROUNDING

- A. Connect surge arrestor ground terminals to equipment ground bus.

3.11 INSTRUMENT GROUND - SURGE SUPPRESSION

- A. Connect all instrument surge protection with #6 insulated copper groundwire (in conduit where above grade) to closest plant ground system

3.12 BONDING

- A. Bond to Main Conductor System:
- B. All roof mounted ventilators, fans, air handlers, masts, flues, cooling towers, handrails, and other sizeable metal objects.
- C. Roof flashing, gravel stops, insulation vents, ridge vents, roof drains, soil pipe vents, and other small metal objects if located within 6 feet of main conductors or another grounded object.
- D. Provide air terminals as required.
- E. Bond steel columns or major framing members to grounding system per National Electrical Code.
- F. Bond each main down conductor to grounding system.
- G. All conduits terminations in panels shall be grounded using appropriate ground bushing and conductor to nearest ground point.

3.13 GROUNDING SYSTEM

- A. Grounding Conductor, per section 16120:
 - 1. Completely encircle building structure.
 - 2. Bury minimum 30" below finished grade.
 - 3. Minimum 2 feet distance from foundation walls.
- B. Interconnect ground rods by direct-buried copper cables.
- C. Connections:
 - 1. Install ground cables continuous between connections.
 - 2. Exothermic welded connections to ground rods, cable trays, structural steel, handrails, and buried and non-accessible connections.
 - 3. Provide bolted clamp type mechanical connectors for all exposed secondary connections.
 - 4. Use bolted offset parapet bases or through-roof concealed base assemblies for air terminal connections.
 - 5. Provide interconnections with electrical and telephone systems and all underground water and metal pipes.
 - 6. Provide electric service arrestor ground wire to building water main.

3.14 FIELD QUALITY CONTROL

- A. As specified in Section 16950, ELECTRICAL TESTING.

END OF SECTION

SECTION 16480

LOW VOLTAGE MOTOR CONTROL

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American National Standard Institute (ANSI):
 - a. C2, National Electrical Safety Code (NESC).
 - b. C57.12.28, Switchgear and Transformers - Pad-Mounted Equipment- Enclosure Integrity.
 - c. Z55, Gray Finishes for Industrial Apparatus and Equipment.
 2. National Electrical Manufacturers Association (NEMA):
 - a. AB 1 Molded Case Circuit Breakers.
 - b. ICS 1, General Standards for Industrial Control and Systems.
 - c. ICS 2, Standards for Industrial Control Devices, Controllers, and Assemblies.
 - d. ICS 2.3, Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers
 - e. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - f. 250-1997, Enclosures for Electrical Equipment (1,000 volts maximum).
 3. National Fire Protection Association (NFPA): 70-90, National Electrical Code. (NEC) Latest Edition.
 4. Underwriters Laboratories, Inc. (UL):
 - a. 98, Standard for Safety Enclosed and Dead-Front Switches, Eleventh Edition.
 - b. 489, Standard for Safety Molded Case Circuit Breakers and Circuit Breaker Enclosures, Seventh Edition.
 - c. 845, Standard for Safety Motor Control Centers, Third Edition.
 - d. 508A Industrial Control Equipment.
 5. Uniform Building Code (UBC): Section 2312, Earthquake Requirements.
 6. InterNational Electrical Testing Association (NETA) Acceptance Testing Specifications, latest edition.
 7. Institute of Electrical and Electronics Engineers (IEEE):
 - a. 112, latest revision, Standard Test Procedure for Polyphase Induction Motors and Generators
 - b. 43, latest edition, Recommended Practice for Testing Insulation Resistance of Rotating Machinery

1.02 SUBMITTALS

- A. Shop Drawings:
1. Itemized bill of material.
 2. Descriptive information.
 3. Dimensional drawings.
 4. Conduit entrance locations/provisions.
 5. Bus data including horizontal and vertical bus capacities, voltage rating and interrupting capacity. Include materials of construction

6. Protective Devices: Copies of time-current characteristics.
7. Anchoring instructions and details.
8. Typed tabulation:
 - a. Motor name; tag (equipment) numbers as shown on Drawings.
 - b. Motor horsepower.
 - c. Nameplate full load current.
 - d. Measured load current and voltage.
 - e. Heater catalog number.
 - f. Protective device trip settings.
9. Attach above typed, tabulated data to a copy of starter manufacturer's overload heater selection tables for the starters provided.
10. Control Diagrams:
 - a. NEMA ICS 2, Section 322.08 Type I.
 - b. Wiring Type B.
 - c. In addition to standard NEMA control diagrams, provide the following:
 - 1) Remote control devices.
 - 2) Remote indication and/or pilot lights.
 - 3) Interconnections and interlocking circuits between starter and remote equipment.
 - 4) Remote sensors.
 - 5) Tag numbers associated with all control devices and equipment.
 - 6) Clearly identify items provided by others.
11. One-line diagrams.
12. Schematic (elementary) diagrams. Custom schematics shall be furnished. Diagrams shall include all remote devices. Submittals with drawings not meeting this requirement will not be reviewed further and will be returned to the Contractor stamped "REJECTED-RESUBMIT".
13. Outline diagrams.
14. Interconnection diagrams.
15. Enclosure NEMA rating and color.
16. Ground bus size and material of construction.
17. Main incoming line entry provision (top or bottom).
18. Control unit nameplate schedule.
19. All circuit breaker types, frames and settings.
20. All starter NEMA sizes, auxiliary contact provisions, coil voltage Relays, timers, pilot devices, control transformer VA and fuse sizes.
21. Short circuit rating of the complete assembly.
22. Replacement parts lists and operation and maintenance procedures.
23. Plan and elevation dimensional views of each MCC section.

B. Quality Control Submittals:

1. Manufacturer's installation instructions.
2. Operation and Maintenance Manual.
3. Factory test reports, certified.

1.03 UL COMPLIANCE

- A.** Products manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL Listing Mark. Where shown or required motor control centers shall be suitable for service entrance.

1.04 PACKING AND SHIPPING

- A. Shipping Splits: Established by Contractor to facilitate ingress of equipment to final installation location within the building.

1.05 RESPONSIBILITIES:

- A. The information provided on the drawings is for guidance only and does not limit the equipment size. When motors furnished differ from the expected rating indicated the Contractor shall make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate the motors actually installed.

1.06 INSPECTION COORDINATION:

- A. The Contractor shall provide access to the WORK for the Engineer as requested for inspection. The Contractor shall provide 48 hours notice of its intention to begin new WORK activities.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Square D.
- B. Eaton (Cutler-Hammer).
- C. General Electric.
- D. Allen-Bradley
- E. Or approved equal.

2.02 MOTOR CONTROL

- A. General:
 - 1. Provide each motor with a suitable controller and devices that will function as specified for the respective motors and meeting NEMA ICS 2, (class A), the NEC, and UL.
 - 2. Like Items of Equipment: Same manufacturer as low voltage switchboard and panelboards for standardization. Devices of the same type shall be products of the same manufacturer. This requirement applies to all control devices, and insofar as practical, to equipment manufactured on a production basis. It also applies without exception to equipment custom fabricated for this project.
 - 3. Make adjustments as necessary to wiring, conduit; disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate motors actually provided under this Contract.

4. Overload Protection:
 - a. Each motor shall have a direct current sensing solid-state overload protection in all ungrounded phases. This protection shall have current overload relays sensitive to motor current, and mounted within the motor controller. Reset of the protection shall be manually activated with externally operated reset button. All overload protection devices shall be the inverse time limit type and match the motor characteristic.
 5. Control Transformer:
 - a. Two winding, 120-volt secondary, primary voltage to suit.
 - b. Two current-limiting fuses for primary circuit.
 - c. One fuse in secondary circuit.
 - d. Mount within starter unit.
 6. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 7. Lifting lugs on all equipment and devices weighing over 100 pounds.
 8. Anchor Bolts: Galvanized, sized by equipment manufacturer, and as specified in Section 05500, METAL FABRICATIONS AND CASTINGS.
 9. Operating Conditions:
 - a. Ambient Temperature: Maximum 40 degrees C.
 - b. Equipment to be fully rated without any derating for operating conditions listed above.
 10. Enclosures: In accordance with NEMA 250 and ANSI C57.12.28.
 11. Equipment Finish:
 - a. Electro-coating process applied over a rust-inhibiting phosphated base coating.
 - b. Exterior Color: Manufacturer's standard.
 12. All manual starters and combination motor starters shall be lockable in the off position.
- B. Manually Operated Starter, Fractional Horsepower:
1. Rating: 16 amperes continuous at 277 volts maximum.
 2. Single-phase, non-reversing, full voltage with overload protection.
 3. Toggle operated, keyed where shown.
 4. Enclosure: NEMA 250, Type 4, unless shown otherwise.
 5. Neon Light: Red.
 6. Handle guard/lock-off attachment.
- C. Manually Operated Starter, Integral Horsepower:
1. Rating: Horsepower rated to maximum of 10 horsepower at 600 volts with overload protection.
 2. Single or three-phase, non-reversing, full voltage.
 3. Control: Toggle or pushbutton.
 4. Enclosure: NEMA 250, Type 4, unless shown otherwise.
 5. Red pilot light in series with an auxiliary contact.
 6. Locking in OFF position.
 7. Two spare auxiliary, field-convertible contacts.
- D. Combination Full-Voltage, Magnetic Starter:
1. Rating: Horsepower rated at 600 volts, UL labeled for 100,000 amperes with overload protection.
 2. Three-phase, non-reversing, full voltage.

3. Control: As shown.
4. Disconnect Type: Motor circuit protector.
5. Enclosure: As shown.
6. Pilot Lights: As shown.
7. Pad-lockable operating handles.

E. Solid State Reduced Voltage Starter: Not used.

2.03 MOTOR CONTROL CENTERS

A. General:

1. In accordance with NEMA ICS 2 and UL 845.
2. The motor control centers shall be 600-volt class suitable for operation on a three-phase, 60-Hz system. The system operating voltage and number of wires shall be as indicated, on project drawings.
3. MCC designated as service entrance rated shall include provision for termination of an incoming neutral conductor in conformance to NEC requirements.
4. Short Circuit Rating: Amperes rms symmetrical as shown on Drawings for entire motor control center as a complete assembly.
5. All controllers, main and branch circuit breakers, wire connections, and other devices to be front mounted and accessible unless otherwise noted.
6. NEMA ICS 2, Section 322.08.
 - a. Class: IIS.
 - b. Type: B. Diagrams and wiring.
 - c. Provide blank spaces on interconnection diagrams to add control conductor code designations during installation of equipment.
7. Size and Arrangement
 - a. Motor control centers shall be of mechanical groupings of control center units, assembled into a lineup of control center sections. Each control section shall be nominally 90-inches tall by minimum 20-inches deep.
 - b. MCC's shall be designed to not exceed the space requirements as indicated on the Contract Drawings, including spaces, spares, and future compartments. MCC's shall be subject to rejection for exceeding the lengths indicated where allotted space is critical.
 - c. Equipment within the MCC may be rearranged at the discretion of the manufacturer, providing the MCC provides the spares, space, and future provisions indicated.
 - d. All switches and circuit breakers used as switches shall be located so that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, will not be more than 6-feet 7-in.

B. Enclosure:

1. Type: NEMA 250, Type 1, gasketed.
2. Construction:
 - a. Sheet steel reinforced with channel or angle irons.
 - b. Butt sections flush, end-to-end against similar section without bolts, nuts, or cover plates causing interference.
 - c. Removable top cover plates and bottom cover plates.

- d. Removable plates on end panels for future bus extension.
 - e. Structural members shall be fabricated of not less than 12 gauge steel and side and top panels and doors shall be not less than 14 gauge steel.
- 4. Section Mounting: Removable formed-steel channel sills and lifting angles.
 - 5. Horizontal Wiring Compartments: Accessible from front, full width, top and bottom.
 - 6. Vertical Wiring Compartment: Full height, isolated from unit starters with separate door.
 - 7. Unit Compartment: Individual compartments separated by steel barriers for each starter, feeder, or other unit capable of being wired from front without unit removal.
 - 8. Compartment Doors: Separate hinged doors for each starter, feeder, or other unit.
 - 9. Door Interlocking: Interlock starter and feeder doors mechanically so doors cannot be opened with unit energized. Provide defeater mechanism to allow intentional access at any time.
 - 10. External disconnect handles, pad-lockable in OFF position.
 - 11. Cable Entrance: Main leads enter as shown on the Drawings. Control and feeder circuits enter from top and bottom.
 - 12. Spaces designated as "SPACE" or "BLANK" shall include blank hinged doors and vertical bus bars.
 - 13. Control units inside compartments shall be clearly identified with tags or stencil markings.
 - 14. Each control unit including spares, spaces and blanks, lights, and devices shall be identified by an engraved nameplate. Identification shall include circuit number as indicated.
 - 15. Each motor control center shall be fitted with the manufacturer's nameplate which shall include the NEMA Standard electric rating and other pertinent data, including manufacturer, sales order number, date of manufacture, and place of manufacture.
 - 16. Where "L" or "U" shaped MCC layouts are indicated, corner compartments shall have similar current and short circuit ratings as functional compartments.
 - 17. Fans, heat exchangers, transformers, capacitors, junction boxes, or other devices may not be mounted on the outside of the motor control center enclosure.
 - 18. Finish for motor control center shall be light grey, ANSI 61. The panels shall be given 2 coats of primer inside and out and 2 coats of enamel finish. External colors other than ANSI 61 will not be acceptable.
 - 19. Each section shall be dead-front and dead-back construction. Rear access shall not be necessary for inspection and maintenance. The structure arrangement shall be for front only mounting of units.
 - 20. Power cables to the motor control center shall be either top or bottom feed as indicated on the project drawings. Provide all necessary lugs, clamps, and supports to terminate incoming power cables.

C. Bus:

- 1. Horizontal Power Bus:
 - a. Three-phase tin-plated, copper, entire width of control center, rated as indicated.

- b. Silver-plated at joints.
 - c. Construct to allow future extension of additional sections.
 - d. Pressure type solderless lugs for each incoming line cable.
 - e. Isolated from top horizontal wireway.
 - f. Provide Belleville washers on bus connection bolts.
 - 2. Vertical Power Bus:
 - a. Three-phase tin-plated, copper, full height of section, rated as required by the load but not less than 300 amperes, minimum.
 - b. Silver-plated at joints.
 - c. Sandwich type bus insulation providing deadfront construction with starter units removed except for bus stab openings.
 - d. Insulated and isolated barrier complete with shutters.
 - e. Provide Belleville washers on bus connection bolts.
 - 3. Neutral Bus: None.
 - 4. Ground Bus:
 - a. Copper, tin-plated, 33 percent minimum of phase bus ampacity, entire width of control center.
 - b. Provide Belleville washers on bus connection bolts.
 - 5. Bus Bracing: 65,000 amperes rms symmetrical.
- D. Motor Controller Unit:
- 1. Provide indicated individual components and control devices including pushbuttons, selector switches, LED indicating lights, control relays, time delay relays, and elapsed time meters as specified in Section 16050, BASIC ELECTRICAL MATERIALS AND METHODS.
 - 2. Each motor starter unit shall consist of a combination magnetic contactor and short circuit protective device. Short circuit protective device shall be an instantaneous, magnetic only circuit breaker or thermal magnetic circuit breaker as defined in the project one line diagrams. All circuit breakers provided as part of a motor starter unit shall be capable of being padlocked in the open position. Reset of thermal overload elements shall be possible with unit door closed. Three phase overload trip units shall be furnished to suit the full load current of the equipment installed. Overload relays shall be solid state type capable of detecting phase loss and ground faults and shall meet NEMA class 20 tripping characteristics.
 - 3. Magnetic starters shall have auxiliary contacts as required by electrical motor control diagrams, including N-O and N-C contacts as indicated, plus one each spare N-O and N-C contact. As a minimum, provide one normally open and one normally closed auxiliary contact.
 - 4. Each starter unit shall have its own control power transformer. It shall have a 115-volt grounded secondary. One secondary fuse and 2 primary fuses shall be provided. Control power transformers shall be sized to accommodate the control devices indicated. Minimum transformer size is 50 VA. Local control devices shall be mounted independently of the cover door. All starters shall have a local "running" lamp and a "off" light to indicate the presence of control power when the motor is not running. Indicating lights shall be push-to-test LED type. Starters shall be provided with elapsed time meters, hand/off/auto selector switches, and other devices as indicated. All cubicle control wires shall be terminated at a pull apart disconnecting terminal block at the cubicle.

5. The motor control center manufacturer shall be responsible for identifying each control wire within each motor starter unit with wrap-around permanent plastic markers. Each control wire shall be identified at both ends. Markers shall be produced from a device specifically made to produce tags, such as manufactured by Brady Corporation or Thomas & Betts. Hand lettered markers are not acceptable.
6. Motor starters shall be designed to NEMA ratings. Starters designed to IEC ratings or with dual IEC/NEMA ratings will not be acceptable, either as part of any MCC, as remote starters, or as part of any equipment package.
7. Construction:
 - a. Draw out combination type with stab connections for starters NEMA ICS, Size 4 and smaller. The fixed-type unit assembly shall be constructed so that it can be easily removed from its panel after disconnecting the wires to the terminal block and withdrawing from the primary bus. Removal of a unit assembly shall be possible without rear access and without disturbing any other unit in the motor control center.
 - b. Bolt-on combination type with cable connection to riser for starters NEMA ICS, Size 5 and larger.
 - c. Readily interchangeable with starters of similar size.
 - d. Pull-apart unit control wiring terminal boards on all units.

E. Starters:

1. NEMA ICS 2, Section 322.08 standard rating, except none smaller than NEMA ICS, Size 1.
2. Rating: Horsepower rated at 600 volt, UL labeled for 65,000 amperes with overload protection.
3. Three-phase, non-reversing, unless otherwise shown.
4. Disconnect Type: Motor circuit protector.
5. Combination Full Voltage, Magnetic Starter:
 - a. Control: As shown.
 - b. Pilot Lights: Red-ON and Green-OFF.
6. Combination Reduced Voltage Auto-Transformer Starters:
 - a. Reduced voltage auto-transformer starters shall consist of a molded-case motor circuit protector in combination with a closed transition type auto-transformer starter with 50 percent, 65 percent, and 80 percent taps, and shall be set on the 65 percent tap.
 - b. The starter shall have three phase solid state overload relays capable of sensing phase loss and ground fault with manual reset.
 - c. The auto-transformer shall include a thermal switch wired to protect itself from overheating.
 - d. Timing of the starting period shall be controlled by an adjustable accelerating relay. Requirements set forth in paragraph 2.03 for enclosures and devices apply herein.

7. Solid State Reduced Voltage Starters:
- a. Solid state reduced voltage starters shall meet the requirements of UL 508 and shall consist of an incoming power circuit breaker, a power section; logic board, isolation contactor, and paralleling full load bypass contactor.
 - b. Soft Starters shall conform to the following:
 - 1) The SCR-based power section shall consist of 6 back-to-back SCRs, two SCRs per phase, and shall be rated for a minimum peak inverse voltage rating of 2.5 times line voltage, 1200 PIV for 480 volts. Units using triacs or SCR/diode combinations shall not be acceptable. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dv/dt characteristics of the electrical system.
 - 2) Starters shall include the following logic and control functions:
 - Adjustable maximum starting current from 200 percent to 500 percent
 - Ramp time adjustment from 1 to 40 seconds
 - Adjustable linear voltage deceleration
 - Kick start
 - Phase loss protection
 - Adjustable Undervoltage/ overvoltage protection
 - Current unbalance protection
 - Instantaneous overcurrent detection.
 - Phase rotation protection (prevents starting)
 - Shorted SCR detection.
 - Selectable Class 10, 20, 30 electronic overload protection. Heat sink overtemperature protection shall be provided.
 - Dry contacts for remote indication of RUN and TRIP status
 - Battery "back up" of set starter parameters.
 - Event recorder.
 - Elapsed time meter.
 - LCD status display.
 - 3) The paralleling bypass contactor shall energize when the motor reaches full speed. The contactor shall be fully rated for across-the-line starting duty. The effect of the bypass contactor during normal operation is the elimination of heat buildup resulting from the voltage drop across the SCR's. The bypass contactor may also be used as a means of starting the motor should problems be encountered with the soft starter. A door mounted selector switch shall be furnished such that the starting means can be selected as being either via the soft starter or via the bypass contactor as across-the-line.
 - 4) An isolation contactor shall be supplied. The isolation contactor shall remove three phase power from the input side of the solid state controller when the bypass contactor is selected for across-the-line starting.

- 5) The starter shall be housed in an appropriate NEMA rated enclosure as directed by project drawings. Heaters and cooling fans shall be provided if required to maintain the equipment within the manufacturer's environmental guidelines.
- 6) The enclosure shall be of two-door compartment type construction. The left hand compartment shall contain the starter power section and any equipment rated at line voltage. The right hand compartment shall include only that equipment rated at 120 VAC or less including the starter's CPU PC card and LCD display. The enclosure shall include a partition dividing the two compartments. Each compartment shall be designed to provide a barrier between the equipment at line voltage and the equipment at 120 VAC or less
- 7) The starter shall be provided with a control power transformer sized to accommodate all controls indicated on the Contract Drawings. An input power circuit breaker shall be provided. Lug termination of the incoming power conductors shall not be permitted. The starter and circuit breaker shall be rated for 65 KAIC RMS at 480V.
- 8) The starter shall have door mounted indication of run, phase rotation, phase loss, undervoltage, current unbalance, and current trip.
- 9) Door mounted LCD / keyboard display assembly designed to:
 - Set or examine operating parameters.
 - Provide starter status information.
 - Provide real-time information about line current, voltage, and frequency.
 - Provide a means to start and stop the starter
- c. Pad-lockable operating handle when de-energized.
- d. Unit door interlocked to prevent opening when disconnect is in closed position.
- e. Mechanical interlocked to prevent placing disconnect in ON position when unit door is open.
- f. Minimum Dimensions: 12 inches high by full section width, less vertical wireway.
8. Two Speed Starters:
 - a. Two Speed Starters shall be of the two-winding type unless otherwise indicated.
 - b. Requirements set forth in paragraph 2.03 for enclosures and devices apply herein.
9. Disconnecting Device:
 - a. In each starter, control circuit disconnect to de-energize circuits in unit which are not de-energized by starter power disconnect device.
 - b. Pad-lockable in OPEN position.
10. Circuit Breaker:
 - a. Meeting the requirements of NEMA AB1 and UL 489.
 - b. Molded case with manufacturer's recommended trip setting for maximum motor protection.

- c. Magnetic trip only.
 - d. Tripping indicated by operating-handle position.
 - e. Interrupting capacity required for connection to system with short circuit capacity indicated.
 - 11. Fused Switch:
 - a. Heavy-duty, motor rated load-break, quick-make, quick-break type meeting the requirements of UL 98 and NEMA KS 1.
 - b. Current-limiting fuses, with rejection clips.
 - 12. Load Detector Relay:
 - a. Manual reset with adjustable differential.
 - b. Manufacturer:
 - 1) Cutler-Hammer; Type D60LA.
 - 2) Allen-Bradley; Bulletin 2100.
 - 3) Or approved equal.
 - 13. Motor Overload Protection:
 - a. Direct current sensing solid-state overload protection in all ungrounded phases.
 - b. Manual-reset overload relays.
 - 14. Motor Thermal Protector Interface: Manual-reset interposing relay for connection to motor-mounted thermal protector system.
 - 15. Ground Fault Protection: Where indicated and as specified in paragraph Feeder Units and Main Protective Device, except provide instantaneous operation device.
 - 16. Capacitor Connection: Terminals to allow easy connection of power factor correction capacitors on source side of starter overload relays on starters where capacitor connection is shown.
- E. Control Unit:
- 1. Disconnecting Device: Capable of de-energizing external source control circuits in unit.
 - 2. Control Devices: As indicated and as specified in Section 16050, BASIC ELECTRICAL MATERIALS AND METHODS.
 - 3. Control Wiring:
 - a. Minimum wire size 14 AWG copper.
 - b. Permanent sleeve type markers with wire numbers applied to each end of wires.
 - c. Terminate wires using insulated locking fork or ring type crimp terminals.
 - d. Terminate current transformer leads on shorting type terminal blocks.
- F. Incoming Line Terminal:
- 1. Construction: As specified in Paragraph Motor Controller Unit.
 - 2. Incoming Service Feeder: Cable entering section as shown.
 - 3. Maximum short-circuit rating of 65,000 amperes.
 - 4. Mechanical type CU-/AL lugs for 75 degrees C cable.
- G. Feeder Unit and Main Protective Device:
- 1. Construction: As specified in Paragraph Motor Controller Unit.
 - 2. Incoming Service Feeder: Cable entering section as shown.
 - 3. Molded Case Circuit Breaker:
 - a. In accordance with NEMA AB 1 and UL 489.

- b. Main and feeder protective device.
 - c. UL labeled as suitable for service entrance.
 - d. Thermal-magnetic trip and interrupting capacity required for connection to system with short circuit capacity indicated.
 - e. Indicate tripping by operating-handle position.
 - f. Suitable for use with 75 degrees C wire at full NEC 75 degrees C ampacity.
 - g. Circuit breakers having a frame size of 150 amperes or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units.
 - h. Circuit breakers with a frame size of 225 amperes to 1,200 amperes shall be molded case with interchangeable thermal and adjustable magnetic trip or RMS sensing electronic trip elements.
 - i. The interrupting capacity of all main, and feeder branch circuit breakers shall be a minimum of 65,000 RMS symmetrical amperes. Service disconnects rated 1000A or more shall provide ground fault protection of equipment.
4. Ground Fault Protection:
- a. Suitable for 480-volt, three-phase, three-wire, solidly grounded wye system.
 - b. Ground sensors to encircle all phase conductors and neutral conductor where used and connected to ground relays with adjustable pickup settings and time-current characteristics indicated.
 - c. Circuit breaker shunt trip and relay operating from fused 120-volt ac control source within control center.
 - d. Manufacturers:
 - 1) Ground Fault System ITE; Ground Shield.
 - 2) General Electric; Ground Break.
 - 3) Or approved equal.
5. Phase Monitoring Relay:
- a. Three-phase monitoring relay to protect against low voltage, voltage unbalance, and phase reversal.
 - b. Manufacturer: Furnas; Class 47 or approved equal.
- H. Instruments:
- 1. Provide solid state type metering where indicated. Include CT's and PT's of ratios as indicated.
 - a. Solid state "metering" shall include but not be limited to the following functions:
 - 1) Metering: Device shall monitor Voltage (VLL/VLN), Current (Amps per phase), Real Power (W), Reactive Power (VAR) and Apparent Power (VA). Device shall have data gathering ability for analysis. The device(s) shall conform to the requirements of UL 508.

- 2) Alarms: Device shall utilize assignable output relays to trigger alarms for specific applications. Alarm messages shall be displayed on the front panel of the device. Alarm outputs via dry contacts shall alarm Over/Under Current, Over/Under Voltage, Current Unbalance/Neutral Current, Phase Sequence, Over/Under Frequency, Power Factor and Switch Inputs.
 - 3) Communications: Device shall be able to communicate with current and future process control systems using standard protocols such as Devicenet, Ethernet, Modbus, Profibus, or as called for on project drawings. Front and rear panel communications ports shall be available for information access. Display of monitored values shall be available both locally and remotely.
- I. Pushbuttons, selector switches, and pilot lights shall be the heavy-duty, oil-tight type, sized to 30 mm. Miniature style devices are not acceptable. All devices shall conform to the requirements of UL 508.
1. Lens colors for “run”, “stop”, “on”, “off”, “open”, and “closed” shall be coordinated with the District’s requirements.
 2. Pilot lights shall be LED, push-to-test type.
 3. Provide hazardous location type pilot devices in classified locations per the NEC.
- J. Elapsed Time Meters: As specified in Section 16050, BASIC ELECTRICAL MATERIALS AND METHODS.
- K. Time Delay Relays: As specified in Section 16050, BASIC ELECTRICAL MATERIALS AND METHODS.
- L. Relays shall be 3 PDT with 10 amp contacts, plug-in type utilizing rectangular blades and provided with sockets for screw-type termination and hold-down clips.
- M. Reset Timers: As specified in Section 16050, BASIC ELECTRICAL MATERIALS AND METHODS.
- N. Nameplates:
1. Laminated plastic; white, engraved to black core.
 2. Provide for each motor control center and each unit.
 3. Engrave with inscription shown on single-line diagram.
 4. Provide blank nameplates on spaces for future units.
 5. Attach with stainless steel pan head screws on face of control center.
- O. Factory Testing: NEMA ICS 1, Section 109.

2.04 SPARE PARTS

- A. The Contractor shall furnish the following for each MCC as a minimum:
1. Three bezels of each color installed for pilot indicators
 2. One dozen panel lamps
 3. One dozen control fuses of each size installed

- B. Spare parts shall be identified by MCC number, type, size, and manufacturer

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with NEMA ICS 2.3, Submittal Drawings, and Manufacturer's Instructions and Recommendations.
- B. Secure equipment to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions.
- C. Install equipment plumb and in longitudinal alignment with pad or wall.
- D. Coordinate terminal connections with installation of secondary feeders.
- E. Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.
- F. Motor control centers shall be installed on 3-1/2-inch concrete pads. After leveling and shimming, the Contractor shall anchor motor control centers to concrete pads, and shall grout so that no space exists between the pad and support beams.
- G. The Contractor shall:
 - 1. Torque all bus bar bolts to manufacturer's recommendations. Tighten all sheet metal and structure assembly bolts.
 - 2. Adjust all Motor Circuit Protector (MCP) devices to the instantaneous trip setting position recommended for the actual horsepower and full load amps of the motor. Verify that overload devices are proper for equipment installed; make necessary changes in overload devices as required for motors having power factor correcting capacitors.
 - 3. After equipment is installed, touch up scratches and verify that nameplate, and other identification is accurate.
 - 4. Provide high voltage switchboard matting in front of the MCC. The mat shall be 1/4-inch thick and 36-inches wide.

3.02 TESTING

- A. Factory Test: All motor control centers, micro processor based soft starters and their components shall be given manufacturer's standard electrical and mechanical production tests and inspections. The tests shall include electrical continuity check, dielectric tests for each circuit, and inspection for proper functioning of all components including controls, protective devices, metering, and alarm devices.
- B. Field Test MCC:
 - 1. Visual and mechanical inspection after installation
 - a. Inspect for physical damage, proper anchorage, and grounding
 - b. Verify that the ratings of the solid state overload relays match the motor full-load current nameplate data.

- c. Check tightness of bolted connections.
- C. Electrical Tests
 - 1. Insulation tests
 - a. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute. Test voltage and minimum acceptable resistance shall be in accordance with manufacturer's recommendations.
 - b. Measure insulation resistance of each starter section phase to phase and phase to ground with the starter contacts closed and the protective device open. Test voltage and minimum acceptable resistance shall be in accordance with the manufacturer's recommendations.
 - c. Measure insulation resistance of each control circuit with respect to ground
 - 2. Verify proper operation of control logic in all modes of control.

3.03 CIRCUIT BREAKERS

- A. Field adjust trip settings of motor starter magnetic-trip-only circuit breakers.
- B. Adjust to approximately 11 times motor rated current.
- C. Determine motor rated current from motor nameplate following installation.

3.04 OVERLOAD RELAY

- A. Adjust overload relays after the actual nameplate full-load current rating of motor has been determined.

3.05 MOTOR DATA

- A. Provide typed, self-adhesive label attached inside each motor starter enclosure door displaying the following information:
 - 1. Motor served by tag number and equipment name.
 - 2. Nameplate horsepower.
 - 3. Motor code letter.
 - 4. Full load amperes.
 - 5. Service factor.
 - 6. Installed overload relay heater catalog number.

3.06 FIELD QUALITY CONTROL

- A. In accordance with Section 16950, ELECTRICAL TESTING.

3.07 MANUFACTURERS' SERVICES

- A. Furnish manufacturer's representative in accordance with Section 01640, MANUFACTURERS' SERVICES, for the following services at jobsite or classroom as designated by Owner, for minimum person-days listed below, travel time excluded:
 - 1. 1 person-day for installation assistance, and inspection of installation.

2. 1 person-day for functional and performance testing.
3. 1 person-day for plant startup.

END OF SECTION

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. VFD's for below 150HP and above 30HP shall be 6-pulse drives with 5% input line reactor and output filter. VFD's for 30HP and below shall be 6-pulse drives with 3% input line reactor and output filter. External phase shifting transformers will not be accepted.

1.02 RELATED WORK SPECIFIED ELSEWHERE

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

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. Eaton (Cutler-Hammer)
 - 4. 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% efficient at full load and full speed and 95.5% efficient at 51% load and 80% 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%, -5% at rated load, 3-phase.
 - a. Voltage Dip Ride-Through: VFD shall be capable of sustaining continued operation with a 40% 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% 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%.
7. AC Line Frequency Variation: +/- 3 Hertz.
8. Power Unit Rating Basis: 110% rated current continuous, 150% rated current for one minute, at rated temperature.
9. VFD Unit Rating shall be minimum 110% of the motor full load current nameplate rating. If the 110% 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% 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% 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% 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 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. VFD's shall be installed in the MCC line-up.

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% 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 16500

LIGHTING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - 2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 3. Uniform Building Code (UBC): Section 2329, Earthquake Requirements.
 - 4. Underwriters Laboratories, Inc. (UL):
 - a. 595, Standard for Safety Marine-Type Electric Lighting Fixtures.
 - b. 844, Standard for Safety Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
 - c. 924, Standard for Safety Emergency Lighting and Power Equipment.

1.02 SUBMITTALS

- A. Shop Drawings:
 - 1. Interior Luminaires:
 - a. Catalog data sheets and pictures.
 - b. Luminaire finish and metal gauge.
 - c. Lens material, pattern, and thickness.
 - d. Candle power distribution curves in two or more planes.
 - e. Candle power chart 0 to 90 degrees.
 - f. Lumen output chart.
 - g. Average maximum brightness data in foot lamberts.
 - h. Coefficients of utilization for zonal cavity calculations.
 - i. Mounting or suspension details.
 - j. Heat exchange and air handling data.
 - 2. Exterior Luminaires:
 - a. Catalog data sheets and pictures.
 - b. Luminaire finish and metal gauge.
 - c. Lens material, pattern, and thickness.
 - d. IES lighting classification and isolux diagram.
 - e. Fastening details to wall or pole.
 - f. Ballast type, location, and method of fastening.
 - g. For light poles, submit wind loading, complete dimensions, and finish.
 - 3. Lamps:
 - a. Voltages.
 - b. Colors.
 - c. Approximate life (in hours).
 - d. Approximate initial lumens.
 - e. Lumen maintenance curve.
 - f. Lamp type and base.
 - g. Copy of lamp order, including individual quantities, for Project.
 - 4. Ballasts:
 - a. Type.
 - b. Wiring diagram.

- c. Nominal watts and input watts.
- d. Input voltage and power factor.
- e. Starting current, line current, and restrike current values.
- f. Sound rating.
- g. Temperature rating.
- h. Efficiency ratings.
- i. Low temperature characteristics.
- j. Emergency ballasts rating and capacity data.
- 5. Photo-Time Control:
 - a. Wiring diagram.
 - b. Contact ratings.
- 6. Photocells:
 - a. Voltage, and power consumption.
 - b. Capacity.
 - c. Contacts and time delay.
 - d. Operating levels.
 - e. Enclosure type and dimensions.
 - f. Temperature range.

1.03 UL COMPLIANCE

- A. Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

1.04 LATEST LED TECHNOLOGY

- A. LED (light emitting diode) technology is changing rapidly and most of the LED light fixtures specified in the project may no longer available when the project is going into construction phase. Light fixture supplier shall provide and equivalent or greater LED light fixtures (lumen output) without additional cost to the Owner and get approval from Engineer.

PART 2 PRODUCTS

2.01 LUMINAIRES

- A. Specific requirements relative to execution of Work of this section is located in the Luminaire Schedule on Drawings.
- B. Feed-through type, or separate junction box.
- C. Ballasts: Two-lamp when possible.
- D. Tandem wired for three-lamp, fluorescent fixtures.
- E. Wire Leads: Minimum 18 AWG.
- F. Component Access: Accessible and replaceable without removing luminaire from ceiling.
- G. Soffit Installations:
 - 1. UL Labeled: SUITABLE FOR DAMP LOCATIONS.
 - 2. Ballast: Removable, prewired.

H. Exterior Installations:

1. UL Labeled: SUITABLE FOR WET LOCATIONS.
2. Ballast: Removable, prewired.
3. When factory-installed photocells are provided, entire assembly shall have UL label.

I. Emergency Lighting:

1. Power Pack: Self-contained, 120-volt transformer, inverter/charger, sealed nickel cadmium battery, and indicator switch in accordance with UL 924.
2. Lighted, push-to-test indicator.
3. Capable of providing full illumination for 1-1/2 hours in emergency mode.
4. Capable of full recharge in 24 hours, automatically upon resumption of normal line voltage.
5. Capable of protecting against excess charging and discharging.

2.02 LAMPS

A. Fluorescent:

1. Type Efficiency: Energy.
2. Color: Cool white.

B. LED:

1. Type Efficiency: Energy.
2. Color: as stated on plans.

C. Manufacturers:

1. Sylvania.
2. General Electric.
3. North American Phillips.
4. Or approved equal.

2.03 BALLASTS

A. General:

1. Meet requirements for fixture light output, reliable starting, radio interference, total harmonic distortion, electromagnetic interference, and dielectric rating.
2. Certified by electrical testing laboratories to conform to Certified Ballast Manufacturer's specifications.

B. LED:

1. LED fixture driver shall be as per the LED light fixture manufacturer's recommendation if not otherwise noted on the drawings.
2. LED driver shall be fixed or dimmable version, as noted on the drawings.

2.04 LIGHTING CONTROL AND SWITCHES

A. Photocell:

1. Automatic ON/OFF switching photo control.
2. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.
3. Setting: ON at dusk and OFF at dawn.
4. Time delay feature to prevent false switching.

- 5. Field adjustable to control operating levels.
- 6. Manufacturers:
 - a. Tork.
 - b. Paragon.
 - c. Or approved equal.

B. Light Switches: Occupancy Sensor Type (Infrared Wall-Switch)

- 1. Not used.

C. Light Switches: Non-occupancy Sensor Type (Only use when indicated on drawings)

- 1. Not used.

2.05 POLES

- A. Rating (with Luminaire): All pole installation shall be suitable for wind loading and appropriate gust factor per applicable zone of installation as defined in the Florida Building Code. The contractor shall include with the shop drawing submittal, a pole wind loading calculation signed and sealed by a structural engineer registered in Florida showing that the proposed installations will meet the given wind loading requirement.

- B. Material: Extruded aluminum or concrete, as shown on plans.

2.06 EMERGENCY BALLAST

- A. In accordance with UL 924.
- B. Nickel cadmium battery, charger, and electronic circuitry in metal case plus ac ballast.
- C. Solid state charging indicator monitoring light and double-pole test switch.
- D. Capable of operating one fluorescent lamp for a period of 90 minutes with output of 1,100 to 1,200 lumens.
- E. Manufacturers:
 - 1. MagneTec Jefferson.
 - 2. Bodine.
 - 3. Radiant.

PART 3 EXECUTION

3.01 LUMINAIRES

- A. General:
- 1. Install in accordance with manufacturer's recommendations.
 - 2. Provide proper hangers, pendants, and canopies as necessary for complete installation.
 - 3. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building and to concrete pole bases required to safely mount.
 - 4. Install plumb and level.

5. Mounting heights shown for wall mounted or pendant mounted luminaires are measured from bottom of luminaire to finished floor or finished grade, whichever is applicable.
 6. Install each luminaire outlet box with galvanized stud.
- B. Pendant Mounted:
1. Provide swivel type hangers and canopies to match luminaires, unless otherwise noted.
 2. Space single-stem hangers on continuous-row fluorescent luminaires nominally 48 inches apart.
 3. Provide twin-stem hangers on single luminaires.
- C. Pole Mounted:
1. Provide precast concrete base.
 2. Provide branch circuit in-line fuses in pole base handhole.
- D. Swinging Type:
1. Not used.
- E. Finished Areas:
1. Install symmetrically with tile pattern.
 2. Locate with centerlines either on centerline of tile or on joint between adjacent tile runs.
 3. Install recessed luminaires tight to finished surface such that no spill light will show between ceilings and sealing rings.
 4. Combustible Low Density Cellulose Fiberboard: Provide spacers and mount luminaires 1-1/2 inches from ceiling surface, or use fixtures suitable for mounting on low density ceilings.
 5. Junction Boxes:
 - a. Flush and Recessed Luminaires: Locate minimum 1 foot from luminaire.
 - b. In concealed locations, install junction boxes to be accessible by removing luminaire.
 6. Wiring and Conduit:
 - a. Provide wiring of temperature rating required by luminaire.
 - b. Provide flexible steel conduit.
 7. Provide plaster frames when required by ceiling construction.
 8. Independent Supports:
 - a. Provide each recessed fluorescent luminaire with two safety chains or two No. 12 soft-annealed galvanized steel wires of length needed to secure luminaire to building structure independent of ceiling structure.
 - b. Tensile strength of chain or wire, and method of fastening to structure shall be adequate to support weight of luminaire.
 - c. Fasten chain or wire to each end of luminaire.
- F. Unfinished Areas: Locate luminaires to avoid either conflict with other building systems or blockage of luminaire light output.
1. Fixture Suspension: Provide 1/4-inch threaded steel hanger rods. Scissor type hangers not permitted.
 2. Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.

3.02 LAMPS

- A. Provide in each fixture, the number and type for which the fixture is designed, unless otherwise noted.

3.03 BALLASTS

- A. Install in accordance with manufacturer's recommendations.
- B. Utilize all ballast mounting holes to fasten securely within luminaire.
- C. Replace noisy or defective ballasts.

3.04 LIGHTING CONTROL

- A. Outdoor luminaires: Photocells switch lights ON at dusk and OFF at dawn, unless otherwise noted on drawings.

3.05 EMERGENCY BALLAST

- A. Install battery, charger, and electronic circuitry metal case inside fluorescent fixture housing adjacent to ac ballast.
- B. Install monitoring light and double-pole switch adjacent to light fixture.
- C. Wire in accordance with manufacturer's wiring diagrams.

3.06 OCCUPANCY SENSOR WALL-SWITCH

Not used.

3.07 CLEANING FOLLOWING CONSTRUCTION

- A. Remove all labels and other markings, except UL listing mark.
- B. Wipe luminaires inside and out to remove construction dust.
- C. Clean luminaire plastic lenses with antistatic cleaners only.
- D. Touch up all painted surfaces of luminaires and poles with matching paint ordered from manufacturer.
- E. Replace all defective lamps at time of Substantial Completion.

END OF SECTION

SECTION 16950

ELECTRICAL TESTING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards, which may be referenced in this section:
1. American National Standards Institute (ANSI):
 - a. 450, Recommended Practice for Maintenance, Testing, and Replacement of Large lead Storage Batteries for Generator Stations and Substations.
 - b. C2, National Electrical Safety Code.
 - c. C37.20.1, Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear.
 - d. C37.20.2, Metal-Clad and Station-Type Cubicle Switchgear.
 - e. C37.20.3, Metal-Enclosed Interrupter Switchgear.
 - f. C62.33, Standard Test Specifications for Varistor Surge- Protective Devices.
 2. American Society for Testing and Materials (ASTM):
 - a. D665, Standard Test Method for Rust Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water.
 - b. DS77, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
 - c. D923, Standard Test Method for Sampling Electrical Insulating Liquids.
 - d. D924, Standard Test Methods for A-Class Characteristics and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
 - e. D971, Standard Test Method for Interfacial Tension of 0.1 Against Water by the Ring Method.
 - f. D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
 - g. D1298, Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
 - h. D1500, Standard Test Method for ASTM Color of Petroleum Products.
 - i. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.
 - j. D1533, Standard Test Methods for Water in Insulating Liquids.
 - k. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.
 - l. D2285, Standard Test Method for Interfacial Tension of Electrical Insulating Oils of Petroleum Origin Against Water by the Drop- Weight Method.
 3. Institute of Electrical and Electronics Engineers (IEEE):
 - a. 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.
 - b. 48, Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminators.
 - c. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

- d. 95, Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage.
- e. 118, Standard Test Code for Resistance Measurement.
- f. 400, Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field.
- 4. National Electrical Manufacturers Association (NEMA):
 - a. AB 4, Guideline for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
 - b. PB 2, Deadfront Distribution Switchboards.
 - c. WC 7, Cross-Linked-Thermosetting-Polyethylene- Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - d. WC 8, Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- 5. International Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety Requirements for Employee Workplaces.

1.02 SUBMITTALS

- A. Administrative Submittals: Submit 30 days prior to performing inspections or tests:
 - 1. Schedule for performing inspection and tests.
 - 2. List of references to be used for each test.
 - 3. Sample copy of equipment and materials inspection form(s).
 - 4. Sample copy of individual device test form.
 - 5. Sample copy of individual system test form.
- B. Quality Control Submittals: Submit within 30 days after completion of test:
 - 1. Test or inspection reports and certificates for each electrical item tested.
- C. Contract Closeout Submittals:
 - 1. Operation and Maintenance Data:
 - a. In accordance with Section 01782, OPERATION AND MAINTENANCE DATA.
 - b. After test or inspection reports and certificates have been reviewed by ENGINEER and returned, insert a copy of each in operation and maintenance manual.

1.03 QUALITY ASSURANCE

- A. Testing Firm Qualifications:
 - 1. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
- B. Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.
- C. Test instrument calibration shall be in accordance with NETA ATS.

1.04 1.04 SEQUENCING AND SCHEDULING

- A. Perform inspection and electrical tests after equipment has been installed.
- B. Perform tests with apparatus de-energized whenever feasible.
- C. Inspection and electrical tests on energized equipment are to be:
 - 1. Scheduled with ENGINEER prior to de-energization.
 - 2. Minimized to avoid extended period of interruption to the operating plant equipment.
- D. Notify ENGINEER at least 24 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 GENERAL

- A. Tests specified in this section are to be performed in accordance with the requirements of Section FACILITY STARTUP.
- B. Tests and inspection shall establish that:
 - 1. Electrical equipment is operational within industry and manufacturer's tolerances.
 - 2. Installation operates properly.
 - 3. Equipment is suitable for energization.
 - 4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, and ANSI C2.
- C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
- D. Set, test, and calibrate protective relays, circuit breakers, fuses, and other applicable devices in accordance with values established by the short circuit and coordination study as specified in Section 16015, ELECTRICAL SYSTEMS ANALYSIS.
- E. Adjust mechanisms and moving parts for free mechanical movement.
- F. Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- G. Verify nameplate data for conformance to Contract Documents.
- H. Realign equipment not properly aligned and correct unlevelness.
- I. Properly anchor electrical equipment found to be inadequately anchored.

- J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.
- K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- L. Provide proper lubrication of applicable moving parts.
- M. Inform ENGINEER of working clearances not in accordance with NFPA 70.
- N. Investigate and repair or replace:
 - 1. Electrical items that fail tests.
 - 2. Active components not operating in accordance with manufacturer's instructions.
 - 3. Damaged electrical equipment.
- O. Electrical Enclosures:
 - 1. Remove foreign material and moisture from enclosure interior.
 - 2. Vacuum and wipe clean enclosure interior.
 - 3. Remove corrosion found on metal surfaces.
 - 4. Repair or replace, as determined by ENGINEER, door and panel sections having dented surfaces.
 - 5. Repair or replace, as determined by ENGINEER, poor fitting doors and panel sections.
 - 6. Repair or replace improperly operating latching, locking, or interlocking devices.
 - 7. Replace missing or damaged hardware.
 - 8. Finish:
Provide matching paint and touch up scratches and mars.
If required due to extensive damage, as determined by ENGINEER, refinish the entire assembly.
- P. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents.
- Q. Replace transformer insulating oil not in compliance with ASTM D923.

3.02 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

- A. Visual and Mechanical Inspection:
 - 1. Inspect Each Individual Exposed Power Cable No. 6 and Larger For:
 - a. Physical damage.
 - b. Proper connections in accordance with single-line diagram.
 - c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
 - d. Color coding conformance with specifications.
 - e. Proper circuit identification.
 - 2. Mechanical Connections For:
 - a. Proper lug type for conductor material.
 - b. Proper lug installation.
 - c. Bolt torque level in accordance with NETA ATS, Table 10. 1, unless otherwise specified by manufacturer.

3. Shielded Instrumentation Cables For:
 - a. Proper shield grounding.
 - b. Proper terminations.
 - c. Proper circuit identification.
 4. Control Cables For:
 - a. Proper termination.
 - b. Proper circuit identification.
 5. Cables Terminated Through Window Type CTs: Verify that neutrals and grounds are terminated for correct operation of protective devices.
- B. Electrical Tests for Conductors No. 6 and Larger:
1. Insulation Resistance Tests:
 - a. Test each conductor with respect to ground and to adjacent conductors per IEEE 118 procedures for 1 minute.
 - b. Evaluate ohmic values by comparison with conductors of same length and type.
 - c. Investigate values less than 50 megohms.
 - d. Utilize 1,000V dc megohmmeter for 600V insulated conductors.
 2. Continuity test by ohmmeter method to ensure proper cable connections.

3.03 SAFETY SWITCHES, 600 VOLTS MAXIMUM

- A. Visual and Mechanical Inspection:
1. Proper blade pressure and alignment.
 2. Proper operation of switch operating handle.
 3. Adequate mechanical support for each fuse.
 4. Proper contact-to-contact tightness between fuse clip and fuse.
 5. Cable connection bolt torque level in accordance with NETA ATS, Table 10.1.
 6. Proper phase barrier material and installation.
 7. Verify that fuse sizes and types correspond to one-line diagram.
 8. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.
- B. Electrical Tests:
1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 10.2.
 - b. Phase-to-phase and phase-to-ground for 1 minute on each pole.
 - c. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
 2. Contact Resistance Tests:
 - a. Contact resistance in microhms across each switchblade and fuse holder.
 - b. Investigate deviation of 50 percent or more from adjacent poles or similar switches.

3.04 MOLDED AND INSULATED CASE CIRCUIT BREAKERS

- A. General: Inspection and testing limited to circuit breakers rated 70 amperes and larger and to motor circuit protector breakers rated 50 amperes and larger.
- B. Visual and Mechanical Inspection:
1. Proper mounting.
 2. Proper conductor size.

3. Feeder designation according to nameplate and one-line diagram.
 4. Cracked casings.
 5. Connection bolt torque level in accordance with NETA ATS, Table 10.1.
 6. Operate breaker to verify smooth operation.
 7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
 8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.
- C. Electrical Tests:
1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 480- and 600-volt circuit breakers and 500-volt dc megohmmeter for 240-volt circuit breakers.
 - b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
 - c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
 - d. Test values to comply with NETA ATS, Table 10.2.
 2. Contact Resistance Tests:
 - a. Contact resistance in microhms across each pole.
 - b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
 3. Primary Current Injection Test to Verify:
 - a. Long-time minimum pickup and delay.
 - b. Short-time pickup and delay.
 - c. Ground fault pickup and delay.
 - d. Instantaneous pickup by run-up or pulse method.
 - e. Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - f. Trip times shall be within limits established by NEMA AB 4, Table 5-3.
 - g. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4.

3.05 GROUNDING SYSTEMS

- A. Visual and Mechanical Inspection:
1. Equipment and circuit grounds in motor control centers, panelboards, switchboards, and switchgear assemblies for proper connection and tightness.
 2. Ground bus connections in motor control centers, panelboards, switchboards, and switchgear assemblies for proper termination and tightness.
 3. Effective transformer core and equipment grounding.
 4. Accessible connections to grounding electrodes for proper fit and tightness.
 5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.
- B. Electrical Tests:
1. Fall-Of-Potential Test:
 - a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
 - b. Main ground electrode system resistance to ground to be no greater than 5 ohms.

2. Two-Point Direct Method Test:
 - a. In accordance with IEEE 81, Section 8.2. 1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
 - b. Equipment ground resistance shall not exceed main ground system resistance by 0.50 ohm.

3.06 LOW VOLTAGE MOTOR CONTROL OR STARTER PANELS

- A. Visual and Mechanical Inspection:
 1. Proper barrier and shutter installation and operation.
 2. Proper operation of indicating and monitoring devices.
 3. Proper overload protection for each motor.
 4. Improper blockage of air-cooling passages.
 5. Proper operation of drawout elements.
 6. Integrity and contamination of bus insulation system.
 7. Check Door and Device Interlocking System By:
 - a. Closure attempt of device when door is in OFF or OPEN position.
 - b. Opening attempt of door when device is in ON or CLOSED position.
 8. Check Key Interlocking Systems For:
 - a. Key captivity when device is in ON or CLOSED position.
 - b. Key removal when device is in OFF or OPEN position.
 - c. Closure attempt of device when key has been removed.
 - d. Correct number of keys in relationship to number of lock cylinders.
 - e. Existence of other keys capable of operating lock cylinders; destroy duplicate sets of keys.
 9. Check Nameplates for Proper Identification Of:
 - a. Equipment title and tag number with latest one-line diagram.
 - b. Pushbuttons.
 - c. Control switches.
 - d. Pilot lights.
 - e. Control relays.
 - f. Circuit breakers.
 - g. Indicating meters.
 10. Verify that fuse and circuit breaker sizes and types conform to Contract Documents.
 11. Verify that current and potential transformer ratios conform to Contract Documents.
 12. Check Bus Connections for High Resistance by Low Resistance Ohmmeter and Thermographic Survey:
 - a. Ohmic value to be zero.
 - b. Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
 - c. Thermographic survey temperature gradient of 2 degrees C, or less.
 13. Check Operation and Sequencing of Electrical and Mechanical Interlock Systems By:
 - a. Closure attempt for locked open devices.
 - b. Opening attempt for locked closed devices.
 - c. Key exchange to operate devices in OFF-NORMAL positions.
 14. Verify performance of each control device and feature furnished as part of the motor control center.

15. Control Wiring:
 - a. Compare wiring to local and remote control, and protective devices with elementary diagrams.
 - b. Check for proper conductor lacing and bundling.
 - c. Check for proper conductor identification.
 - d. Check for proper conductor lugs and connections.
 16. Exercise active components.
 17. Inspect Contactors For:
 - a. Correct mechanical operations.
 - b. Correct contact gap, wipe, alignment, and pressure.
 - c. Correct torque of all connections.
 18. Compare overload heater rating with full-load current for proper size.
 19. Compare motor protector and circuit breaker with motor characteristics and power factor correction capacitors for proper size.
 20. Perform phasing check on double-ended motor control centers to ensure proper bus phasing from each source.
- B. Electrical Tests:
1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 10.2.
 - b. Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.
 - c. Contactor phase-to-ground and across open contacts for 1 minute on each phase.
 - d. Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.
 - e. Test values to comply with NETA ATS, Table 10.2.
 2. Overpotential Tests:
 - a. Maximum applied ac or dc voltage in accordance with NETA ATS, Table 7.1.2.
 - b. Phase-to-phase and phase-to-ground for 1 minute for each phase of each bus section.
 - c. Test results evaluated on pass/fail basis.
 3. Current Injection Through Overload Unit at 300 Percent of Motor Full-Load Current and Monitor Trip Time:
 - a. Trip time in accordance with manufacturer's published data.
 - b. Investigate values in excess of 120 seconds.
 4. Control Wiring Tests:
 - a. Apply secondary voltage to control power and potential circuits.
 - b. Check voltage levels at each point on terminal boards and each device terminal.
 - c. Insulation resistance test at 1,000 volts dc on control wiring except that connected to solid state components.
 - 1) 1) Insulation resistance to be 1 megohm minimum.
 5. Operational test by initiating control devices to affect proper operation.

3.07 SWITCHGEAR AND SWITCHBOARD ASSEMBLIES

- A. Visual and Mechanical Inspection:
1. Insulator damage and contaminated surfaces.
 2. Proper barrier and shutter installation and operation.

3. Proper operation of indicating devices.
4. Improper blockage of air cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check Door and Device Interlocking System By:
 - a. Closure attempt of device when door is in OFF or OPEN position.
 - b. Opening attempt of door when device is in ON or CLOSED position.
8. Check Key Interlocking Systems For:
 - a. Key captivity when device is in ON or CLOSED position.
 - b. Key removal when device is in ON or CLOSED position.
 - c. Closure attempt of device when key has been removed.
 - d. Correct number of keys in relationship to number of lock cylinders.
 - e. Existence of other keys capable of operating lock cylinders.
 - 1) Destroy duplicate sets of keys.
9. Check Nameplates for Proper Identification Of:
 - a. Equipment title and tag number with latest one-line diagram.
 - b. Pushbutton.
 - c. Control switch.
 - d. Pilot light.
 - e. Control relay.
 - f. Circuit breaker.
 - g. Indicating meter.
10. Verify that fuse and circuit breaker ratings, sizes, and types conform to those specified,
11. Check bus and cable connections for high resistance by low resistance ohmmeter and calibrated torque wrench thermographic survey applied to bolted joints.
 - a. Ohmic value to be zero.
 - b. Bolt torque level in accordance with NETA ATS, Table 10. 1, unless otherwise specified by manufacturer.
 - c. Thermographic survey temperature gradient of 2 degrees C, or less.
12. Check Operation and Sequencing of Electrical and Mechanical Interlock Systems By:
 - a. Closure attempt for locked open devices.
 - b. Opening attempt for locked closed devices.
 - c. Key exchange to operate devices in OFF-NORMAL positions.
13. Verify performance of each control device and feature.
14. Control Wiring:
 - a. Compare wiring to local and remote control and protective devices with elementary diagrams.
 - b. Proper conductor lacing and bundling.
 - c. Proper conductor identification.
 - d. Proper conductor logs and connections.
15. Exercise active components.
16. Perform phasing check on double-ended equipment to ensure proper bus phasing from each source.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 7.1.1.
 - b. Each phase of each bus section.

- c. Phase-to-phase and phase-to-ground for 1 minute.
 - d. With switches and breakers open.
 - e. With switches and breakers closed.
 - f. Control wiring except that connected to solid state components.
 - g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
- 2. Overpotential Tests:
 - a. Applied ac or dc voltage and test procedure in accordance with ANSI C37.20.3 and NEMA PB 2.
 - b. Each phase of each bus section.
 - c. Phase-to-phase and phase-to-ground for 1 minute.
 - d. Test results evaluated on a pass/fail basis.
- 3. Current Injection Tests:
 - a. For entire current circuit in each section.
 - b. Secondary injection for current flow of 1 ampere.
 - c. Test current at each device.
- 4. Control Wiring:
 - a. Apply secondary voltage to control power and potential circuits.
 - b. Check voltage levels at each point on terminal boards and each device terminal.
- 5. Operational Test:
 - a. Initiate control devices.
 - b. Check proper operation of control system in each section.

3.08 THERMOGRAPHIC SURVEY

- A. Provide a thermographic survey of connections associated with incoming service conductors, bus work, and branch feeder conductors No. 2 and larger at each:
 - 1. Medium voltage switchgear and transformer.
 - 2. Switchboard.
 - 3. Low voltage motor control center.
 - 4. Panelboard.
- B. Provide a thermographic survey of feeder conductors No. 2 and larger terminating at:
 - 1. Motors rated 30 horsepower and larger.
 - 2. Low voltage disconnect switches.
- C. Remove necessary enclosure metal panels and covers prior to performing survey.
- D. Perform with equipment energized during periods of maximum possible loading.
- E. Do not perform survey on equipment operating at less than 20 percent of rated connected operating load.
- F. Utilize Thermographic Equipment Capable Of:
 - 1. Detecting emitted radiation.
 - 2. Converting detected radiation to visual signal.
 - 3. Detecting 1 degree C temperature difference between subject area and reference point of 30 degrees C.

- G. Temperature Gradients Of:
1. 3 degrees C to 7 degrees C indicates possible deficiency that warrants investigation.
 2. 7 degrees C to 15 degrees C indicates deficiency that is to be corrected as time permits.
 3. 16 degrees C and above indicates deficiency that is to be corrected immediately.
- H. Provide Written Report Of:
1. Areas surveyed and the resultant temperature gradients.
 2. Locations of areas having temperature gradients of 3 degrees C or greater.
 3. Cause of heat rise and actions taken to correct the cause of heat rise.
 4. Detected phase unbalance.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 17000

INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

- A. The 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 contractor's bid.
 - 2. The instrument 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 instrument 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 contractor, documented, and controlled to prevent duplicate numbers. The 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 instrument 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 one new BFP master control panel (PCP-DW) as shown on drawings and as per this specification complete in place. 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, media converter (as needed), patch cables, relays, terminal blocks, etc. as required for a complete and working PLC system in place.

7. Furnish and install one new stand alone Panelview HMI touch screen in a NEMA 1 painted steel enclosure in the 2nd floor Laboratory Room – Dewatering Building. New HMI touch screen panel shall be wall mount type and provide all necessary mounting hardware. New HMI touch screen panel shall be provided with one HMI touch screen mounted on the door of enclosure, main breaker, surge arrestor, terminal blocks, 550VA UPS, panel name tag, etc. for a complete and working HMI panel in place.
 8. Furnish and install new instruments as shown on drawings and as per this specification.
 9. Existing BFP feed pump pressure transmitters, and flowmeters will be installed as part of the on-going CMAR project. They will not be connected to PLC nor 120V power source and Contractor shall be responsible to setup and connected them as shown on drawings and as needed for a complete and functional instrument.
 10. Perform loop check for the Belt Filter Press Control panel, conveyor control panels, and other packaged systems supplied by packaged system suppliers.
 11. After completion of the project, Instrumentation (I&C) Contractor shall provide laminated panel wiring diagrams (11x17) inside each new PLC and RIO panel, including new I/O points added to the existing panels. Panel wiring diagrams shall incorporate the red-line mark-ups during the start-up and testing phase. Wiring diagrams without including the red-line mark-ups will be rejected and will need to recreate them without additional cost to the Owner.
- 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 – 2nd floor to add fiber optic patch panel and fiber optic connection as shown on drawings. Refer to communication block diagram for additional requirements.
 - b. New PLC panel (PCP-DW) at Dewatering Building – 1st floor Electrical Room as shown on drawings and as describes in this specification.
 - c. New BFP#1 and new BFP#2 local control panels are to be provided per the BFP supplier as per specification 11362. I&C Contractor and coordinate with BFP's supplier software programmer for identify each scope of PLC programming and perform accordingly. Coordinate with packaged belt filter press supplier for interfacing with plant PLC and SCADA system and as shown on N-drawings. Provide new fiber optic cables with appropriate connectors as shown on drawings and as required. Refer to specification 11362 for control function description of BFP and associated system. I&C Contractor shall be responsible for programming of the remaining control functions of other components at the Dewatering Building.
 - d. Contractor shall program the plant SCADA system, including SCADA server, Historian server, etc. for the entire project. Existing plant SCADA system is CitectSCADA system.

- e. BFP's software programming is responsible for PLC programming BFP control strategy, including horizontal and incline conveyor, polymer dilution system, etc. in the BFP master control panel PLC system. I&C Contractor shall responsible for PLC programming associated with remaining systems in the dewatering building system. New PCP-DW PLC will need to be programmed by both BFP supplier and I&C Contractor for different components of the Dewatering system and it will require communication between both software programmers of BFP supplier and I&C Contractor so that one control function or I/O point is not to overwrite to another programmer's control function or I/O point in the same PLC.
- 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, 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. Obtain from Contractor, manufacturer's information on installation, interface, function, and adjustment.
 - b. Coordinate with 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 Contractor's software programmer. HMI touchscreen (part of the new control panel) programming shall also be performed by the Contractor's software programmer.

1.02 SINGLE INSTRUMENT SUPPLIER

- A. The Contractor shall assign to the Single Instrument and Control (I&C) supplier full responsibility for the functional operation of all new instrumentation systems. The 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: system engineering, documentation including panel assembly, schematics and wiring diagram, field testing, calibration and start-up, operator instruction and maintenance training.
- C. The foregoing shall enable the 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.
- D. The single I&C supplier shall have a UL approved shop and shall build all panels according to UL 508A.
- E. Instrumentation and Controls supplier shall be Blackburn Controls, Curry Controls, Commerce Controls, Inc., Rocha Controls, and Revere Controls, CEC Controls, Sanders and Company, or Owner approved equal.
- F. 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 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 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 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 Contractor, the Single I&C supplier shall prepare and submit through the 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 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 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 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 Contractor shall utilize technical service personnel designated by the Single I&C supplier to which the 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 Contractor's failure to fulfill this requirement.

1.10 RELATED WORK

- A. Division 16 -Electrical
- B. Division 11 -Equipment
- C. Division 13 - Special Construction

1.11 COORDINATION MEETINGS

- A. The Instrumentation (I&C) Contractor shall schedule a minimum of three (3) mandatory coordination meetings. The meeting shall be held at the Owner's offices and shall include, as a minimum, attendance by all key personnel involved (e.g. the Owner, the Engineer, the I&C Contractor Engineer, BFP supplier and the Electrical Subcontractor, etc.).

- B. The meeting shall be held in advance of the first I&C Contractor shop drawing submittal. The purpose of the meeting shall be for the I&C Contractor to: Summarize their understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery milestone dates; provide a forum for the I&C Contractor, Engineer, and Owner to coordinate hardware and software related issues; and request any additional information required from the Engineer and/or Owner. Also, the I&C Contractor shall coordinate conduit and wire requirements for all instrumentation and controls with the Electrical Subcontractor before electrical work is begun. The I&C Contractor should bring draft working drawings to the meeting to provide the basis for the Engineer and Owner's input into their development.
- C. The second meeting shall be held after the first complete instrumentation and control (hardware and software) shop drawing package has been reviewed by the Owner and Engineer and returned to the I&C Contractor. The purpose of the second meeting is to discuss comments made on the submittal package; to refine scheduled milestone dates; coordinate equipment installation activities; and provide a forum for any further required coordination.
- D. The third meeting shall be held one month prior to start-up and field loop check/testing. The purpose of this third meeting is to discuss any remaining coordination requirements.

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 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 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:
- c. 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.
 - d. 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 Contractor shall furnish all necessary equipment supplier's Shop Drawings to facilitate inclusion of this information by the I&C system supplier.
 - 1) 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.

- i. After completion of the project, I&C Contractor shall provide laminated panel wiring diagrams (11x17) inside each new PLC and RIO panel. Panel wiring diagrams shall incorporate the red-line mark-ups during the start-up and testing phase. Wiring diagrams without including the red-line mark-ups will be rejected and will need to recreate them without additional cost to the Owner

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. Two (2) 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, unless otherwise noted, 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 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. Final technical manuals shall include the electronic version on a CD, DVD, or Flash 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

- A. The Contractor shall include, as part of the bid package, spare parts listed below and as listed in instrument list table of this specification. The I&C supplier shall be responsible for delivery of the spare parts, as directed by the Owner either during or after plant start-up.
- B. Provide one spare PLC power supply, one spare I/O module for each type used, and one spare Ethernet switch, and media converter to the Owner.

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:
 - 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 Controllogix family with Ethernet Communication module, no exception.
 - 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 $\pm 0.05\%$ 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 for Controllogix family and 1769-IF8 for Compactlogix family. Confirm model with Owner during submittal phase.
 - 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 for Controllogix family and 1769-IQ16 for Compactlogix family. Confirm model with Owner during submittal phase.
- 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% in 24 hours. Each DAC shall have a 12 bit resolution and an accuracy of $\pm 0.05\%$ full scale. Analog output cards shall match existing type and shall be Allen Bradley 1756-OF8I for Controllogix family and 1769-OF8C for Compactlogix family. Confirm model with Owner during submittal phase.
- 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 for Controllogix family and 1769-OB16 for Compactlogix family. Confirm model with Owner during submittal phase.
- 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 for Controllogix family and 1769-PA4 or 1769-PB4 for Compactlogix family. If power consumption is more than the listed 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 Controllogix 1756 or Compactlogix 1769. 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. 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 Cables:
1. Fiber optic cables media shall consist of 62.5/125 (core/clad) micron graded index, multimode, plenum and riser rated, fiber optic cable containing at least six strings (3-pairs) of fibers, unless otherwise indicated in the drawings. The fiber optic cable shall be an all dielectric, heavy duty design. The fiber optic cable shall consist of multiple fibers each surrounded by a buffer tube, all contained in a flame retardant PVC outer jacket. The cable shall be designed for installations requiring high pull tensions for conduit pulls. The cable shall be gel filled or shall be provided with a water-swallowable tape surrounding the buffer tube(s) to protect the fibers from moisture damage.
 2. The fiber optic cable shall be designed to operate at an optical wavelength of 850 nm with a minimum bandwidth of 160 MHz-km.
 3. The fiber optic communications system shall utilize stainless steel ST style connectors for all fiber optic connections. The connector shall be designed for use with 62.5/125 micron cable, and shall be capable of operating a range of 0 to 80 degrees C. Each connector shall cause a maximum signal attenuation of 1.6 dB. Connectors shall be provided by Phoenix Digital, 3M, or approved equal. All fiber optic cables, including spares, shall be tested for performance and loss after termination and installation to verify that at least a 3 dB power safety margin is obtained between all transmitters and receivers. Test data from each fiber and safety margin calculations for each fiber path shall be provided to the Owner and Engineer after installation to verify conformance with this specification.
 4. The fiber cable shall be similar and compatible with the existing system and will be responsibility of the Instrumentation Control Supplier. Utilization of existing cable is acceptable as long as the final installation is fully operational and in good working condition.

- K. Fiber Optic Patch Panel:
 - 1. Fiber optic termination cabinets shall be provided inside all control panels to terminate all active and spare incoming fiber optic tubing pairs. Cabinet/patch panels shall include a minimum of 12 fiber ports, or more if all 12 ports are used. Connectors shall be ST type, Corning, Black Box, or equal. Each port and fiber shall be labeled. A fiber optic cabinet/patch panel shall be provided in each rack to terminate all active and spare incoming fiber optic tubing pairs. Patch cables between the patch panel and the fiber optic device shall be multimode, ceramic terminated fiber optic cable with appropriate connectors (ST at patch panel, unless PLC components required a different type).
- L. Ethernet Switch: Ethernet switch to be installed in the PLC control panel shall be Allen-Bradley Stratix Switch or Red Lion, or Owner/Engineer approved equal. Refer to Instrumentation drawings for fiber optic ports requirements for the Ethernet switch and provide accordingly. Contractor shall have the option to use media converter in lieu of Ethernet switch with fiber ports.

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. F1. 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:
 - c. Power requirements: Match to converter/transmitter.
 - d. Accuracy: Plus or minus 1 percent of rate (including converter/transmitter) and an ambient of 65 degrees Celsius.
 - e. RFI protection - Provide RFI protection.
 - f. Pressure rating - 240 PSI if 150 lb flanges are used, 700 PSI if 300 lb flanges are used.
 - g. Temperature rating: Suitable for process liquid temperature up to 70 degrees Celsius
 - h. Additional - Meter shall be capable of running empty indefinitely without damage to any component.
2. Physical:
 - a. Metering Tube: Stainless steel unless otherwise indicated.
 - b. 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.
 - c. Liner - TFE. For chemical application, provide liner material compatible with chemical to be measured.
 - d. Electrodes - 316 stainless steel, bullet nosed or elliptical self cleaning type unless otherwise noted.
 - e. 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.
 - f. Mounting: Remote mounting with ANSI Class 150 flanges with alignment rings and hardware.
 - g. Painting - All external surfaces shall be painted with a chemical and corrosion resistant epoxy finish.
 - h. Accessories/Options Required:
 - i. Factory calibration - All meters shall be factory calibrated. A copy of the report shall be in the O&M manual.
 - j. 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.
 - k. Manufacturers: ABB WaterMaster or Rosemount with remote transmitter or Owner/Engineer approved equal.
3. Flow Converter/Transmitter:
 - a. Type: Match to flow element.
 - b. Functional/Performance:
 - c. Power requirements: 120V AC plus or minus 10 percent.
 - d. Accuracy: As defined for flow element.
 - e. Temperature: minus 25 degrees C to plus 65 degrees C
 - f. Output: Isolated 4-20 ma into 0 to 1000 ohms.
 - g. Physical: Housing - NEMA 4X wall mount.

- h. Accessories/Options Required:
- i. Cable - Provide signal cable between magmeter and signal converter.
- j. Indicator - Provide local indicator with scale engraved 0 to 100 percent which indicates actual converter output signal.
- k. 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.
- l. 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.
- m. Mounting: 2 inch pipe stand. Mounting hardware shall be Type 316 stainless steel, unless otherwise noted on drawings.
- n. Manufacturer: (same as flow element): ABB Model WaterMaster or Rosemount or Owner/Engineer approved equal.

B. P1. Pressure and Differential Pressure Transmitter (Electronic)

- 1. This specification covers the following services:
 - a. Absolute pressure.
 - b. Level inferred from pressure
 - c. Differential pressure.
 - d. Flow inferred from differential pressure.
 - e. Vacuum
 - 1) Gauge and differential pressure transmitters shall be of the capacitance type with a field adjustable 10:1 input range. Span and zero shall be continuously adjustable externally over the entire range. Transmitter shall be of the smart type microprocessor-based. Transmitters shall be Nema 4X construction with 316 stainless steel process wetted parts, if not otherwise stated. Accuracy, including nonlinearity, hysteresis and repeatability errors shall be $\pm 0.1\%$ of calibrated span. The maximum zero elevation and maximum zero suppression shall be adjustable to 150% of maximum span. Output shall be linear isolated 4-20 mA 24 VDC. Power supply shall be 24 VDC, two wire design. Each transmitter shall be furnished with a junction box, external zero and indicator calibrated in engineering units and mounting hardware as required. Overload capacity shall be rated at a minimum of 200% of maximum range. Each transmitter shall have a stainless steel tag with calibration data attached to body.
 - 2) Range: 30 inches to 200 psig. Refer to the instrument schedule for calibrated span for the individual instrument(s).
 - 3) Maximum Static Pressure: 2,000 psig.
 - 4) Humidity: 10 to 100 percent non-condensing.
 - 5) Sensing Element: Diaphragm type.
 - 6) Vent/Drain Valve: One per sensing cavity.
 - 7) Material: Sensing element components to be 316 stainless steel, or as shown on the instrument schedule.
 - 8) Process Connection: 0.5 inch NPT, unless noted otherwise in the instrument schedule.
 - 9) Electrical: 0.5 inch rigid conduit with screw terminals. Provide electrical protection against lightning.

- 10) Freeze Protection: If the transmitter and process piping are located outdoors, provide freezing protection for both.
- 11) Provide block and shutoff valves. Meet the following requirements:
 - a) Size: 0.5 inch (1.0 inch for diaphragm seal installations).
 - b) Type: Ball.
 - c) Pressure: Up to 400 psi.
 - d) Body: Brass or bronze, for non-corrosive atmosphere, PVC or epoxy coated for corrosive atmosphere.
 - e) Seats and Seals: Teflon.
 - f) Ball and Stem: Same material as sensing element.
 - g) Provide: Gemini valve series 76, or equivalent
- 12) Differential pressure indicating transmitters shall be the same as the gauge pressure transmitter except for body specifications. Differential pressure units shall be furnished with close coupled stainless steel three valve manifold assembly. Manifold assembly shall be HEX Products Model HM, or equal. Overpressure limits shall be as scheduled.
- 13) Differential pressure transmitters shall have an integral square root extractor to provide a linear 4-20 mA flow signal output. In addition, each flow transmitter shall be furnished with laminated flow versus differential pressure curves wall mounted adjacent to the transmitter. Where scheduled, transmitters shall be furnished with remote diaphragm seals and 316 stainless steel sealed capillary tubes to isolate the transmitter from the process fluid.
- 14) Provide corrosive resistant mounting hardware for mounting the instrument. Unless otherwise shown on the instrument schedule, provide NEMA 4X enclosure, pipe mounted.
- 15) Provide differential pressure transmitters complete with a three-valve manifold. Meet the following requirements:
 - a) Materials: Same as block and shutoff valves.
 - b) Process Connection: 0.5 inch NPT.
 - c) Outlet Ports: 0.5 inch NPT.
 - d) Purge Taps: 0.5 inch NPT located between block valves and outlet ports.
- 16) Transmitter shall be as manufactured by Rosemount model 1151 smart, or approved equal.
- 17) INSTALLATION:
 - a) Install the transmitter in an orientation where the sensing diaphragms are in a vertical plane.
 - b) Allow sufficient clearance overhead for cover removal and around the transmitter to provide an access for necessary adjustments.
 - c) Provide connections for drain and vent ports on the transmitter as per manufacturer's recommendations.
 - d) Locate transmitters as close to the process pipe and pressure tap as practical with the lengths of meter lead piping/tubing kept to a minimum. Do not exceed 50 feet lead length. Locate the transmitter to minimize exposure to shock and vibration, or with proper vibration protection hardware and rugged frame. Select location to avoid any thermal shocks.

- e) Slope horizontal leads a minimum of one inch per foot downward from the pressure taps for liquid and steam measurement.
- f) Slope horizontal leads at least one inch per foot upward from the pressure taps for gas measurement,
- g) Wrap Teflon tape on the external threads of screwed fittings.
- h) Install differential pressure transmitters for flow measurement to insure that vertical leads on the high and low pressure sides are of equal length so as not to create an error in the measured signal.
- i) Do not run horizontal meter leads in excess of six feet without supports.
- j) Locate output indicators allow easy access for viewing and service by operations personnel.

C. P2. PRESSURE SWITCH

- 1. Type:
 - a. Diaphragm actuated.
- 2. Functional/Performance:
 - a. Repeatability - Better than 1.0 percent of pressure.
 - b. Set Point - Field adjustable and set between 30 and 70 percent of the adjustable range.
 - c. Deadband - shall be fixed unless noted otherwise on the Instrument Device Schedules.
 - d. Reset - Unit shall be of the automatic reset type unless noted otherwise on the Instrument Device Schedules.
 - e. Over-range Protection - Provide over-range protection to maximum process line pressure.
 - f. Switch Rating - 250V AC at 10 amps; and 30V DC at 5 amps.
- 3. Physical:
 - a. Housing - NEMA 4X.
 - b. Switching Arrangement - Provide single pole double throw (SPDT) unless double pole double throw (DPDT) switches are shown on the instrument device schedule.
 - c. Wetted Parts - Teflon coated diaphragm, viton seals, stainless steel connection port.
 - d. Connection Size – 1/2-in NPT.
- 4. Accessories/Options Required:
 - a. Shutoff Valve - Provide process shutoff valve which can be used as an adjustable pressure snubber.
- 5. Manufacturers:
 - a. Ashcroft, Mercoid, Square D or Owner/Engineer approved equal.

D. P3. PRESSURE GAUGE OR PRESSURE INDICATOR

- 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, unless otherwise noted for small pipe connection in other specifications.
 - 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/Engineer Approved Equal.
- E. W1. HYDRAULIC WEIGHT SCALE PLATFORM WITH DISPLAY DIAL AND 4-20MA SIGNAL
1. Furnish and install low profile platform scales that shall be the hydraulic cell type. Scale shall be sized to accept tote from dimension of 50" x 50" minimum. Coordinate with tote supplier during bidding to confirm the dimension of tote and adjust accordingly. The low profile platform shall include an adjustable backstop to accommodate easy loading and unloading of chemical tote bins. Platform scale coating system shall be a minimum dry thickness of 80 mils and be resistant to moisture, chemicals, abrasion, impact and UV light.
 2. Load cell shall be of the temperature stable, rolling diaphragm type. A 5 ft. (meter) flexible length of tubing shall lead from the load cell to allow easy installation of the dial on the platform mounted dial stand. Load plate shall be able to tilt to 4 degrees without affecting accuracy to allow easy installation. Flexible hose shall lead from the load cell to allow easy remote installation of the dial and shall be 12ft minimum. Load cell system shall require no electric power and shall be immune to all RFI/EFI, power failures and lightening strikes.
 3. Dial diameter shall be 8-1/2" and read zero to XXX lbs. (kgs) with provision for tare adjustment. Dial shall be temperature stable with damper installed to prevent shock damage. Coordinate with process Engineer for tote capacity (lbs) and select appropriate platform capacity and model number.

4. Scale shall carry a minimum Five (5) Year Factory Warranty . “Limited” Warranties shall be considered unacceptable.
5. Scale shall have a SATELLITE® loop powered 4-20mA output proportional to gross weight.
6. Full scale accuracy shall be better than ½ of 1%. Scale shall be CHEM-SCALE™ TOTE BIN SCALE with TUF-COAT™ coating and hydraulic CENTURY® dial indicator, Model 50-12DXX-TB (where XX is capacity in lbs), as manufactured by FORCE FLOW, 2430 Stanwell Drive, Concord, CA 94520 USA (www.forceflow.com), or Owner/Engineer approved equal. Provide pipe stand support and mounting hardware for hydraulic CENTURY® dial indicator near each tote and mount approximately 4-feet above finished grade.

F. X1. Sunshade / Rain Hood:

1. Instrumentation sun 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. The PLC software programmer shall include an additional 80 hours on-site to fine tune control systems and make minor software modifications in order to resolve any logic discrepancies encountered during start-up, and supply the Owner with a complete functional system. This is part of the bid package with no additional cost to the Owner.
- B. Existing BFP feed Pumps Control: BFP feed pumps and VFD (variable frequency drive) are existing and will remain. Contractor shall provide new BFP feed pump control strategy in the BFP master PLC system (PCP-DW) as needed and as describes in this specification. Existing BFP feed pump VFD units have LOCAL/REMOTE control selection. If LOCAL control is selected at the VFD unit, the unit can be started/stopped from the local START/STOP selector switch at each VFD panel. If REMOTE control is selected at the VFD unit, the PLC program will control the start/stop of each BFP 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 BFP feed pump from the SCADA screen. In AUTO mode, the PLC logic shall start/stop the appropriate BFP feed pump based on the automatic pump selection logic.

- C. BFP feed Pump Automatic Pump Selection Logic: There are five existing BFP feed pumps and a minimum of one BFP feed pump will be needed for one BFP. The PLC logic shall rotate pump based on the total runtime if more than one pump is assigned to the same BFP unit. The PLC logic shall have a pump rotating matrix that can be assigned thru SCADA screens and the operator can easily take any pump "out of service" to remove from the rotation. BFP Feed pump VFD shall have flow setpoint (field adjustable) control and adjust the speed based on the associated flowmeter measurement.
- D. The existing VFD unit of each BFP feed pump signals and control will be connected to the new BFP master panel (PCP-DW) as shown on drawings.
- E. Each Belt Filter Press (BFP) unit shall require a permissive of "BFP feed Pump Running" signal based on the pump assignment. If more than one BFP feed pumps are assigned to one BFP unit, only one running signal permissive is needed.
- 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.1 or No. 2 unit. Future Horizontal conveyor No.2, future Inclined conveyor No.2, and Truck Loading conveyor shall be running to start the future BFP No.3 and No.4 unit.
- G. No sludge flow alarm: If BFP feed pump is running and no flow is registered at the associated flowmeter after 2 minutes (field adjustable), 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 inside the BFP No.1 or No.2 Local control panel. BFP supplier's software programmer may need some programming in the BFP master control panel and contractor shall coordinate with the software programmer of the BFP's supplier for programming in the same PLC processor and avoiding duplicate address or tag, etc. Refer to specification 11362 for BFP Control Description.
- I. Polymer Tote weight scale: If weight scale of polymer tote is below 10% (field adjustable from HMI/SCADA), the PLC program shall send an alarm to the Plant PLC/HMI system for "Polymer Tote No.X low alarm".
- J. TSS meter selection: PLC program shall have TSS meter selection to control the BFP feed pump speed and shall be selectable from the SCADA/HMI screen. Existing TSS meters are connected to the existing PCP-2 panel in Electrical Building No.2 and shall message between PLC system to obtain the measurement. PLC logic shall have TSS meter selection logic and allow operator to select from the SCADA/HMI screens. Selection choices shall be "TSS meter at Distribution Box No.2", "TSS meter at Distribution Box No.3", or "average TSS value".
- K. 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 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. 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

2.10 PROGRAMMING SOFTWARE

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

2.11 TOUCH SCREEN HUMAN-MACHINE INTERFACE (HMI)

- A. General:
 1. 1 Function: Allows operator to monitor and control at DPC/PLC level.
 2. Type: Allen-Bradley Panelview plus 7 touch screen. Match with Belt Filter Press Local Control Panel HMI touch screen model.
 3. 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% (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; 10.4"
 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 or equal. Provide software license for HMI touch screen, if needed. 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.

2.12 INSTRUMENT LIST

TAG NO.	COMPONENT CODE	COMPONENT TITLE	COMPONENT OPTIONS	REMARKS
WI/WT-TK-PL01	W1	POLYMER STORAGE TOTE NO.1 WEIGHT	0-2500 lbs	
WI/WT-TK-PL02	W1	POLYMER STORAGE TOTE NO.2 WEIGHT	0-2500 lbs	
FE-WW01/ FIT-WW01	F1	BFP NO.1 WASHWATER FLOW	0-300 gpm	2" Diameter.
FE-WW02/ FIT-WW02	F1	BFP NO.2 WASHWATER FLOW	0-300 gpm	2" Diameter.
PIT-WW01	P1	BFP NO.1 WASHWATER PRESSURE	0-200 PSIG	
PIT-WW02	P1	BFP NO.2 WASHWATER PRESSURE	0-200 PSIG	

TAG NO.	COMPONENT CODE	COMPONENT TITLE	COMPONENT OPTIONS	REMARKS
Provide one spare pressure transmitter (Component Code: P1) – matching the model supplied.				

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 Contractor among all parties involved so that the tests may proceed without delays or disruption by incomplete work.
 - a. Unwitnessed Factory Test (UFT):
 - 1) An unwitnessed factory test shall be conducted to prepare the I&C Supplier to demonstrate compliance with this specification.
 - 2) The I&C Supplier shall inspect and test the Integrated Control System (ICS). 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)
 - 3) 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).
 - 4) Excluded New Panels: None
 - b. Factory Acceptance Test (FAT):
 - 1) Not used.

C. INSTALLATION AND CONNECTION:

1. The 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 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 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 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 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.

D. 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 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".

E. 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 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.

F. Start-up and Instruction

1. When all systems are assessed by the 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.

G. Modifications to Existing Facilities

1. The 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 Contractor's original bid amount and no additional payment shall be allowed.

H. 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.

I. 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

COMPONENT				STATUS		
TAG NO.	DELIVERED*	TAG/IDENTIFICATION CHECK*	INSTALLATION CHECK	TERMINATION WIRING*	TERMINATION TUBING*	CALIBRATED*
REMARKS				LOOP READY FOR START-UP		
				BY		
				DATE		

* INITIAL AND DATE WHEN COMPLETE

FUNCTIONAL ACCEPTANCE TEST SHEET

PROJECT 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: 30%;"> RANGE <input type="checkbox"/>INDIATE/ RECORD SCALE <input type="checkbox"/>TRANS/ CONVERT OUTPUT </div> <div style="width: 20%;"> VALUE _____ _____ _____ </div> <div style="width: 10%;"> UNITS _____ _____ _____ </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.

THIS PAGE INTENTIONALLY LEFT BLANK